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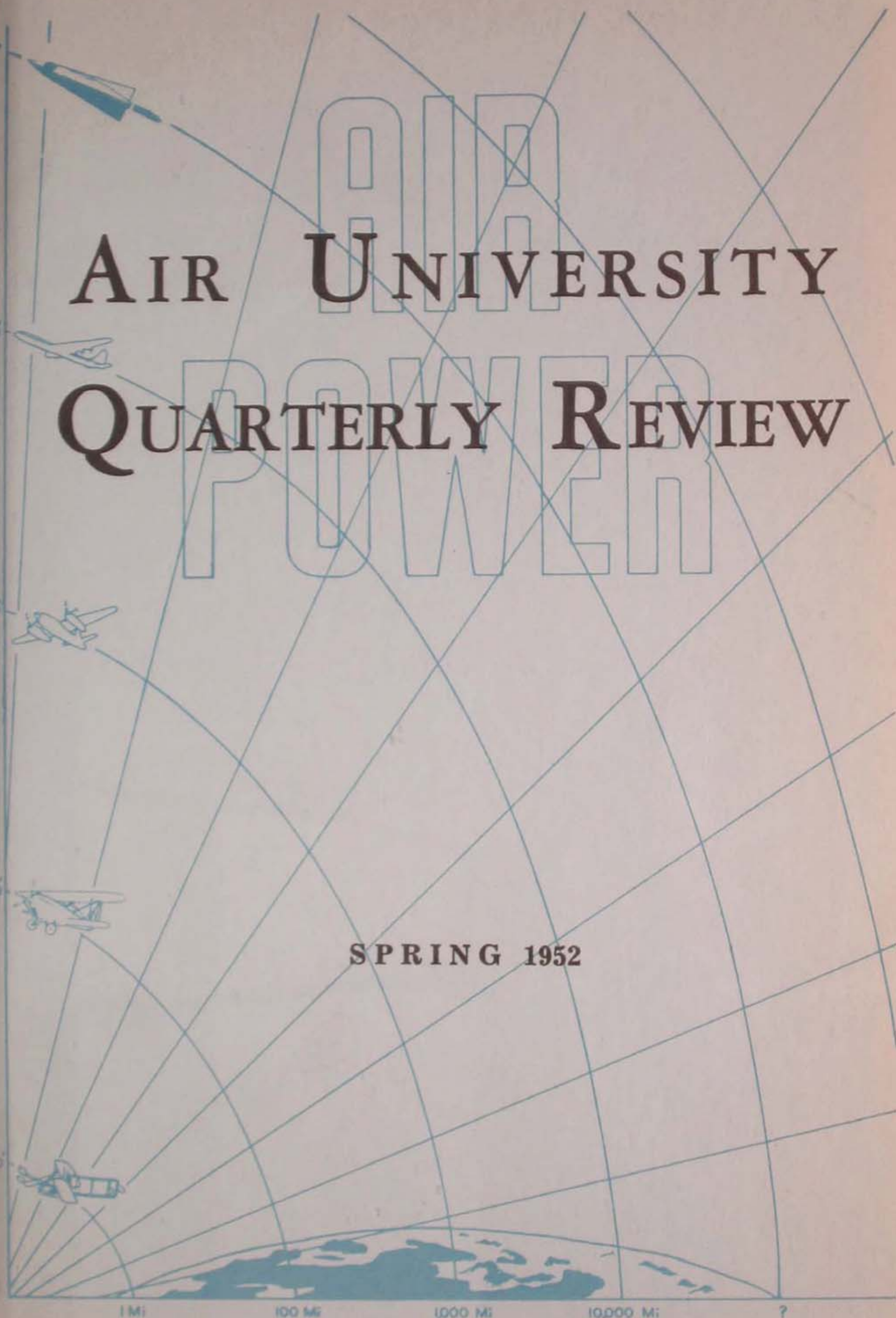

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ATTENTION

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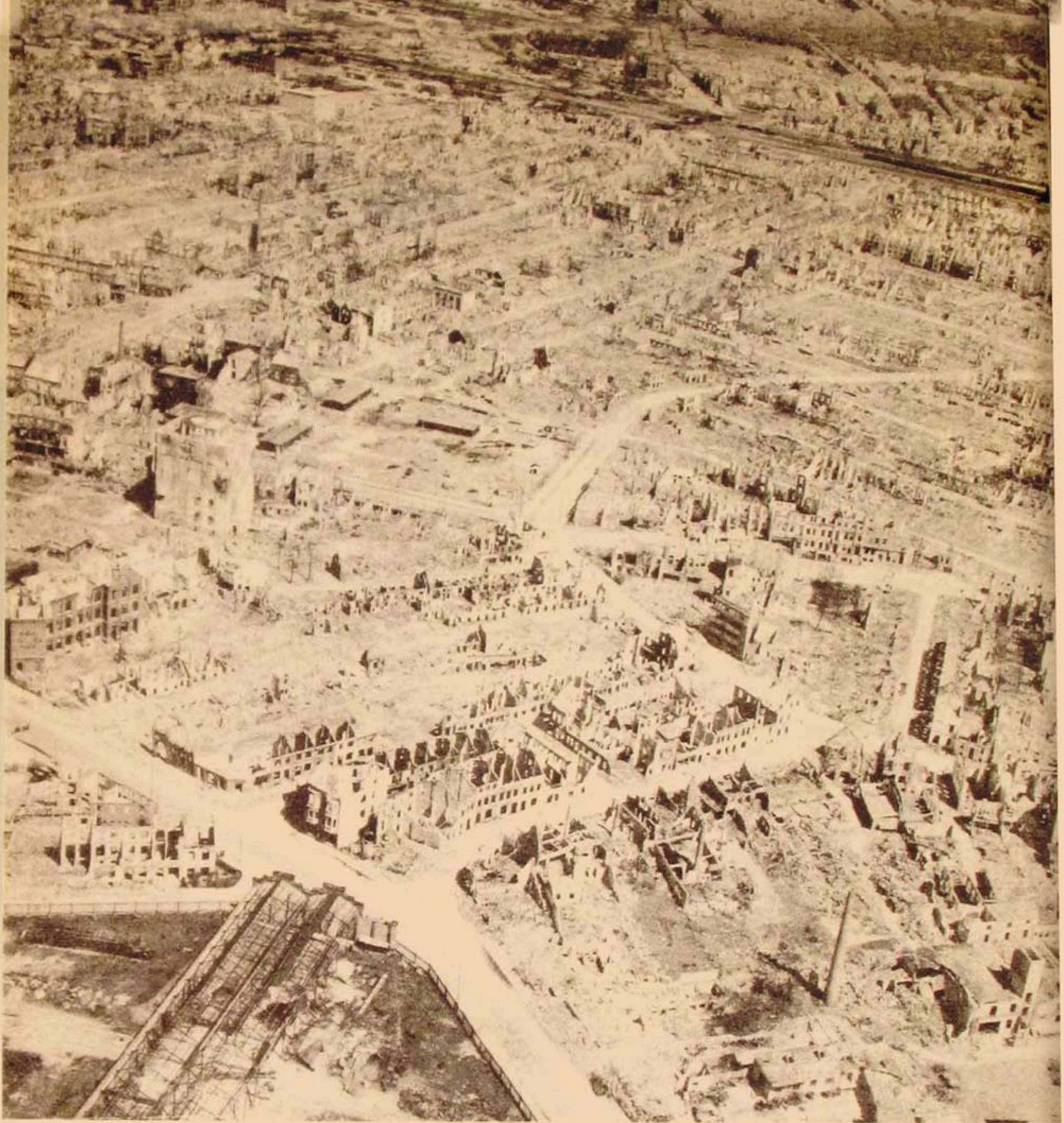


The roofless ruins of Bremen, Germany, lie silent and lifeless before the eye of the camera, evidence of the effectiveness of the Allied strategic air campaign in the Second World War. Neither the Luftwaffe nor the Red Air Force had envisaged the need for air forces conceived and committed for the neutralization of an enemy's corpus of war: his transportation, his factories, his oil refineries, his will to work and fight—the target systems we have come to call "strategic." The decisive exhibition of the capability of air forces to destroy a nation's determination and its ability to fight was perhaps the greatest single Allied contribution to the advancement of warfare. As Asher Lee points out, the Soviet and German Air Forces were directed at the outset of the Second World War to the prime job of supporting armies in the field. Since both powers were primarily land powers fighting essentially a land war backed by internal lines of supply, this was a logical, if short-sighted, view of the use of air forces. But by the end of the war the Allies had written its basic lesson across the rubble-strewn land of Germany and the burned-out cities of Japan—that air power, centrally controlled and its resources committed to strategically planned objectives, is decisive.

The Soviet Air Debt to Germany

Asher Lee, O.B.E.

NO modern air force can afford not to learn from other air forces. This has always been particularly true of the Soviet Air Force. It was born out of the chaos of a bitter civil war into a state of complete aeronautical poverty. Lenin simply had to look abroad for air engineers, designers, technicians, and instructors. He found them in America, France, and Britain but above all in Germany, with whom the Soviet concluded their first international treaties. German aviation was heavily restricted by the 1919 Versailles peace treaty. The Luftwaffe was glad of the outlet in the U.S.S.R., where it was easiest to continue military aviation activities and evade the treaty restrictions. It is therefore not surprising that Hugo Junkers built the first modern bomber plant near Moscow in the early 1920's or that many of the first Soviet fighter squadrons flew planes designed by Ernst Heinkel. And when the Soviet started to make their own machines in the late 1920's, many of the engines fitted to their bombers, fighters, and reconnaissance planes were blueprints of a German model. In addition there were German flying instructors in a high proportion of Soviet flying training schools. At Kharkov for instance nearly all the instructors in 1925 were Germans.

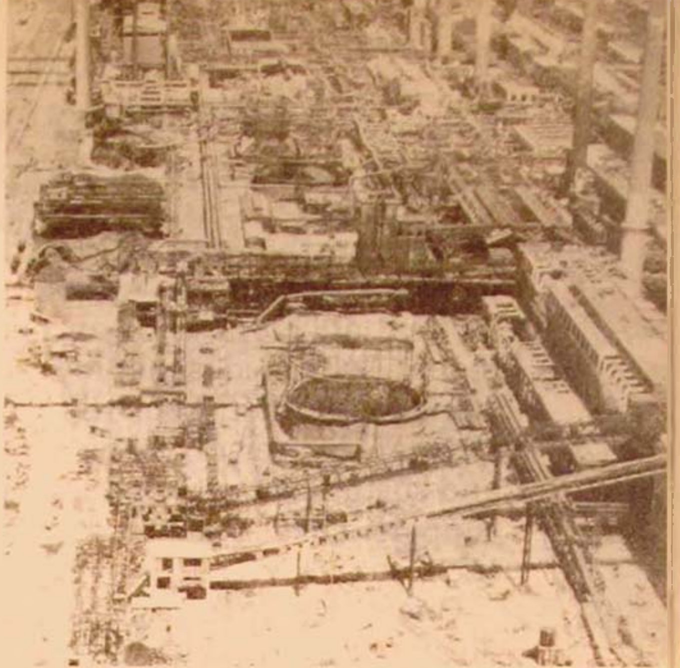
But quite apart from the strong initial German influence, which was bound to leave its mark, there would inevitably be a close parallel between the Soviet Air Force and the German Air Force doctrine at the outbreak of World War Two. Both Germany and the U.S.S.R. were great continental powers that would naturally think of the air arm mainly as a weapon of tactical support for ground troops. Both possessed huge armies which had to fight land-locked battles over a wide area. The organisation of the two air forces in 1939 was similar. Most of the squadrons were grouped into air divisions intended to give close support to the ground troops. In the German Air Force an air division was a tactical air force of bombers, fighters, and reconnaissance planes. In the Soviet Air Force, however, as in the U.S.A.F. in World War Two, an air division was composed of only one type of plane, that is fighters or bombers. There were no Soviet reconnaissance divisions. This type of plane was only organised at regimental strength, that is, about 30 to 35 planes. In both the German and Soviet Air Forces, air corps were later organised. In both air forces the strength of an air division or air corps varied enormously from front to front, from as few as 150 planes to as many as 750 planes. In both air forces reserves of planes were always inadequate and squadrons were often below strength. The policy in Germany and the U.S.S.R. was to get the maximum number of squadrons into combat. Nearly all modern operational aircraft were in the shop window.

Red Air Force units were part and parcel of the army and navy. There were no independent air force units. The Luftwaffe units were only subordinated to the army when on active operations in the field. The powerful, possessive Reichsmarshal Hermann Goering exercised strong personal control over the German Air Force. Soviet Air Force commanders-in-chief were much less powerful and much more expendable. During the five years which preceded World War Two Alksnis, Loktionov, Lychagov, and Smushkevich came and went after a brief tour of duty. Their air authority was strictly controlled by the Politburo, in particular by Molotov and Malenkov, who were its air specialists.

At the outbreak of World War Two the Soviet and German Air Forces were working to similar strategic directives. The big differences between them were at the tactical level. The tenet of these directives was that the prime job of an air force is to support the army and that strategic long-range bombing was to be reduced to a minimum. The support of ground operations was to include the large-scale use of airborne troops to seize bridges and road-junctions and to form advanced spear-heads. The operations of both air forces were to be concentrated at the crucial moments of the ground battle, when a maximum intensive ground support on secondary fronts or in quiet periods was to be made. Neither Russia nor Germany then saw the major need for long-range naval air power either in the form of carriers or shore-based torpedo-bomber or antisubmarine units. Both air forces were reducing their totals of squadrons equipped with flying boats and float-planes at the outbreak of World War Two, the Russians more drastically than the Germans.

It was, of course, under the four years of combat conditions from the summer of 1941 to the summer of 1945 that Soviet air

Battered by eight heavy attacks earlier in 1944, the huge Merseburg-Leuna synthetic oil plants was blanketed with 6728 tons of bombs in November and December.



THE GREAT LESSON

The German Air Force, closely watched by the Soviet Air Force, attempted only one major deviation from its traditional role of support for the land armies. This occurred in the Battle of Britain, where its bombing campaign was defeated by a combination of the superb skill and courage of the RAF and by its own vacillations in tactics. From this time onward, it might be said that Germany had lost the air war. The Eighth Air Force, the Fifteenth Air Force, and RAF Bomber Command steadily increased the weight and intensity of the assault until in 1944 more than 1,000,000 tons of bombs fell on enemy targets. The Luftwaffe found that it could not keep its aircraft at the fighting front in support of the army, but must pull more and more of its strength back into Germany to defend vital industrial targets. As early as September 1942 the Allied air commanders had established seven major target systems which the Combined Allied Bomber Offensive was to destroy in order of importance—the Luftwaffe and the German aircraft industry, the submarine threat, transportation, electric power, oil, alumina, and rubber. One alteration in this master plan raised the oil on the priority list. Because a number of oil plants were concentrated in a central area deep in Germany, Allied strategists believed that prolonged aerial attack on these targets would force the Luftwaffe out of hiding. They were right. The concentrated assault began on 12 May 1944. By November the Eighth Air Force alone had flown over 5500 heavy bomber sorties against oil targets, the RAF had equalled this in tonnage, and the Fifteenth Air Force had also run up an impressive total. The Luftwaffe swarmed into the skies and was mortally wounded, its losses averaging 500 aircraft a week during the summer. German oil production fell off to a trickle and the oil shortage became one of the decisive factors in the collapse of the German war machine. A further corollary to this successful campaign was that the critical nature of the targets and the heavy losses suffered by the defenders forced the German High Command to recall so many of their fighter units to Germany that when the transportation interdiction campaign began shortly before D-Day, German fighter opposition was meager. When the armies swept ashore on the Normandy beaches, the air forces, victorious in the air war, committed 10,000 sorties on the first day to their air defenses and support. But the defeated Luftwaffe could commit only 70 aircraft to its prewar forte of close support of armies in the field.

RAF bombs, in shattering this railroad viaduct at Bielefield, helped cut off the Ruhr from Germany.

thinking and Soviet air tactics were most directly affected by the Luftwaffe. This applied especially to the German Air Force heyday on the eastern front from June to August 1941, when in the space of six weeks the Luftwaffe operated five elite tactical air corps with an operational strength of about 3500 planes, switched squadrons brilliantly from one Eastern air front to another, kept right up with the rapid advance of the German panzer divisions over distances of hundreds of miles, and sustained that advance with closely coordinated air-ground support which reached an average daily figure over one thousand sorties.

One of the great secrets of the German air success then, as during the previous summer on the western front, lay in the great mobility of Luftwaffe squadrons. With over 500 Junkers-52 transport planes at its disposal it was able to move equipment, fuel, bombs, spares to the advanced air bases from which the Russians had hastily departed. In contrast the Soviet Air Force, which was not then organised for mobility, was caught flat-footed and had to abandon hundreds of usable planes and dumps of bombs and equipment at its forward bases in Poland, the Ukraine, and the Baltic States of Latvia, Lithuania, and Esthonia. The bitter lesson that the Red Air Force learned in the first two months of war from the Luftwaffe was that a modern air force must be highly mobile if it is to be effective. This means that airfield staffs, wireless stations, bombs, fuel, and spares must be able to be moved at short notice to new air stations with the aid of a large number of transport planes. A strong air transport command, which was an unheard of luxury in World War One, became an indispensable facet of air power in World War Two.

THIS lesson of mobility is one which the Red Air Force learned gradually. At the beginning of World War Two, Soviet air transport was totally inadequate to do the job of fetching and carrying for the Air Force. There was no separate air transport command but only a single division of air transport planes and the liaison flights attached to each air division. Early in the war against Germany some of the Soviet-built Dakotas had to be diverted to bomber squadrons; to keep the single air transport division up to strength, both crews and aircraft had to be taken from the civil air lines of Aeroflot. The shortage of transport planes in the Soviet Air Force persisted throughout World War Two. Their importance was driven home again and again by both German and Soviet success and failure. The Luftwaffe Junkers-52's helped to rescue the Sixteenth German Army when it was surrounded at Staraya Russa in the winter of 1940-1941. Luftwaffe air transport did an inadequate job when Von Paulus' Sixth German Army was trapped at Stalingrad, chiefly because the Red Air Force had gained local control of the air. It was improvised air transport, consisting mainly of Soviet bomber squadrons, which enabled the Red Army to rush the reinforcement divisions to the Stalingrad front in October and November 1942 and so help to save Stalin's name town at a crucial stage in the war.

That the Soviet has absorbed the air transport lesson can be seen by the increase in the production of Soviet transport aircraft since the end of World War Two. There are now two heavy four-engined transport planes in large scale production, the Tupolev-70 and the Ilyushin-18. In the last war there were none. In addition the Soviet is building large numbers of twin-engined Ilyushin-12's and the shorter ranged YAK twin-engined transport machine. There are also reports of a twin-engined Bratukin helicopter machine which will be able to carry more than twenty armed troops.

The strategic expansion of Soviet civil air lines in the Far East is part of the same story, for Soviet civil aviation is closely linked to military air transport, more so than in other countries. In addition the satellite air lines in Poland, Czechoslovakia, Hungary, Roumania, and Bulgaria are linked with the Soviet Aeroflot network and are equipped with Soviet planes. The Red Air Force of to-day is more transport conscious than ever before. The Kremlin is only too aware of the potential bombing threat to its tenuous, vulnerable rail and sea communications. It knows that the Red Air Force may have to switch its squadrons quickly from Europe to Asia and back again. It knows that the same squadrons of MIG, Lavochkin, and Tupolev jets must be ready to do duty both for the strategic metropolitan defence of the U.S.S.R. and for the tactical support of an army in Europe or elsewhere. All this means that units must be mobile and ready to move at short notice.

The Soviet Air Force of to-day is trained and designed to operate from both home and foreign bases. The air forces of the satellite powers are being gradually fitted with Soviet operational planes, such as the YAK-15 and MIG-15 jets and the Ilyushin transports. Radar equipment, bombs, and the rest are of Soviet design. This policy of standardisation of equipment means that the Red Air Force has already a network of air bases in Central Europe, China, and Manchuria which can facilitate the forward supply position of the Soviet Air Force in any future conflict. Early in 1952, for instance, this writer had eye witness evidence that this was going on at the Hungarian air bases near Kecskemet, Szolnok, and Varpalota. Evidence from the Prague and Warsaw airfields such as Okecie and Razyn has long been available, as Poland and Czechoslovakia are the strongest of Russia's European air allies. Who can doubt that in China and Manchuria the U.S.S.R. is also gradually stock-piling aircraft spares, ground equipment, and fuel?

This does not mean that the Red Air Force will not be hard put to operate at the end of an extended supply line. Russia has nothing like enough transport planes to meet her full global commitments. These commitments could be doubled in a few days, if her communications were successfully hit from the air. The Kremlin knows this of course. That is why we can expect further increases in the production of Soviet transport aircraft, plans for the mobilisation of all civil air line facilities at short notice, an increase in the number of trucks and helicopters available to the Soviet Air Force, and a series of air maneuvers to test the mobilty of the air regiments commanded by General Zhigarev, Russia's air chief until further notice. The Soviet Union realises that mobile air power is a vital necessity to her defence.

Partly as a result of her fighting contact with the Luftwaffe and the German army in World War Two, Russia now has a much soberer view of the potential military value of airborne and parachute troops. For the first year or so of the war the Soviet had to employ many of her crack parachute divisions in emergency defensive ground battles such as the 1941 defence of the Smolensk province and the 1942 operations on the Stalingrad front. In this she did not differ from her German opponents, who were also compelled to use parachute troops as crack defensive infantry in the campaigns in Africa, France, and Germany, as well as on the eastern front.

Later in the war the Red Army found ample opportunity for using large formations of parachute troops in their conventional offensive role. In 1943 and 1944 the stage was ideally set for operations of this type on the eastern front. The German army was deteriorating rapidly. The Soviet Air Force had won air superiority, thanks to the fact that the Anglo-American air assault in Europe and the Mediterranean contained at least two thirds of the total Luftwaffe air forces, and it was the elite two thirds. There were rivers for the Red Army to cross with the help of airborne and parachute troop operations, as at the Volkov, the Lovat, and the Dnieper. The stretched lines of the German communications system were there to be severed almost as the Red Army wished. But when the Red Army re-entered the Don Basin in the autumn of 1943, the newly formed parachute cadres under General Kapitochin failed to hit their drop zones when a large-scale parachute operation was carried out at Kanev. The link-up of the Soviet airborne forces was not effective, and they did little to help the advance of the Red Army on this front. Although Soviet parachute formations did a little better in the spring of 1944 when they aided General Tolbukhin's assault on the Crimea, Soviet reports suggest that they did not play a vital role in the success of this combined operation by land, sea, and air forces.

All these World War Two experiences against a weakened German army added to the Soviet realisation of the difficulties of employing large numbers of parachute troops under combat conditions. They have also studied in detail the lessons of the parachute operations at Arnhem, over Sicily and Crete, in fact of all phases of World War Two in which large numbers of troops went into battle by air. As a result of the lessons learnt, the Soviets will not lightly commit many of her parachute divisions simultaneously in a single large-scale airborne operation. She will not run the risk of heavy losses in transport aircraft except to gain some really vital objective. The U.S.S.R. knows that parachute troops are a vulnerable target even against modest opposition. But Russia also knows that small groups of parachutists operating with guerrilla or Soviet sympathisers dropped over a wide area sufler fewer casualties and can cause much damage. In World War Two these parachute operations were highly successful on the eastern front. At a time when the German man-power situation was severely strained, the Luftwaffe had to find thousands of extra airfield guards to meet the threat of sabotage to planes from these Soviet guerrillas supplied from the air and in close wireless contact with the Red Army from well behind the German lines.

ALTHOUGH the Luftwaffe never presented a serious strategic bombing threat to the U.S.S.R., it influenced the development of the Soviet Air Force strategic fighter defence system. At the outbreak of World War Two neither the Luftwaffe nor the Red Air Force had an integrated system of day or night fighters with a co-ordinated chain of radar stations and sector controls by radio telephony. Both relied on an observer corps for their early warning and on a concentration of antiaircraft guns and on such fighter squadrons as were available locally to defend their metropolitan territory from bomber attacks.

By 1944 two things had happened. The German Air Force had launched a series of moderately successful long-range air attacks at night against rear-area towns such as Gori, Jaroslav, Saratov, and Astrakhan, centers of Soviet tank, oil, and rubber production. These attacks resulted in the formation of a few experimental Soviet night fighter regiments. Much more important was the formation of the Luftwaffe strategic fighter defence system during the war. It reached a peak strength of over 2500 day and night fighters, backed by an efficient radar and early warning system and by effective tactical use of radio telephony and wireless aids.

Although the Red Air Force never had to face the full brunt of the Luftwaffe strategic defence system, its night bombers ran into the night-fighter organisation on the eastern front in the last year or so of the war and developed a healthy respect for it. In Poland, Roumania, and East Prussia Ju-88 and Me-110 night-fighter squadrons, equipped with airborne radar and backed by a radar early warning system, regularly intercepted the attacking Ilyushin twin-engined and Tupolev four-engined raiders.

At the end of World War Two the Russians overran the bases of these night fighters and captured Luftwaffe radar equipment such as airborne *Naxos* and the *Würzburg* long-ranged early-warning radar, as well as a number of experienced radar operators. In addition many thousands of technicians who had worked for Siemens, Askania, and Telefunken in factories in Eastern Germany were taken to the U.S.S.R. and helped to start the large-scale production of radar equipment. This is one of the main reasons why the Red Air Force was able to form its first radar signals units as early as 1946. There is no doubt at all that the Soviet Air Force has benefitted enormously in its blind flying and night-flying techniques as the result of its inheritance from the Luftwaffe of World War Two. The amount of night flying by the Soviet civil air lines has increased greatly in the past few years, and nearly all Soviet bomber and fighter pilots take a thorough course in blind flying with the help of radar, radio-telephony, and wireless aids to navigation.

Because the U.S.S.R. must develop her strategic fighter defences and her strategic bombing more than ever before, this aspect of the German technical air legacy is of crucial importance both for the Kremlin and for the American Air Force. The full story of the exploitation of this legacy of captured German equipment and of the enforced expatriation of captured Luftwaffe technicians, engineers, and scientists could fill many volumes. Part of the story has already been told in articles, pamphlets, and books written by Colonel Tokaev, a Soviet Air Force officer who was a senior member of the staff which exploited captured Luftwaffe equipment after the war. Tokaev escaped to the West in 1949. It is a documented fact that in each of the Soviet air armies operating on the eastern front a new staff group was set up in the spring of 1945 before the end of the war. It bore the innocuous title of "The Department for Work Amongst Local Peoples." From Russia's Foreign Language Institutes English- and German-speaking officers were temporarily commissioned and placed alongside the best officers and N.C.O.'s of the Soviet Air Force corps of engineers. They were sent to captured territory at once. The directive given to them was simple. It was to exploit to the full the unprecedented harvest of modern aeronautical techniques and equipment which fell into the Red Air Force lap in the first six months of 1945. It would be difficult to think of many examples of modern air weapons, tools, or equipment to which Russia did not suddenly become heir. There were jet planes, rocket planes (Me-163), radar equipment, experimental guided missiles, high octane fuels, blueprints for supersonic planes, prototypes of Junkers and Heinkel jet bombers, in fact samples of nearly everything that German Air Force engineers and scientists could offer. We must remember that experimental aircraft and rocket centers like Peenemunde and Heidelage in Poland fell into Soviet hands and that whole units of Arado and Messerschmitt twin jets were picked up by the Red Air Force on airfields near Prague.

THE greatest Luftwaffe contribution to the Soviet Air Force in the immediate post-war period was undoubtedly in the realm of jet aircraft. By the end of World War Two, the

U.S.S.R. had designed only experimental jet engines, which had been tried out in the flying test-bench of the four-engined Tupolev bomber, the TB-7. In 1945 Soviet air engineers were presented with hundreds of samples of Junkers-004 co-axial jet engines and German B.M.W.-003 jet engines. These came from over two hundred Messerschmitt-262, Heinkel-162, and Arado-234 Luftwaffe jets picked up on airfields in Czechoslovakia, Hungary, and Eastern Germany in the last few months of war. There were also dozens of samples of the Walter rocket engine, which, however, the Soviet has not yet developed as fully as the Luftwaffe jet engines.

The German influence on the first Soviet jet aircraft is seen clearly in the YAK-15 single jet and the MIG-9 twin-jet, which went into large scale production in the U.S.S.R. in the 1946-1948 period. The MIG-9 first saw squadron service in 1947. It is essentially a ground-attack, Stormovik type of plane. Its designers certainly drew heavily on German inspiration and research data. The engine was a copy of the German B.M.W.-003 engine which had been fitted to Hitler's jet aircraft failure the Heinkel-162. Then there was the personal advice obtained from German jet engineers and pilots such as Siegfried Gunther, one of Heinkel's best jet engineers. The YAK-15 single-seater fighter jet reported in action in the early days of the Korean war and now being supplied to Russia's satellite air forces in Eastern Europe as an operational training aircraft was originally nothing more than a lash-up of Soviet piston-engined YAK-9 fuselage, fitted with copies of the German Jumo-004 co-axial jet engine. The early models of Tupolev's twin-jet plane, the Soviet equivalent of the British Canberra, were also fitted with turbo-jets of German design. Ilyushin's four-jet bomber produced in 1947 bears the unmistakable stamp of a Heinkel jet bomber designed in 1945.

It cannot be too strongly emphasised that the German influence was at its height only in the formative jet era of the Soviet Air Force from 1945-1948. While Luftwaffe jet engines vastly accelerated the Soviet production of co-axial jet motors, British Rolls Royce Nenes helped to speed up, though not to the same extent, the development of Russian centrifugal-type jets. But the MIG-15 single jet and the Tupolev-10 twin jets which are flying in the 1952 squadrons of the Soviet Air Force are fitted with an original Soviet engine evolved from their 1946-48 apprenticeship. To-day the U.S.S.R. has no great need of German air technicians, and many of them have found their way back to Western Germany. Russia's engine designers like Mikulin, Klimov, Charomski, and Chelomey have enough experience to make personal contributions to improving Soviet jet engine design. The superior fuel injection method and the high metallurgic quality of the Soviet engine in the MIG-15 are common proof of this. But the original debt of Soviet air engineers to the Germans is heavy.

IN the field of rockets and guided missiles the German contribution to Soviet technical progress has also been considerable. Even before World War Two, in 1935, the Soviet acquired some of Germany's best rocket mathematicians and scientists from the big rocket center near Berlin, which was taken over by the Gestapo in that year and reconstituted at Peenemunde. These included the German mathematician Hermann Oberth, author of two well-known books on rockets and space travel. Although the U.S.A. inherited many of Peenemunde's top-ranking rocket and guided missile specialists, such as Professor von Braun and Dr. Doenburger in 1945, the U.S.S.R. also got hold of some of Peenemunde's best brains, including people like Professor von Bock and Dr. Wilhelm Tellman. At the end of 1949 Tellman escaped from the U.S.S.R. via Greece after plying his radar and rocket skills at Tomsk, Leningrad, and Kuibishev. He has now migrated to the Argentine to join the considerable Luftwaffe colony which is modernising Peron's air force at Cordoba, center of Argentinian jet and rocket development.

Tellman has confirmed the evidence already available from Tokaev and other escaped Soviet Air Staff officers. Peenemunde has been completely re-created and further developed for the Russians by German technicians working under the directives of Professor Artakianov, the Soviet scientist. Back in the U.S.S.R. large-scale production of rockets and flying bombs based on the German V-1 and V-2 blueprints is now in process near Moscow, Kazan, Leningrad, Tomsk, Irkutsk, and probably in other industrial centers. The Russians have of course improved on the German models. Eye-witness accounts have reported a two-stage Russian rocket, which may increase the range of the V-2 to some 400 to 500 miles. During the last two years there have been independent reports from both the Usedom area of the Baltic and from near Leningrad, both confirmed by Dr. Tellman's on-the-spot evidence, that experimental radio-guided work is being carried out with these V-2 type rockets. The radio and radar signals are provided from equipment on Russian surface vessels and are effective up to a height of 40,000 feet. (Current performance may be an improvement on this.)

The fact is that the whole range of Luftwaffe and German army radio-guided missiles and equipment fell into Russian hands. There were the two Henschel radar-guided bombs, the Hs-293 and the larger FX-1400. The former was used unsuccessfully as a tactical defence weapon against U.S.A.A.F. Flying Fortresses that bombed Germany in the summer of 1943. Both types of bomb found their mark against American merchant and naval vessels operating in support of the Salerno landings later in the same year. The U.S.S.R. also acquired samples of German antiaircraft radio-guided missiles like the X-4, the Hs-298 air to air projectile with a range of about a mile and a half, the *Rheintochter*, which was fitted with a radar proximity fuse, and the very promising *Schmetterling*, which even in 1945 had an operational ceiling of over 45,000 feet and a planned radius of action of about twenty miles. It could be ground or air launched and was one of the most advanced of the German small-calibre radio-guided defensive rockets. Of these various projectiles the Henschel-293 bomb and the defensive Schmetterling and Hs-298 (the V-3) are undergoing development at Tomsk and Irkutsk, according to the evidence available to this writer. Soon they may be going to production at factories near Riga, Leningrad, Kiev, Khabarovsk, Voronezh, and elsewhere.

At other factories in the same areas improved radar equipment, based on the German *Würzburg* and airborne *Lichtenstein* and *Naxos* are in large scale production, manifesting the technical contribution of the Luftwaffe to the Soviet air problem of accurately tracking the path of incoming bombers and helping fighters to carry out the final interception in bad weather conditions or at night.

GERMAN Air Force influence on Soviet aircraft armament policy has been quite definite. Before World War Two the Luftwaffe pioneered in the use of the 20mm cannon, while the air forces of England and America adhered to a policy of fitting smaller calibre guns to their planes. The Soviet has adhered to the German armament policy and during World

War Two produced cannon of both 23mm and 37mm calibre for their fighter and bomber aircraft. It was the Red Air Force that asked the United States, under Lend Lease arrangements, to produce large numbers of Airocobra and Kingcobra fighter planes fitted with 30mm cannon, showing that they believed in the German policy of fitting their planes with heavier guns.

Now amongst the haul of captured German air equipment were a number of experimental 55mm and 88mm cannon, which were used by the Luftwaffe on twin-engined Heinkel bombers and on twin-engined Junkers-88 fighters and bombers. There is evidence that Junkers armament experts have helped the U.S.S.R. to produce the 53mm cannon which is being currently fitted to Soviet twin-jet Tupolev planes. In short the Soviet has long had a tendency to fit their planes with large-bore cannon, but the Luftwaffe has both influenced and aided Soviet armament trends under this heading.

In the realm of military air training, the German Air Force has exercised at least four distinct influences. The first is to raise the standard of radio telephony communication between ground stations and aircraft and aircraft and tanks in the area of air-ground tactical support. The Soviet Air Force, after monitoring Luftwaffe tactical voice traffic in World War Two, soon realised that their own air/ground support routine was slow in comparison and needed speeding up. This is now being done. In the same way Soviet war-time experience of the high standards of German tactical air reconnaissance, of observation training, of planned visual signals for troop identification, and of mobile front-line photography have all resulted in a sharpening of Soviet training methods under all these headings. The Luftwaffe system of forming operational training units fitted with the same aircraft as front-line units and trained in the special squadron tactics of front-line units was also adopted into the Soviet Air Force during World War Two. Thus the Red Air Force narrowed the gap between the final stages of operational training and front-line flying. This system is not special to the German and Soviet Air Forces, but it was contact with the Luftwaffe which helped to decide the Russians to introduce it. Finally hundreds of Luftwaffe radar technicians and radar signals personnel, including many members of the German Air Force 200th and 300th night fighter formations captured in Poland and Roumania, have helped to lay the foundation of Soviet methods of training radar operators.

THIS article cannot give a complete account of the influence of the German Air Force on the Soviet Air Force. In the realm of air tactics, for instance, the Red Air Force was learning new things all the time it was in combat. But as the German air tactics varied so much from day to day, according to weather conditions, squadron commanders, and the nature of the operation in hand, it would be a difficult task to try to give a representative summary of what tactics the Russians learned from the Germans. This writer can personally vouch for the great attention paid by the Red Air Force staff to Luftwaffe tactics, for in World War Two he was engaged, amongst other things, in supplying them with a stream of Luftwaffe combat intelligence which Red Air Force staff officers seemed never tired of discussing.

In the way of industry, Luftwaffe factories making modern Messerschmitt, Focke-Wulf, Junker, and Henschel planes have been taken over by the Soviet aircraft industry in East Prussia, Poland, East Germany, Hungary, Czechoslovakia, and Roumania and have contributed to the post-war expansion of the Soviet aircraft production. The Soviet system of airfield construction has gained from its capture of hundreds of well-equipped Luftwaffe bases in the 1943-1945 period.

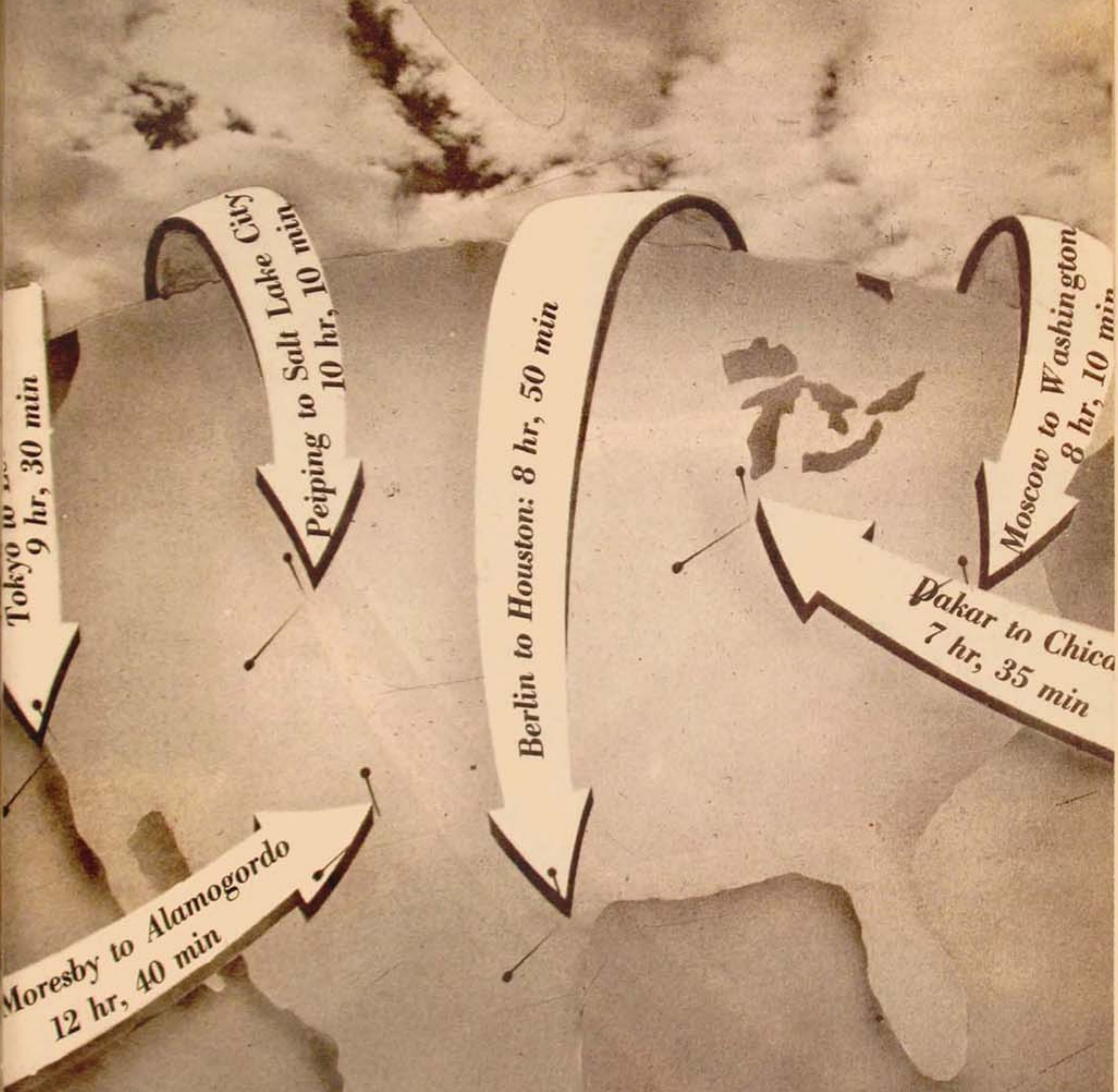
In 1945 the Soviet Air Force stood in urgent need of modernisation in many ways. Thanks largely to the Luftwaffe the technical gap between the Western Air Forces and the Soviet Air Force has been closing rapidly since then. Tactical mobility, radar, strategic defence, rockets, jet aircraft, radio-guided missiles, and training methods—these are some of the fields of aviation in which the Soviet debt to Germany is apparent. But we would be wrong to assume that the U.S.S.R. cannot produce original air doctrine, tactics, and weapons of her own. Let us not forget that the Soviet pioneered in the large-scale use of airborne troops and the employment of the tactical rocket bomb and also the large-scale use of the harassing night bomber, acting as a persistent intruder against the enemy over a wide area. Although Russia's tactical and technical air debt to Germany is great, in aviation as in other things, the Soviet have demonstrated that they learn quickly and profit so much that they often better the instruction they are given.

London

How Long Before the First Battle?

The place: the northern half of the worl

The time: the present



THIS IS WHY LEADERS OF THE STRATEGIC AIR COMMAND, THE NATION'S primary air striking force, hold that the defense of the United States must be conceived and planned as an offensive would be planned. A few hours over the top of the world to Washington is a fact of time yielding little for traditional meas-

In January 1941 Rear Admiral Takijiro Onishi, Chief of Staff of the Eleventh Air Fleet, was ordered to formulate a plan of attack to immobilize the United States Pacific Fleet and give Japanese naval and military forces freedom of action in the Southern Pacific. The Pearl Harbor attack was conceived by Admiral Yamamoto. Early in September the Naval General Staff and the First Air Fleet staff began to work out details of the actual plan.

On 3 November Admiral Nagano, Chief of the Naval General Staff, and Admiral Yamamoto definitely decided to attack Pearl Harbor if diplomatic negotiations with the U.S. failed. Meanwhile those air groups and the surface vessels designated by the plan trained intensively. By the end of November they were ready for the planned mission.

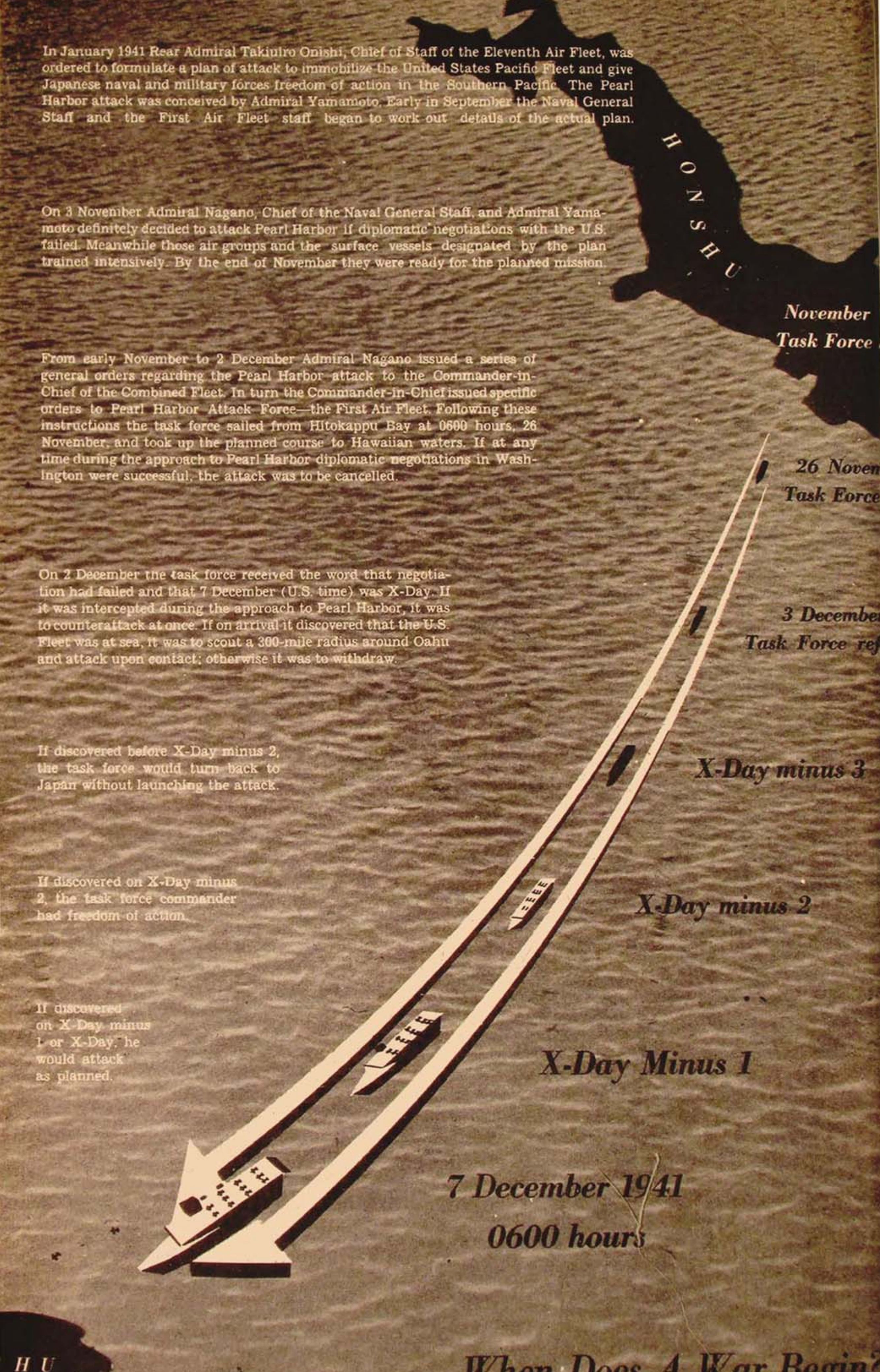
From early November to 2 December Admiral Nagano issued a series of general orders regarding the Pearl Harbor attack to the Commander-in-Chief of the Combined Fleet. In turn the Commander-in-Chief issued specific orders to Pearl Harbor Attack Force—the First Air Fleet. Following these instructions the task force sailed from Hitokappu Bay at 0600 hours, 26 November, and took up the planned course to Hawaiian waters. If at any time during the approach to Pearl Harbor diplomatic negotiations in Washington were successful, the attack was to be cancelled.

On 2 December the task force received the word that negotiation had failed and that 7 December (U.S. time) was X-Day. If it was intercepted during the approach to Pearl Harbor, it was to counterattack at once. If on arrival it discovered that the U.S. Fleet was at sea, it was to scout a 300-mile radius around Oahu and attack upon contact; otherwise it was to withdraw.

If discovered before X-Day minus 2, the task force would turn back to Japan without launching the attack.

If discovered on X-Day minus 2, the task force commander had freedom of action.

If discovered on X-Day minus 1 or X-Day, he would attack as planned.



ures of defense. The age of mobilizing armies and massing fleets for a drive across a natural border into the heartland of an enemy is passing. In less than ten years the day has dawned of the intercontinental bomber, coming with no other warning than its own passage, swift as sound and invisibly high over oceans and mountain range.

The bomb, the bomber, and the aircrew are the three elements of our long-range aerial weapon. With a hostile power possessing the hitherto decisive bomb, how will the USAF retain decisive capability for a war that may be signaled only by the commitment of forces to the first air strike? The answer lies now in superior aircraft and aircrews able to drive home decisive attacks before the enemy can carry out a crucial offensive. In collaboration with the Strategic Air Command the Editors of the *Quarterly Review* survey today's developments in the jet bomber and its crew.

The time has also arrived when the destructive power of an army or a fleet, firing for days, can be packed within the metal casing of one bomb. A paralyzing "Pearl Harbor" type of attack damaging a nation beyond power to retaliate or carry on war is a capability of present-day air forces. And that no nation can endure for long under determined and sustained aerial bombardment was adequately proved by 1945. In fact U.S. power to commit an unlimited global air offensive has been, in the opinion of most competent observers, the chief deterrent to a third world war.

The men of SAC are strong in their belief that national survival depends upon our ability to parry any vital attack by smothering the aggressor before he can mount it. The time lag in swift retaliation to an act of war must be so drastically pared away, our offensive forces so ready and so alert, that we ourselves deal the decisive attacks before the enemy can hit us hard. The response of our air forces must be a split-second offensive so devastating from the beginning that a dangerous enemy offensive can never succeed. We must, in a sense, take off when we hear the enemy warming his engines.

How, then, can this split-second offensive-defense be committed? How can we define and recognize an ultimate act for war? It must be discernible before the bombs drop on our cities. Yet at what instant would we have been justified in attacking the Japanese task force that bombed Pearl Harbor in 1941? As the carriers were launching the bombers? When the task force entered Hawaiian waters? When it was halfway along its course? The commander himself was then not yet irrevocably committed to the attack. Yet he was dangerously close to his target. When the task force sailed from Japan? When the order came for it to sail? When the ships were fitted and trained for their fateful mission? When the decision to immobilize the U.S. Pacific fleet was communicated to the Japanese High Command? The more difficult to define the overt act, beyond which war is upon us, the shorter the time lag we can accept, after it is recognized, before our offensive is driven at the enemy's heart.

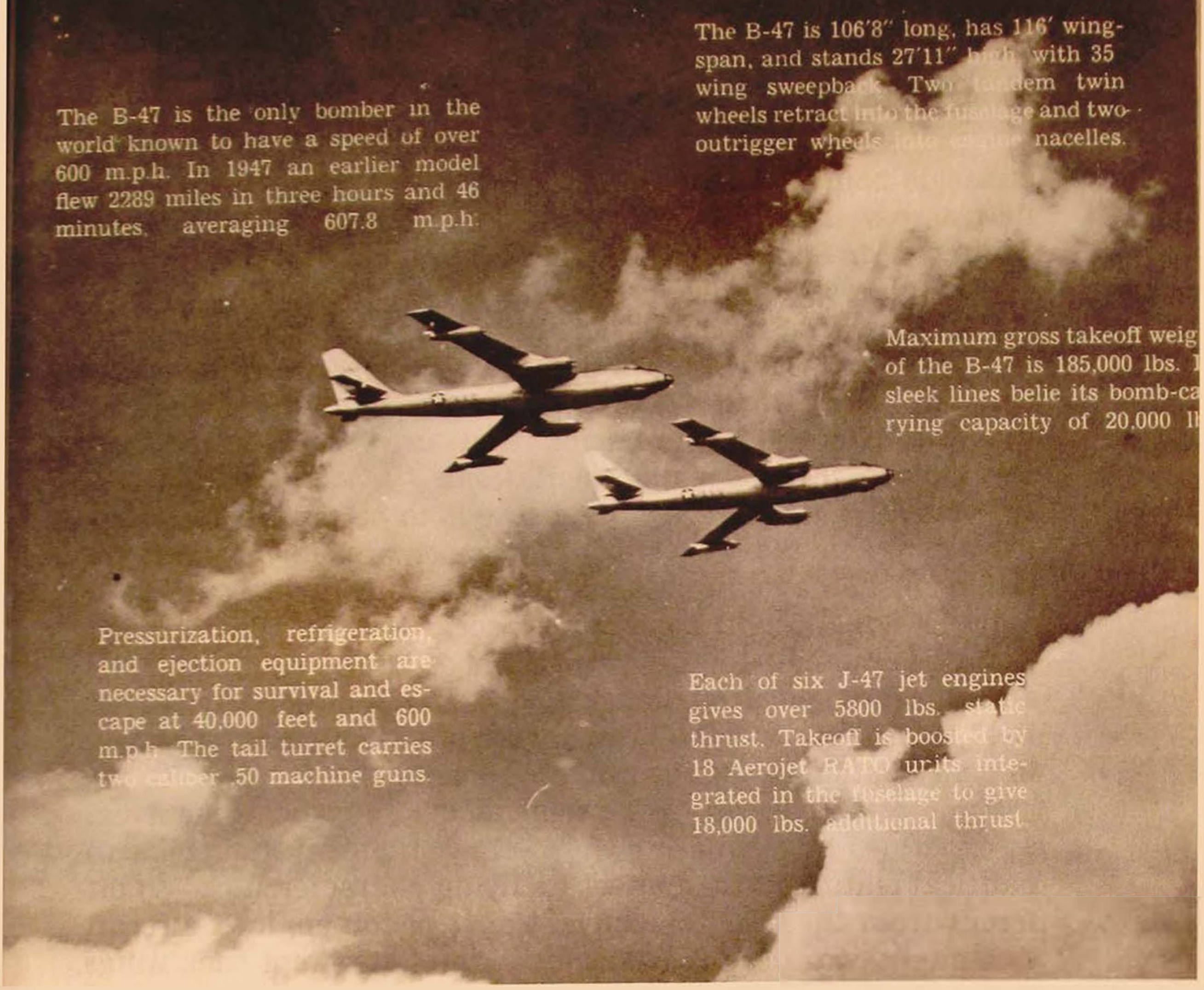
The Weapon

It is therefore imperative that we have a weapon at hand and keyed-up to meet the crisis. Though the commitment of this weapon would follow hostile action that is beyond our national control (and in this sense it is a retaliatory weapon), our strategic air force must be offensive minded in every phase of its operations. If the enemy knows we have this weapon, if he knows that upon his move toward hostilities we can take the offensive, if he knows we can ruin him before he can adequately get his forces in operation, then we can hope the deterrent it must exercise upon his aggressive intent will be enormous. It would constitute our strongest deterrent to war. This is the extent to which our nation depends upon the Air Force to perfect a swift, hard-striking, long-range weapon with the offensive initiative for commitment far beyond any potential enemy's capabilities to match. Since World War II our stockpile of A-bombs *plus* our power to deliver them have constituted that weapon. What of the future?

The Bomb

First, in this age of nuclear explosion, guided missiles, and supersonic aircraft it is definitely within the realm of possibility to win a war by the sole use of strategic bombardment. If not (and at present there is no evidence to believe not), it is then a necessary prerequisite of winning by any other method. Second, the development of the A-bomb and long-range bombardment aircraft by another nation is rapidly equalizing the power of atomic destructivity which for so many years was balanced heavily in our favor.

We must strive with all our resources and technological ingenuity to prevent this equalization. But we must remember



that a superior A-bomb or a numerically superior stockpile of A-bombs will not alone bring victory in war. Nor will either guarantee security, if peace continues, or retain the power of deterring attack as it has in the past. With two potentially hostile nations approaching equality in bombs and capability to deliver them, the balance of military power will increasingly focus upon the nation possessing the swiftest and most accurate means of delivery.

This demands an air striking force continuously adapted to greater speeds, higher altitudes, and changing strategy. It demands, as always, long-range bombardment aircraft possessing operational features equal or superior to those of their contemporary high performance fighters. It demands, as never before, skilled professional aircrews.

The Jet Bomber

The B-47 was the first medium jet-powered strategic bomber designed to meet and fulfill the requirements of a changing era. It can carry the atomic bomb faster and higher than any other strategic bomber known in the world. In 1949 an early model flew across the continent from Moses Lake, Washington, to Andrews Air Force Base, Maryland, in 3 hours and 46 minutes —averaging 607.8 miles per hour.

Being the first in the field of a new type strategic bombardment aircraft possessing revolutionary design and performance characteristics, the B-47, like any prototype, presents engineering and operational problems that are being solved only through operational experimentation.

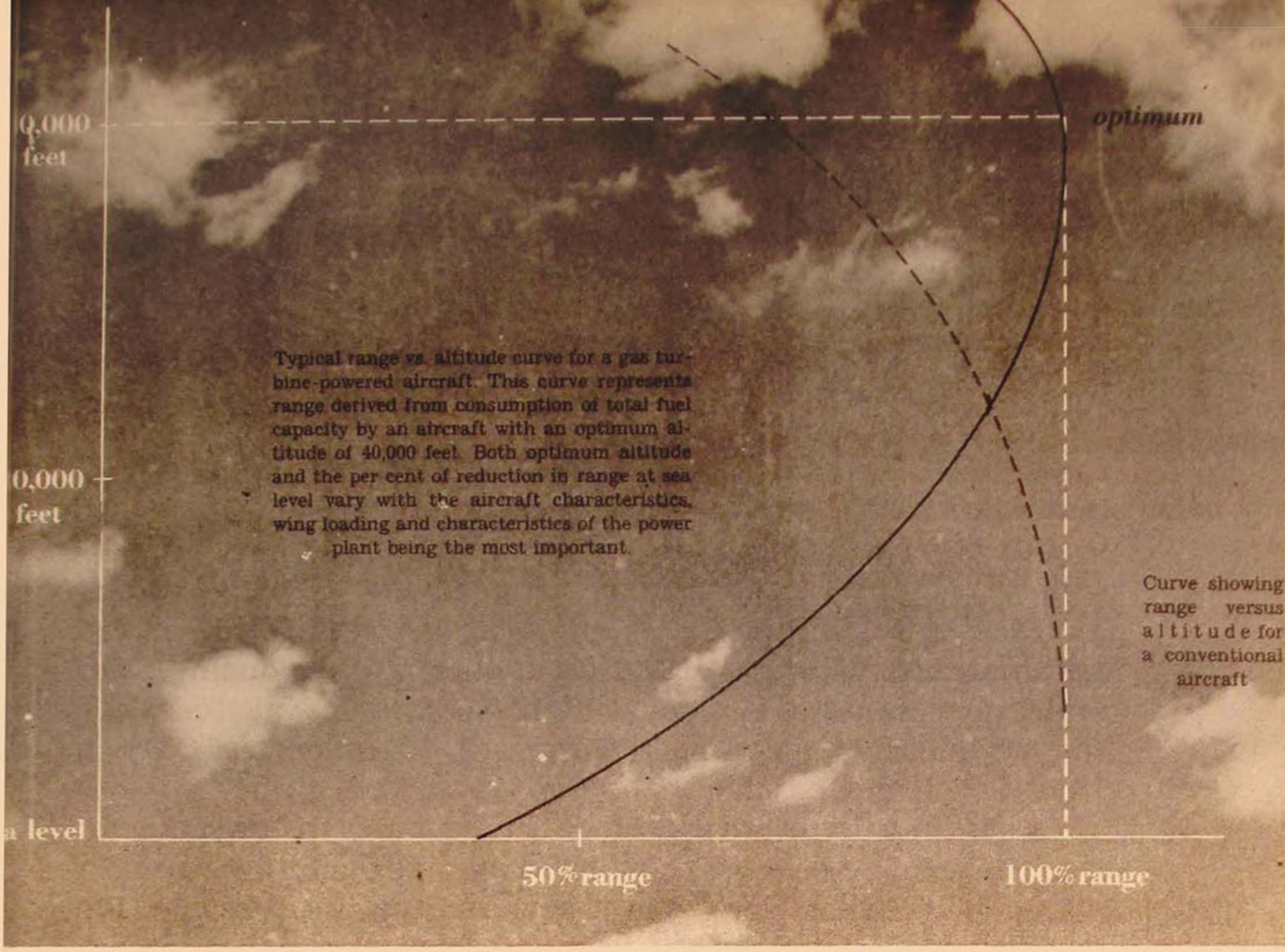
Although the B-47's tests indicate it to be the best strategic jet bomber in the world today, it most probably bears a relation in the dawning age of jet bombardment to the B-10 of another era. With the coming of rocket and nuclear propulsion this new age promises nearly limitless speeds and altitudes, and unprecedented challenge to the men who will fly. In the B-47 we have found the basis for aeronautical designs already in construction or on the drafting boards.

Some of the operational problems of jet bombardment can be explained by examining the B-47's equipment and the aeronautical features which affect its flying characteristics—so different from those of the conventional piston-engined aircraft. One might consider the B-47's jet engines, its swept back wings, its bicycle landing gear, its flaperons, and its drag chute. Each has its specific purpose; each poses advantages and disadvantages for our determined efforts to give increased speed and operational effectiveness to our strategic weapon.

The main advantage of the jet engine is in great operational speeds and altitudes. Since the jet engine is more economical at high altitudes, the obvious way to "lean out" a jet is to go up. This in turn makes operations possible above 35,000 feet and at 400 to 600-plus miles per hour. The hazards of enemy ground or air defense are reduced. The speed of attack is greatly increased. For the first time a strategic bomber has the power to reach and go beyond the critical Mach number* in level flight.

The simplicity of the jet engine greatly diminishes maintenance requirements. It also cuts down the time and effort necessary with conventional bombers to prepare for take-off. Necessary warm-up operations, so typical of conventional aircraft, are limited in the B-47. The main disadvantage of the jet

*The theoretical definition of a critical Mach number is that airspeed at which the velocity of sound is first reached on any part of the aircraft. From a nontechnical standpoint "critical Mach number" is most practically defined as that air speed at which drag starts to rise rapidly and begins to change the normal characteristics of the aircraft.



engine is the effect of its high fuel consumption on maximum range, together with the related high take-off weights of fuel.

Jet engines also need longer take-off runs and planned take-off distances. Since ambient temperatures and runway elevation affect jet performance, the higher the runway and ambient temperature, the longer the take-off run. Jet operations therefore call for lengthened runways.

On the other hand the jet engine requires well-planned airfield approaches. Go-arounds may be critical because of slow acceleration. The current fuel limitation of the jet may not allow for a second pass at the home base if during a mission the flight plan is altered by emergency conditions. Inflight refueling is one solution for fuel limitations being applied to B-47 operations.

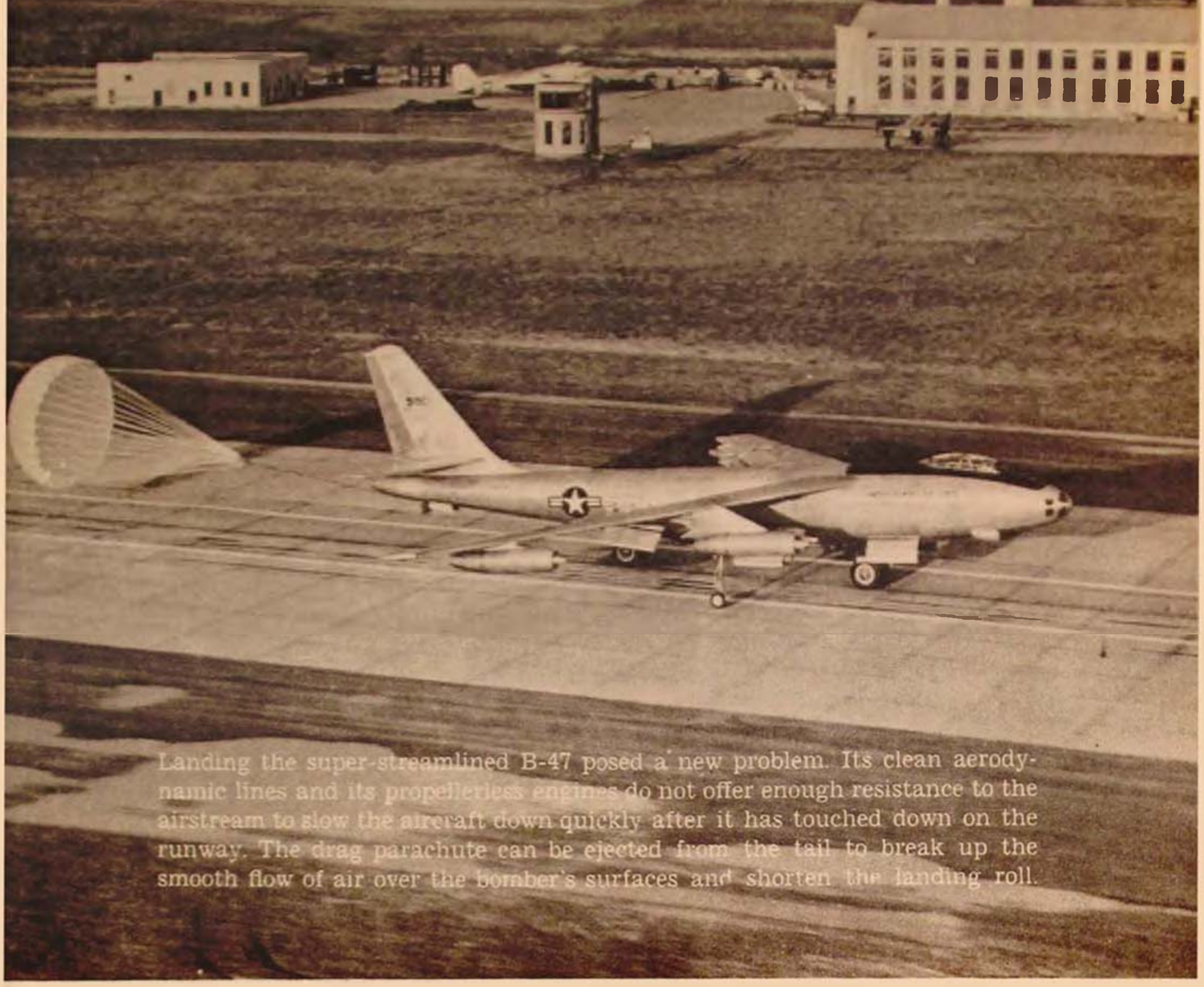
The B-47 is the first U.S. strategic bomber to use the swept-wing. It was used in the original design mainly to push the speed of the aircraft beyond that of the F-80, top jet fighter at the time. The 35 degrees of sweep-back on a B-47 is a compromise between design for speed and design for range, as each is directly affected by the other. Sweep-back greatly reduces gust effects, usually critical at high speeds on conventional aircraft, but it also introduces definite stalling characteristics.

At lower speeds the wing layer of air, present on any airfoil, is forced towards the wing tip by the normal flow of air across the wing. This still layer tends to pile up at the tip and results in tip-stalling that makes lateral control difficult at lower airspeeds. The outboard engine nacelles of the B-47 help somewhat by spilling the still layer overboard before it can pile up, but in general the swept wing does not make for good low-speed handling characteristics—particularly in approach and landing. Another disadvantage of the swept wing is the weight it adds because its structural design requires stronger internal support than the conventional wing. Again, as wing loading increases at higher indicated airspeeds, the wing tends to twist and increase the angle of attack of its tip—introducing some difficulties of lateral control at high speeds in low altitudes. On the other hand, the wing is flexible, with a movement arc of 17 feet. This means smoother riding in turbulent air.

To obtain a high critical Mach number for the swept wing, the wing had to be kept thin. The two main landing gears are placed in tandem along the center line of the fuselage. For stability on the ground, outrigger gears were mounted in each of the inboard nacelles. The bicycle gear demands different pilot technique than the tricycle gear to which most pilots are accustomed. Much variation in the take-off run, from pulling the aircraft off early or holding it on the runway, is not possible. But this characteristic enables the pilot to compute his exact take-off distance from his take-off weight, the runway elevation, the ambient temperature, the wind, etc.

The flaperons are in reality controllable flaps. When fully extended, they rotate with the aileron. They serve to improve lateral control at low airspeeds and overcome many otherwise difficult landing characteristics.

The function of the drag chute is to "dirty up" the B-47. Because of its "clean" aerodynamic design and lack of propellers, which give "drag" after the touchdown, the B-47 rate of deceleration is slow. When it is used, the 32-foot parachute bellies out behind the B-47 just after it touches the runway and by increasing drag cuts down roll. Regular maintenance crews pack the drag parachute, since the extreme care used in packing the canopy-type personnel chute is not necessary. The dragchute may help solve one of the pressing logistics problems connected with the maintenance of aircraft overseas during World War II —the supply of wheels, brakes, and tires. It may also enable the B-47 to operate from normal length runways.



Landing the super-streamlined B-47 posed a new problem. Its clean aerodynamic lines and its propellerless engines do not offer enough resistance to the airstream to slow the aircraft down quickly after it has touched down on the runway. The drag parachute can be ejected from the tail to break up the smooth flow of air over the bomber's surfaces and shorten the landing roll.

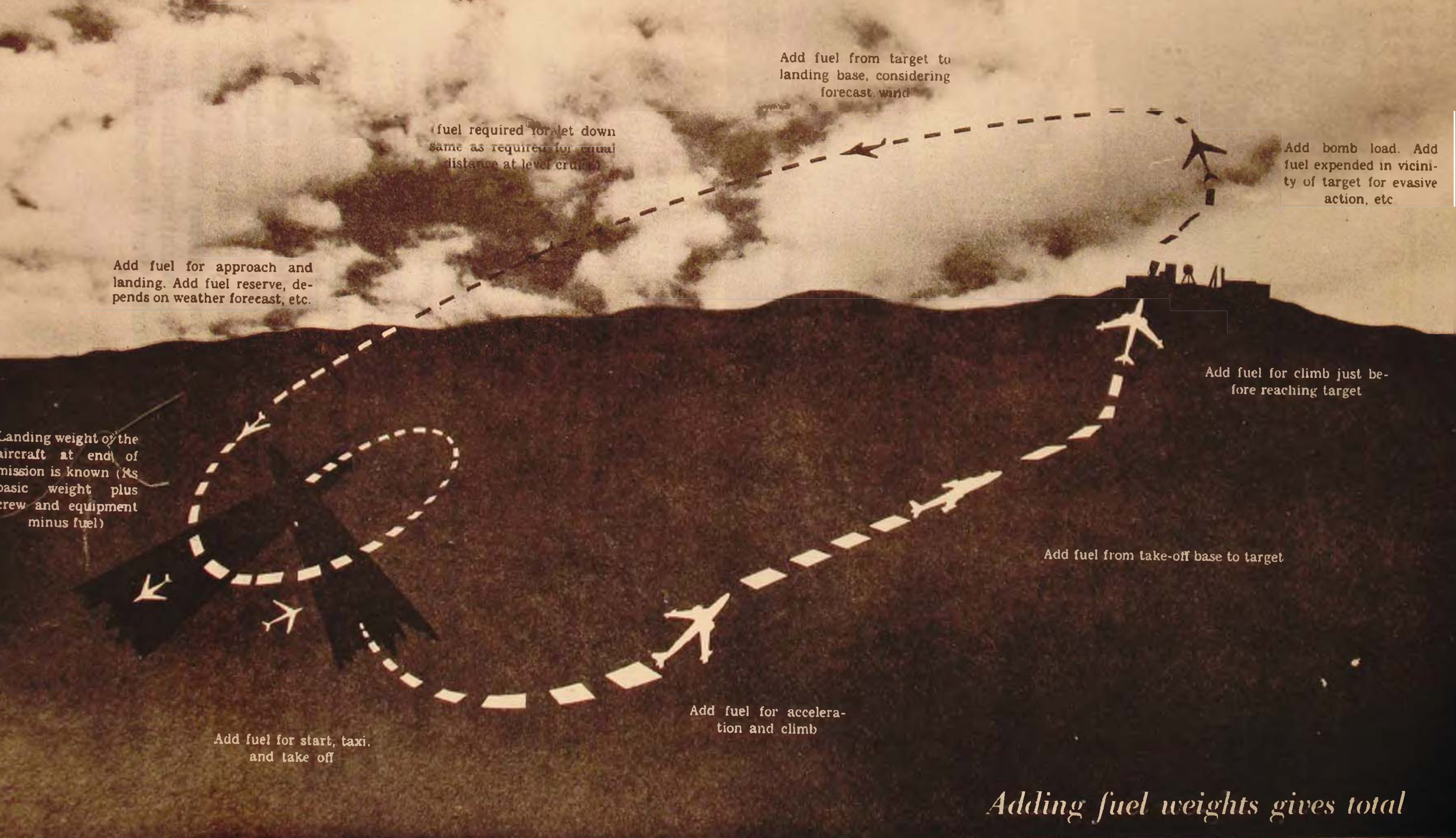
With the development of the B-47 we have given our air weapon new meaning and power. It has placed our strategic air striking force one step nearer the goal of supersonic intercontinental operations. How then has this modification affected the third, and most important, component of the bomb-aircraft-crew weapon?

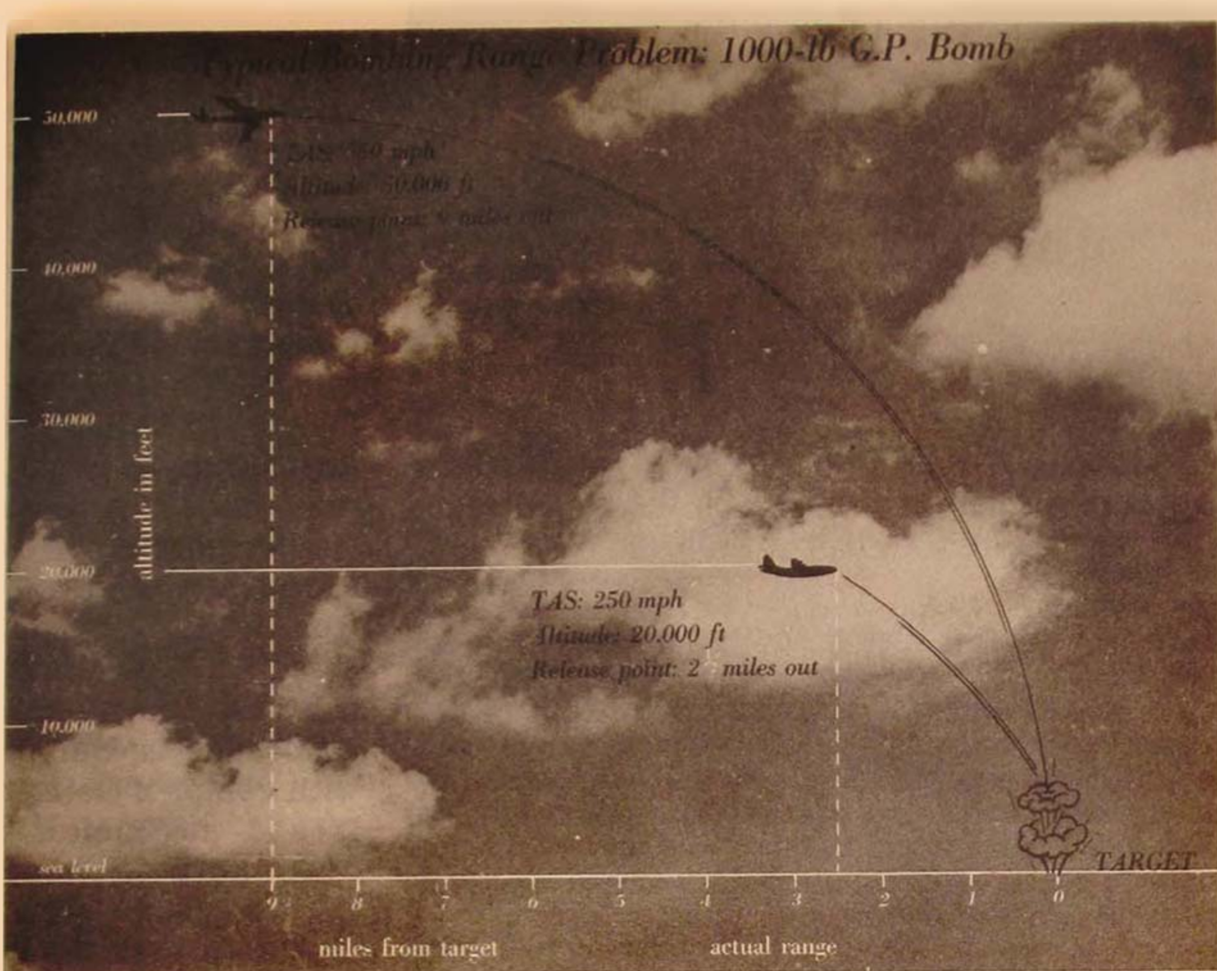
The Jet Bomber Crew

The advent of the jet bomber has not revolutionized aircrew problems, but it has intensified some of the old ones. Increases in speed and altitude have placed a demand upon crew members for qualifications never before required in bombardment aircraft.

Since jet bombardment crews may be called upon to operate at long ranges and over regions where safe landings short of home base are not possible; since they may be called upon to operate singly, without fighter escort over enemy areas where vigorous ground and air defense will be encountered; since one crew may have a mission which in World War II would have

Planning Fuel Requirements for the Long Range Jet Mission



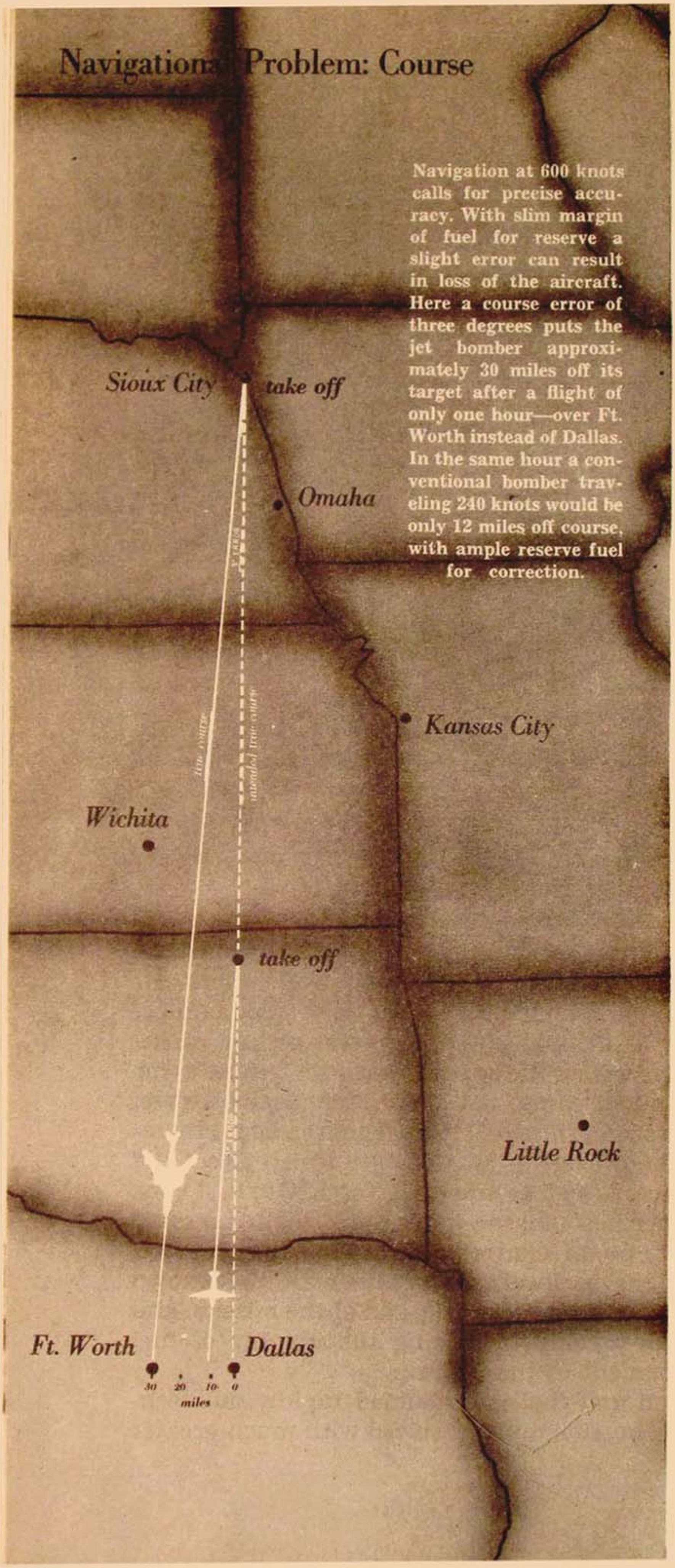


required the combined efforts of 400 B-29 or 900 B-17 crews; exact mission planning and precise execution is mandatory. This requirement stems from the combination of small crews, high speed, and rapid fuel consumption.

To illustrate: the jet bomber cruises at a relatively constant indicated airspeed. No variations in actual pilot technique can increase maximum range by more than a very small percentage, but incorrect choice of altitude, speed, or power setting of engines can drastically reduce the range. Since jet aircraft, for optimum altitude and speed, do not carry large fuel reserves, very little margin exists for mission errors. The crew must therefore have complete knowledge of all variables which affect the aircraft's performance, as well as knowledge of how to best cope with in-flight emergencies (engine flame-outs, cabin pressure failure, fuselage fire, power control failures). Actual mission flight planning is done backwards, starting with the known weight of the aircraft without fuel at the end of the mission and working backward to take-off by adding the weights of fuel required for each segment of the misison.

Since speed is high and fuel is consumed rapidly, all technical problems of the mission must be solved with much greater

Navigational Problem: Course



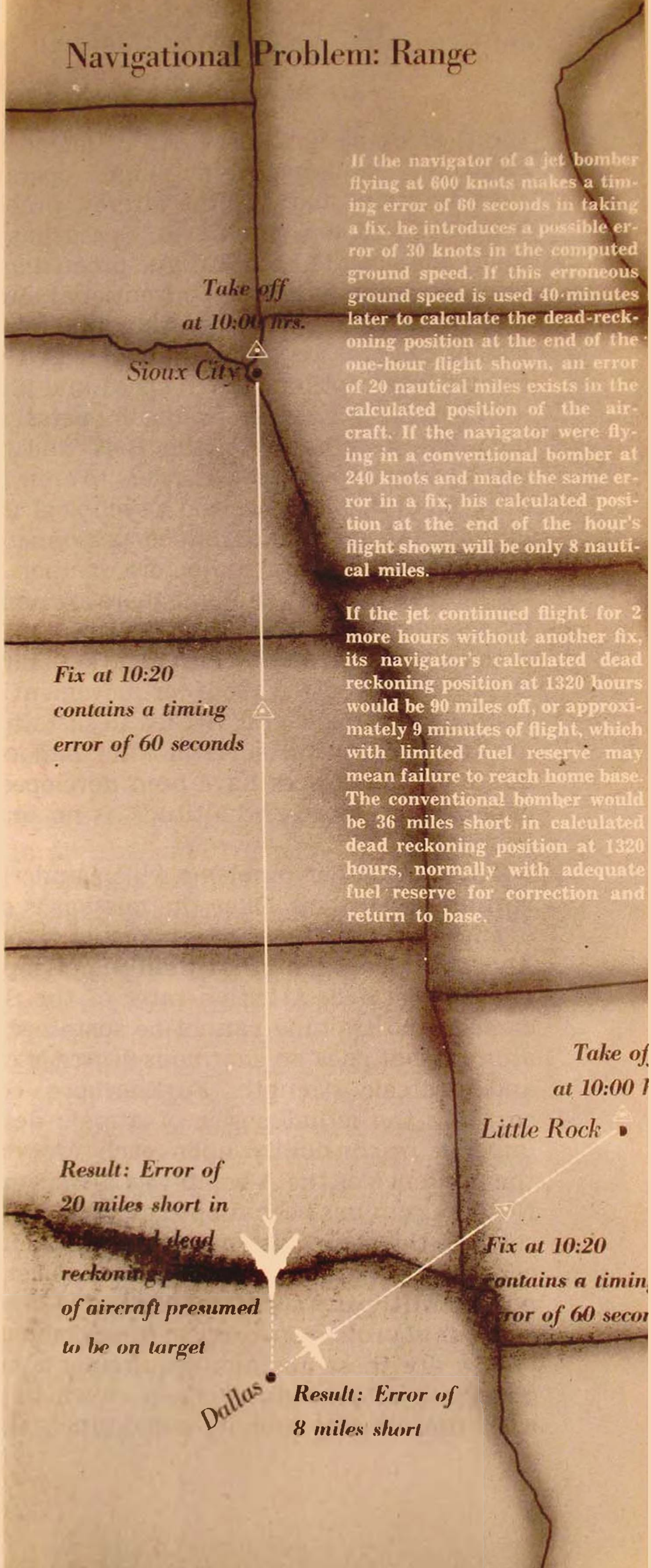
Navigation at 600 knots calls for precise accuracy. With slim margin of fuel for reserve a slight error can result in loss of the aircraft. Here a course error of three degrees puts the jet bomber approximately 30 miles off its target after a flight of only one hour—over Ft. Worth instead of Dallas. In the same hour a conventional bomber traveling 240 knots would be only 12 miles off course, with ample reserve fuel for correction.

rapidity than on missions in conventional aircraft. Accelerated closure on the target necessitates quicker decisions on target identification, approach, target analysis, aiming point, and bomb release point. High altitude and high speed may require bomb release ten or more miles from a target visually obscured. To accomplish this, the modern jet bomber is equipped with complex electronic and mechanical equipment. Although this equipment simplifies the bombing problems in many ways, it requires, in turn, an operator who has had special training and experience.

Faster calculation and greater precision is required in navigation. In the time consumed for taking and plotting a celestial fix the aircraft may have traveled more than 100 nautical miles. At such speeds small errors in time make large errors in distance. Small course errors likewise grow in proportion. A one-degree course error will throw an aircraft

approximately one mile off course in 60 miles of flight. A jet bomber traveling 600 knots will then be 10 miles off course at the end of an hour, whereas a conventional bomber traveling 240 knots will be only 4 miles off course. A three-degree error during the same period of time would place the jet approximately 30 miles off course. With fuel calculated to minimum requirements, small navigational miscalculation or delay in computation could easily result in failure of the mission and loss of the aircraft.

Aerodynamic design of the B-47 necessitates crew reduction to approximately one third the number for the conventional bomber. This demands consolidation of crew func- from a target visually crewmen with wider fields of specialization. But consolidation is not so intense as generally believed. Many functions, such as those of the flight engineer and the aerial gunner have been almost eliminated in



High speeds and high altitudes increase jet crew strain

The jet bomber decreases some causes of fatigue	BUT	Both the B-47 and its operating environment increase strain and fatigue
because		because
● missions are shorter		● operations are rapid and intense
● noise is cut down		● crew space is confined
● vibration is reduced		● clothes are bulky and heavy
● engines are simpler to operate		● fuel reserves are low
● chance of interception is decreased		● periods on oxygen are long
		● escape is hazardous

speeds and altitudes that correct analysis and reaction are quick and automatic in all unusual or emergency conditions. Time does not permit prolonged estimates of situations in an aircraft with a rate of climb over 5000 feet per minute and speed far in excess of most fighters of the last war. Closer teamwork is mandatory. More fields of specialization are required of each crewman. The aircraft commander and copilot may be called upon to assist the observer in visual and radar bombing and high speed, celestial, and radar navigation problems. Some thought is being given to making the crewman who has demonstrated the greatest degree of bombing and navigational accuracy the aircraft commander. This revolutionary change in aircrew authority would be based on the premise that the man in the bombing slot is the key man in high-speed, high-altitude jet bombardment operations. It is entirely feasible, for example, that the pilot, or copilot, after mission take-off would switch positions with the observer, compute the course, control the bomb run, drop the bomb, and then switch positions and fly the aircraft back to base.

Single position training, so characteristic of World War II bombardment crews, has given way to intense cross-training.

Far deeper significance, however, is attached to cross-training by Strategic Air Command than just the desirability of increasing teamwork or enabling interchangeability of crew positions. Cross training will produce a corps of officers able to comprehend all operational problems of jet bombardment.

The whole structure of the Air Force in the last war was built on cross-trained leadership. At the beginning of World War II a small nucleus of Air Force flyers were cross trained. During the war single training had to be adopted to satisfy the demand for rapid build-up. But the cross-trained officers became, in the main, the group and wing commanders and formed the foundation for the vast superstructure of the wartime Air Force. Being themselves familiar with each phase of the complex problems confronting their crews, they were able to personally evaluate and solve many of them. We are now on the threshold of a new age. A foundation—the size of whose superstructure is yet unknown—can again be built by cross training our jet bomber crews. Whatever the size, many of the wing, group, and other commanders of our future strategic air force will be drawn from this nucleus of cross-trained jet bombardment crews.

sional Air Force career men who have grown up in Strategic Air. These men are selected by their wing and group commanders because they meet qualifications and have performed and understood their duties in conventional SAC units—often from the days of World War II. Many possess thousands of hours flying time in all types of bombardment aircraft. Some are ex-navigators, ex-bombardiers, or ex-radar operators who have gone through pilot school. All have sound technical background, comprehensive experience, and possess solid temperaments and mature power of judgment.

The jet bomber has likewise required the modification of the bombardment training curriculum and the establishment of training facilities for it.

Plans for the mass production of combat crews will get underway in the near future with the completion of new Combat Crew Training School installations. Air Training Command will supervise the program. During the interim Strategic Air Command is training its own combat crews. In SAC tactical units as well as in partially completed ATRC centers, these crews are being put through the various phases of training to be incorporated into the permanent program which will train all crew members as 1025's when resources permit.

Each crew member who has been selected for B-47 duty must undergo certain courses before he enters actual team training on a combat crew in the B-47. Crews may be formed before they enter the program or before they enter the last phase of training. The members may or may not have met before. Each goes his single way into the program. Once formed, crews are permanent.*

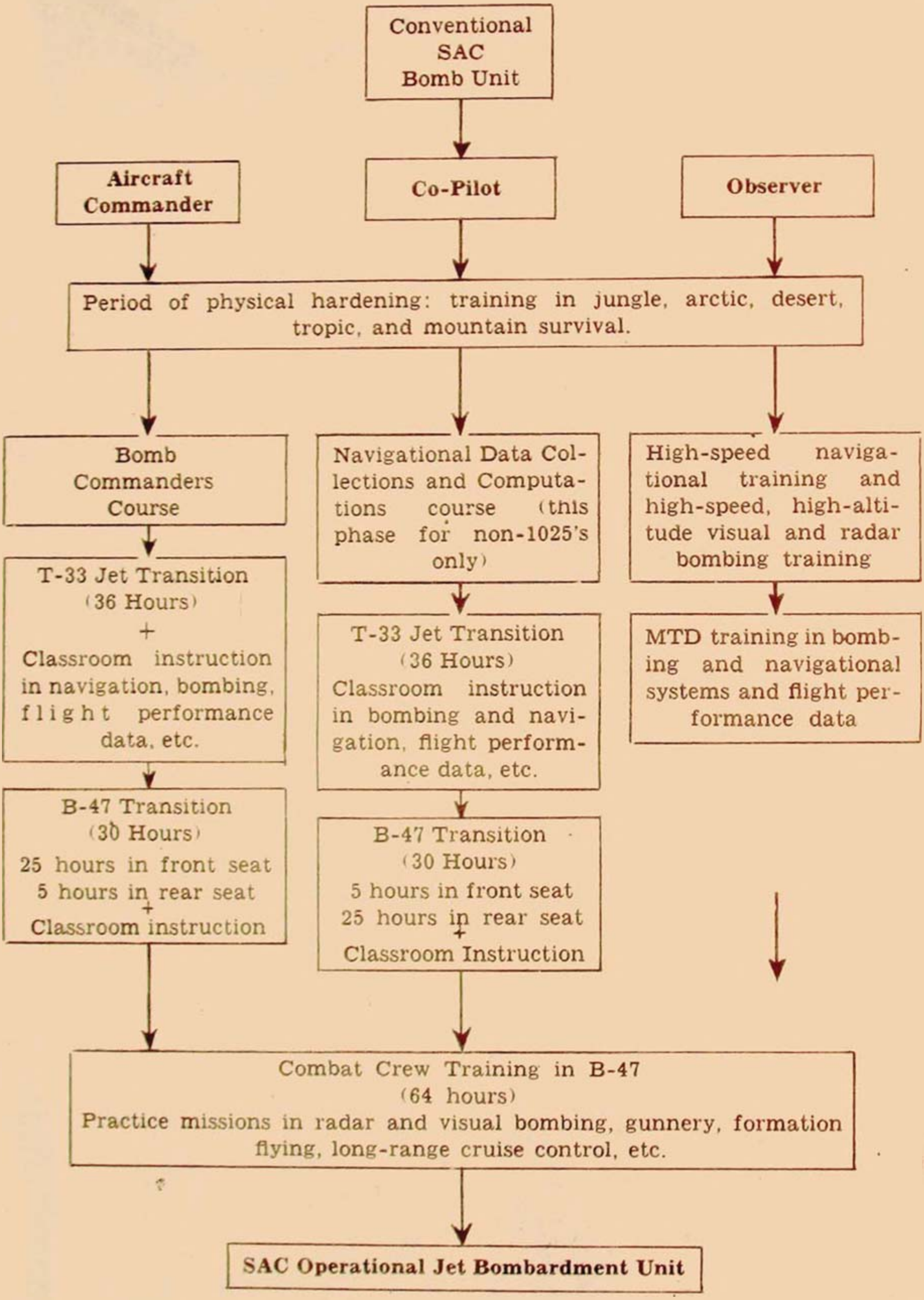
After the crew members complete their individual phases, they are brought together, and for the first time they fly the B-47 as a crew and are assigned realistic practice missions under simulated combat conditions.** This phase of their training is designed to indoctrinate them thoroughly with the capabilities and the intricacies of the aircraft and its actual equip-

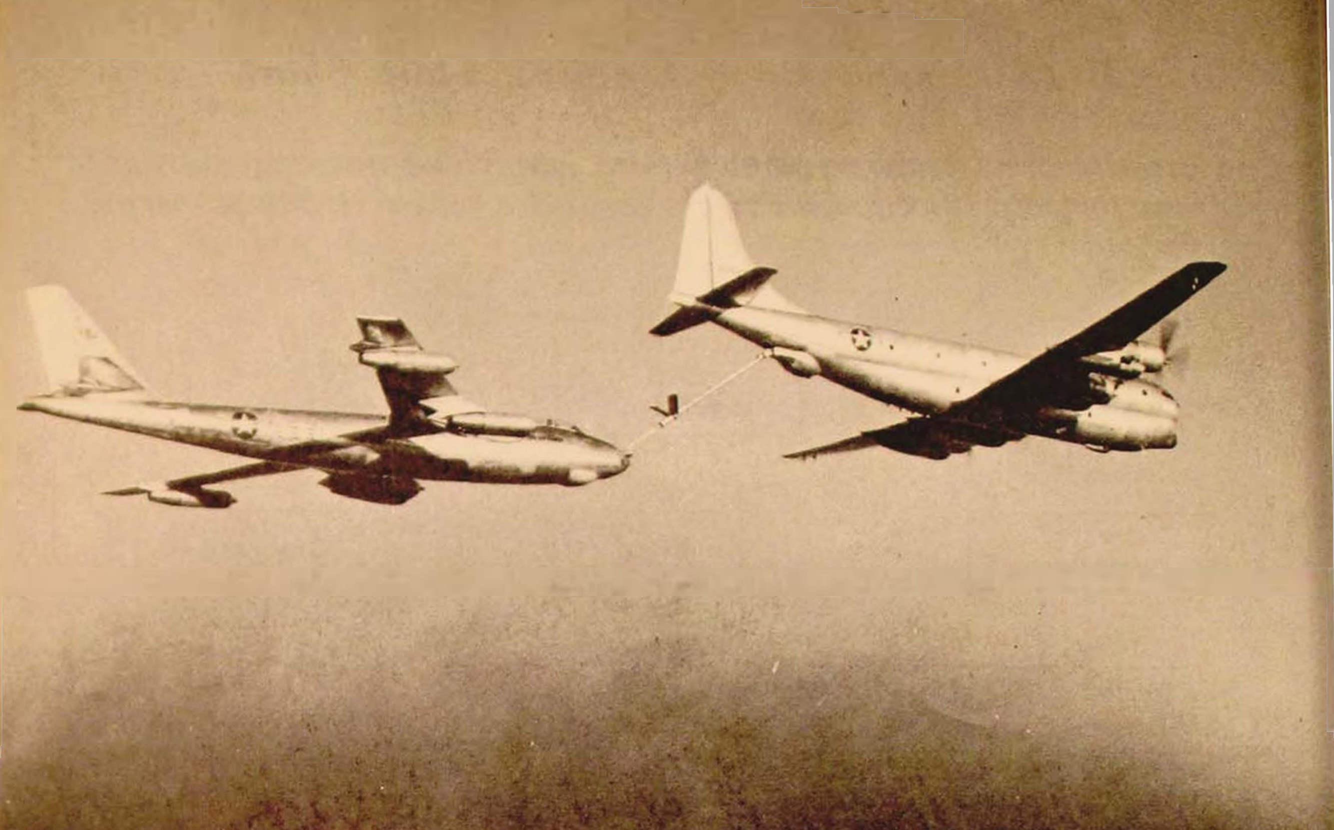
*It is the policy of SAC to maintain permanent crew unity whenever possible. Some of the present SAC crews have been together for many years.

**Several training aids are provided during training and in subsequent operational units. One is the B-47 Mobile Training Detachment (MTD). The normal complement of a B-47 MTD is one officer and fifteen airmen. They are organized to give instruction in maintenance, instruments and auto pilot (A-12), electrical systems, hydraulics, power plants, radar, armament, bomb navigation systems, fire control, turret systems, and aircrew familiarization. Another is the B-47 Flight Simulator, which is designed for original training and maintenance of proficiency after the crews are trained. Simulators are especially useful in tactical units where emergency procedures must be provided, particularly those which are dangerous to practice in the air. The practice of emergency techniques in the Simulator is as effective and realistic as in actual flight and eliminates flight hours on the aircraft and the danger of losing a valuable plane and crew. The simulators also provide inter-position training in the tactical units—thereby assisting in attaining the goal of interchangeable crew functions.

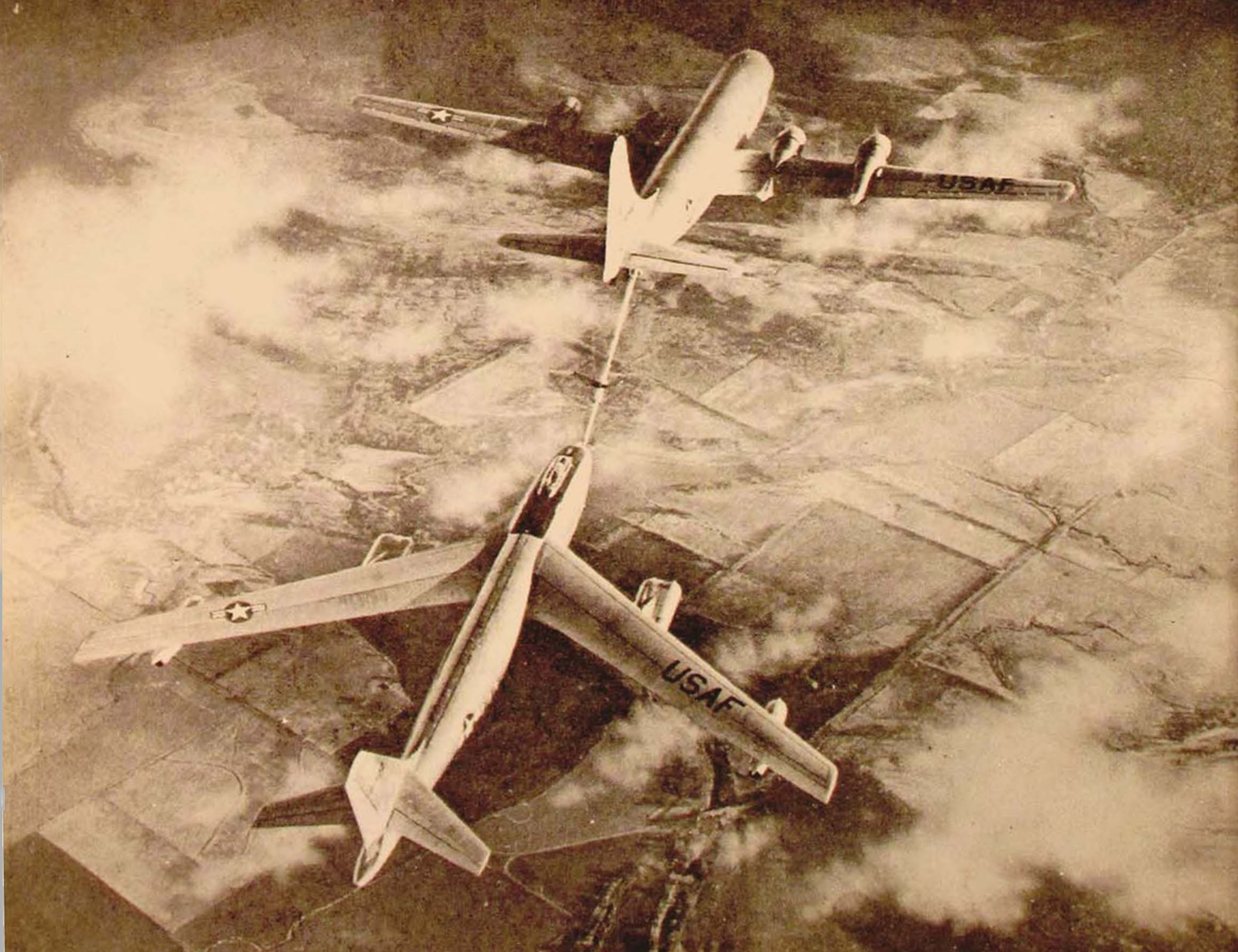
B-47 Combat Crew Training Flow Chart

The interim crew training shown here will phase into the ultimate program to train all crew members as 1025's when resources permit.





Jet aircraft gulp great quantities of fuel, but aerial refueling doubles the range of the B-47. The KC-97A Stratofreighter tanker lowers its swiveling, telescopic flying boom, and the operator in the tail of the tanker guides it into the slipway coupling on the nose of the bomber by maneuvering the V-shaped "ruddevator" control surfaces on the boom. Once the connection is made, the fuel is quickly pumped under pressure into the bomber's tanks.



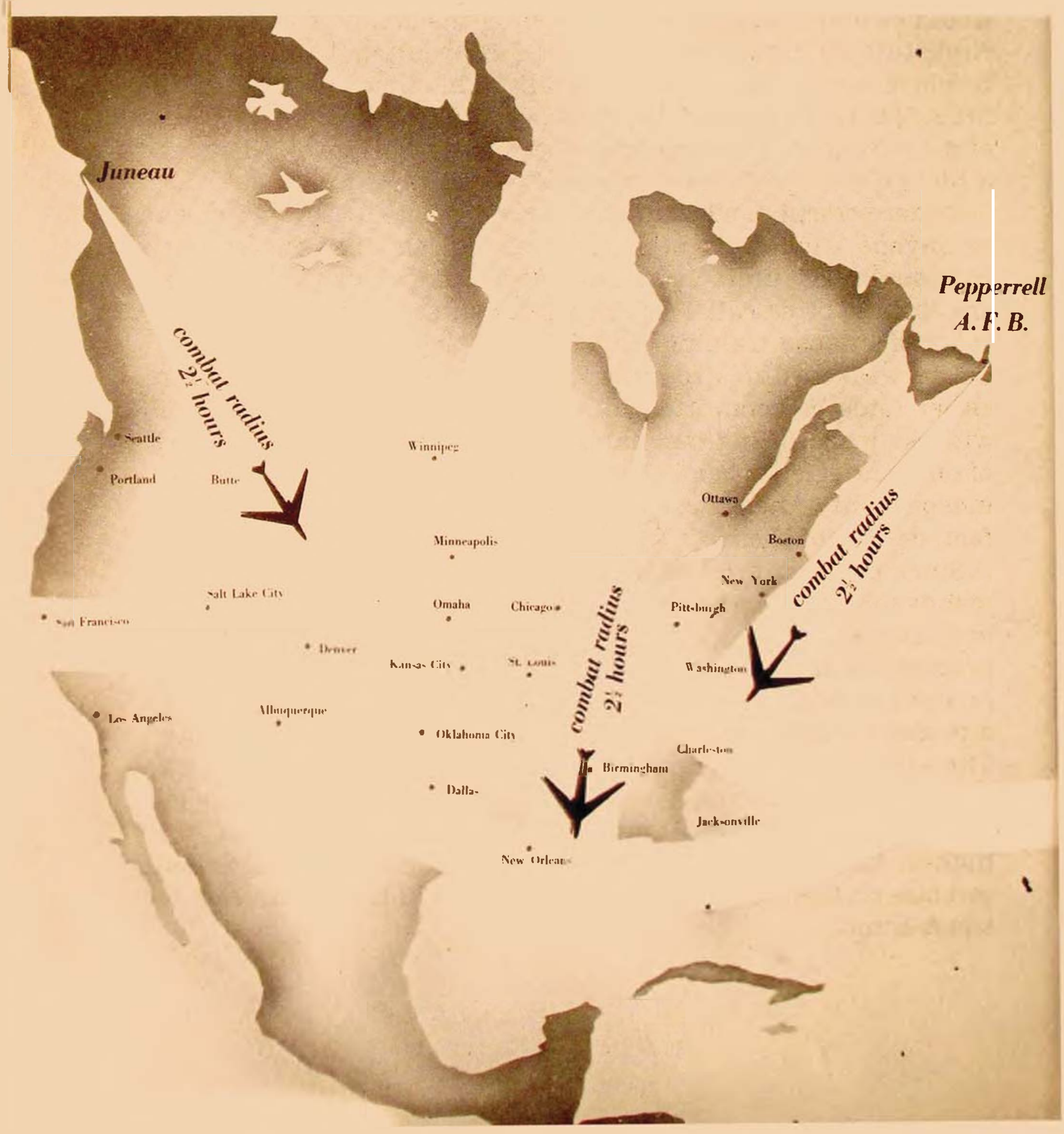
ment, with the various aspects of crew coordination necessary to accomplish a mission, and with the individual and collective demands placed upon them by their high-speed, high-altitude weapon. The program completed, the crews are assigned to regular operational SAC units where training toward combat readiness is continued.

Confronting the whole jet bombardment training program is a question—how much time can we afford to spend on training men to the degree considered necessary for maximum operational proficiency. When will the big bell ring? If there is enough time at the disposal of the planners of our bombardment force, the problem of training jet bombardment crews would be eased considerably. Providing the bombers with quadruple-trained crews and converting conventional units to jet bombers could proceed methodically. The cream of the entire Strategic Air Command could be selected for jet bombardment, and the time in training could be greatly cut down, allowing a rapid build-up of a vast new and powerful air arm.

Under present conditions this is not feasible. It is well known to anyone who reads newsstand periodicals that many conventional SAC units have combat missions for which their crews stand by on call. Preparation for these missions has taken years of intense training. But this striking force-in-being can not be weakened to strengthen a force in the making. Nor can either force be committed to a peripheral war such as Korea without jeopardizing our national security. Thus the building of our strategic jet bombardment force must proceed relatively independent of heavy crew commitments to other purposes, in fact, despite of them.

Since the age of jet bombardment, with its tremendous demands for experienced crew members, has just begun, we cannot believe that as speeds and altitudes increase the complex problem of manpower will decrease. Jet crews cannot be a product of national emergency measures. Jet bombardment is a profession built on a solid foundation of long range training. The establishment of that program is held imperative by the Strategic Air Command, so that the all-important third component of our powerful weapon—the crew—will be of the highest caliber. Its leaders insist that we cannot afford to compromise on the crew any more than we could on the aircraft or the A-bomb.

The B-47 is the beginning of the age of supersonic intercontinental strategic bombardment. This map of the United States purposely portrays a conservative effective combat radius of present jet bombers and indicates the extent to which the jet bombardment age is already upon us. Yet present equipment can be expected to develop rapidly to future stages of far greater effectiveness, just as piston-engined bombers quickly developed their speed and range. Overseas bases of operation will ultimately be pulled back to home bases, heralding the day of an intercontinental air striking force of such magnitude and swift-striking power that no nation on earth could compel its application and then survive against it.



Problems in Air Defense

LIEUTENANT COLONEL PETER J. SCHENK

THE defense of the United States against a sudden and powerful air attack has become, since the advent of the Russian atomic bomb, a problem of supreme urgency. Our very survival as a nation may be at stake.

We have now demonstrated our firm resolve to support the United Nations and to counter aggression anywhere. Furthermore it is evident that our latent military power is so great that, given time to mobilize, we can make aggression profitless. Among the Western allies we alone have this potentiality. This fact makes the elimination of our war-making capacity and, even more urgent, the destruction of the ready power of our long-range bomber force, the necessary first step on the part of an aggressor in any new world war.

Our European, and particularly British, colleagues seem to face a much more desperate problem in defending their homes. This may be an illusion brought on by their proximity to potential enemies. It would be sheer folly for, say, the Communists deliberately to launch World War III by an invasion of Europe or by an air attack against Britain while our strategic air forces remain alert and intact. As these air forces become more truly intercontinental forces, and more of them can be based in the United States, continental North America appears to be slated for the first attack if a war should come. At very least, it would probably be hit simultaneously with the launching of an offensive in Europe. And by the same logic the initial purpose of a Soviet air offensive against continental North America would be partly to neutralize the Strategic Air Command and partly to tie up an extensive portion of our available air power in home defense. Bombing industry and cities to cripple our industrial potential would probably come later.

The USAF has been charged with the responsibility of providing for our two greatest military needs—the maintenance of the long-range bomber force and the air defense of the United States. To a far greater extent than is generally appreciated, these two basic responsibilities must be considered together.

The key role played by our strategic force has been widely appreciated in the Air Force. Air defense until recently has not been nearly so well understood and has consistently been assigned lower priorities. This was justifiable in the TNT age, but under conditions of atomic surprise attack, only our air defenses in being and actually on the alert can be brought to bear on the enemy. If we assume that we shall never be the aggressor, the *only* part of our air power which will be of any consequence in the first critical hours of an all-out war is air defense. Only an air defense capable of deflecting the first enemy strike can buy us the time to energize the counterblow with which we can hope to redress the balance. Discounting the probability of wholesale decisive sabotage, only an enemy air strike can knock out our bombs, bombers, and the bases from which they must operate at home and abroad. Air defense must prevent the destruction of our strategic bombing system before we can bring it into action.

Despite the crucial importance of protecting SAC, classical air defense doctrine tends to overlook the defense of the strategic bombing system (including bases, aircraft, bombs, and bomb storage facilities) and to concentrate more on the defense of conventional target systems of the TNT age—factories, population centers, and transportation. The defense of the SAC target complex should hold a top priority in peacetime deployment of air defense forces.

How does the problem of defending the SAC complex differ from the more familiar problem of defending population and industry? The most apparent difference is that the SAC complex consists of a relatively small number of specific limited-area targets which can be clearly identified and fairly readily arranged in order of relative importance. This is much more difficult to do with industrial and population targets. There are so many more of them, and their exact contribution to the nation's war potential or liquid military assets at any given time is impossible to assess. The problem of defending the SAC complex can be called a "local defense" problem. In many ways it is similar to the Navy's problem of defending a ship or task force in the empty ocean. Conversely population and industry targets are more nearly an "area defense" problem. Yet some SAC installations are in populous areas, surrounded by other valuable targets which are themselves worthy of some measure of defense. This leads us to what might be called the theory of "uniform level of defense." Under this concept the most valuable targets should receive an extra measure of local defense, the less valuable ones somewhat less, and so forth, until, ideally, the entire country or large defended area should present a uniformly unattractive picture to the potential aggressor—leaving no inviting soft spots where he can hurt us most with minimum loss to himself.

This philosophy underlies our choice of a family of "area defense" and "local defense" weapons which must be developed, manufactured, and deployed according to the relative values of the target complexes. The heavy interceptor fighter, possessing relatively great range and speed to allow groups of aircraft from widely separated bases to be mutually supporting, is the standard weapon of area defense. It will be augmented and gradually replaced by the long-range pilotless fighter. Conventional antiaircraft artillery, augmented and eventually in part replaced by short-range ground-to-air missiles, is the backbone of our "point" defenses. The short range high-rate-of-climb fighter is a hybrid weapon particularly useful in defense of highly valuable extended target complexes, such as the metropolitan Connecticut-New York-New Jersey area.

It may be well to digress for a moment and consider the impact on air defense of guided missiles as a new family of weapons. Unfortunately in general usage the term "guided missiles" has been applied rather loosely and indiscriminately to a great variety of devices whose military employment runs the whole gamut of air operations. There are small air-to-air guided missiles, which should be considered with rockets, machine guns, and cannon as aircraft armament. There are air-to-surface missiles used by fighter bombers in air-ground war; these are outgrowths of the guided bombs or torpedoes of World War II. Longer-range pilotless parasite bombers carried by heavy bombers should perhaps be considered in this group of guided missiles as well. Then there are long-range pilotless bombers, which may ultimately replace the piloted strategic bombardment aircraft. And finally there are two distinct classes of ground-to-air guided missiles: the long-range pilotless interceptor, which is an area air defense weapon, and the shorter range ground-to-air missile, a local defense weapon.

Air defense is concerned with only three distinct classes of guided missiles—air-to-air missiles used as interceptor armament, and the two types of ground-to-air missiles for area and local defense. The technical problems in each of these differ, and their full realization will probably occur at different times.

In each of these categories several development projects are underway which differ in details of guidance systems used, aerodynamic configuration, warhead, and propulsion. All pose new problems in design, maintenance, and operation which may in some cases take years of intense effort to overcome.

There are only three valid reasons for accepting the increased technical difficulty inherent in guided missiles: first, if missiles can do a job conventional weapons cannot do; second, if missiles can do the job cheaper; third, if they can do it better. For example, it may be possible to design pilotless interceptors which can perform maneuvers more violent than a human pilot could survive. If this is true and the kill probability of the missile is greater than that of the piloted interceptor it replaces, a valid reason exists for developing missiles. Or short-range ground-to-air missiles with all their complex equipment requirements may be more economical for a given kill probability than heavy antiaircraft artillery. Air-to-air guided missiles, when perfected, may be vastly more effective than conventional fighter armament. But we should never adopt missiles, or any new weapon for that matter, when an older, cheaper, simpler weapon will do the job just as well.

To return to the air defense problem, there would be a number of bases for long-range fighters in a typical large area defense. They would be capable of providing a uniform level of defense anywhere in the area, provided they have adequate early warning and control furnished by the ground radar and communications network. Long-range interceptors can roam at will throughout the defended area and engage the enemy force anywhere within it and at some predetermined range outside its borders. Their operation is independent of the individual target systems below, but not independent of the performance of the control and warning net.

The point-defense weapons, on the other hand, will be found in the immediate vicinity of the key targets within the general defended area, and their numbers and quality will be in direct proportion to the value of the target with which they are associated. The functioning of all the weapons will be coordinated by the central information and control net on the ground.

VAST technical improvements have been made in air defense systems since their crude beginnings in the mid-1930's. Nonetheless they still suffer, and will always suffer, from the classic handicaps of the defense. The attacker can choose his time, place, and method of attack; the defender must distribute his resources as best he can, and wait. No air defense can ever be perfect. A determined attack concentrated in time or space, or both, sooner or later can be expected to saturate the available defenses. Alternatively, by stealth and deception the lone atomic carrier may well find it possible to lose himself in the massive normal air traffic and penetrate to an important target unrecognized. It follows that the greatest single need for an effective air defense is intelligence: the earliest possible warning and the most detailed possible knowledge of the enemy's intentions and actions.

Anyone can readily obtain flawless intelligence information on the U.S. economic structure and erect from this an accurate picture of our vulnerability. Our industrial complex, with but a very few exceptions, is literally an "open book"—it is described in minute detail in trade journals available everywhere. The country as a whole, with but very few exceptions, is open to foreign tourists. Our military intentions are also well known, at least in principle. It can be taken for granted that we shall never engage in premeditated and unprovoked aggression. Under certain circumstances, with a passage of time and change in public opinion, we might be brought to launching the first strike, but only if we were convinced beyond doubt that our own atomic doom was imminent and the aggressor's die already cast—in short, that only desperate measures would save us from extinction.

But the intentions of our potential enemy are most difficult for us accurately to determine, and his military and economic potential is far less well known to the outside world than our own. In truth we are "fighting a ghost," an intangible, evanescent creature hard to visualize and impossible to come to grips with. The value of our air power—offensive as well as defensive—could be multiplied a hundred-fold with adequate intelligence. This is obvious to any serious student of air war.

Then there is another area of intelligence which we might call "tactical intelligence," as opposed to the strategic, or long-term intelligence. Tactical intelligence in air defense is really aircraft control and warning, dedicated to thorough surveillance of the defended air space. Any complete air defense system consists essentially of three parts: an information gathering network (eyes and ears); a communications network and control center (nervous system and brain); and active weapons, such as fighters, antiaircraft guns, missiles (fists). If any of these is lacking or seriously impaired, the system as a whole is worthless. It follows also that improvements in the over-all performance of the system can be made only if improvement of its major components is kept in balance. It is foolish to lavish great care on improving an isolated part—a radar or a gun, for example—when the limit on the performance of the system is actually set by another part—perhaps an overloaded electronic brain or a slow and inaccurate communications channel. The same amount of effort expended on bringing the weak member up to the general level of system efficiency would bring vastly greater returns.

Merely knowing the three-dimensional position and course of aircraft is not sufficient for the demands of the air defense system. We must also know the identity of every aircraft. Once enemy aircraft are identified we must try to answer vital questions of intent. What is their target? Is this one carrying a bomb? Or is he a decoy? This is one of the most vexing problems operational and technical people in the services have ever faced. The electronic identification devices developed and used in World War II were complicated and unreliable. The stakes now are so high that identification must be virtually infallible.

Since this is such an important problem, we should go back to fundamentals and look at the identification process philosophically. Electronic IFF (Identification, Friend or Foe), as developed in World War II, is really nothing more than a mechanical password, given by a black box full of vacuum tubes in the friendly airplane to a black box full of vacuum tubes at the challenging post on the ground. Much effort has been devoted to making these black boxes more sophisticated, quicker, and harder to deceive. In the process they have inevitably become bigger and more complicated, and therefore less reliable. And in the electronic war of wits it is always just a question of time before any device of this sort can be neutralized or fooled by the enemy. Then we must build a still more complicated device. The inherent weakness of this philosophy is that the black boxes, in order to be trusted, must work one hundred per cent of the time. If there is any chance that failure to reply to a challenge from the ground is due to equipment or human error, the air defense controller will be most reluctant to take positive action, lest he destroy a friendly transport full of innocent passengers, for example. or attack a crippled friendly bomber returning from a mission with his IFF shot up.

In our daily routine, people who must identify someone depend on passwords only as a last resort and in the absence of more positive and convenient means of identification. Also they usually do not depend, if they can help it, on any one outstanding feature or characteristic of the person whose identity is in question. They look at his features, color of eyes and hair, posture, clothes, manner of speech, actions; they ask questions; in more rigorous examination they take fingerprints, look at dentures, take blood samples. The cumulative result of this examination finally answers the question of identity.

This may seem a far cry from air defense, but is it really? How much information is there available to the radar outpost on the ground and in the intelligence and information network as a whole which can be analyzed and correlated to identify any one specific aircraft? Quite a lot, some of which has yet to be exploited effectively. If time permits and the situation is sufficiently serious to warrant the extra cost, one of the most obvious things that can be done is to provide alternate "diversionary" airfields outside the defended area, at which all approaching aircraft must land for examination and from which they are then kept under continuous surveillance until they reach their destination within the defended zone. This is a scheme immediately within our capability, requiring only an order from sufficiently high authority. Its implementation, however, must await the time when the danger of air attack is deemed serious enough to warrant such a costly measure.

Another problem related to air raid warning is introduced by the inherent deficiencies of radar, the most widely useful electronic device for detection of aircraft. Radar can see aircraft at great ranges in bad weather and darkness, but at a fearful cost in equipment compared to human eyes and ears. The range of radar is much greater, but its vision is coarse. Instead of the fine detail seen by the eye, all aircraft look very much alike to radars—mere "blips" on the screen of an oscilloscope tube. Also, radar waves, like light waves, ordinarily travel in practically straight lines, so that the earth's curvature causes gaps in their coverage at low altitudes. This phenomenon is so widely known and understood that we must give credit to the enemy for being able to capitalize on it and find holes in the radar pattern for sneak raids. Even moderately complete coverage at the lower altitudes is inordinately costly in men and equipment. In fact the best "gap filler" for this purpose is still a man perched at an observation post with a telephone, watching the skies for low-flying aircraft and reporting their presence to a "filter center."

Ground observers, to be of real value, must be organized, trained, and provided with shelter and communications. Obtaining persons to serve in this capacity in peacetime in the numbers required is an imposing task. If their training is to be truly useful, they must have the stimulus of maneuvers and exercises and constant professional supervision. This strains the country's commercial telephone communications net. Fortunately this network in the U.S. is extremely well developed and has considerable reserve capacity to meet part-time military needs of this sort.

World War II experience indicated that volunteer observers are not hard to obtain during time of war. But this experience may be misleading: we entered the last war shortly after a great depression, with a manpower surplus. Even at the height of the war, production was not seriously held back by lack of manpower. The hidden cost of an observer system in a large area is huge, even if its members work without pay. Our economy since World War II has been expanding so rapidly that the normal supply of manpower has barely kept pace. Under the strain of all-out war production, particularly in view of today's vastly more complex war materiel, we may well not be able to afford the World War II style of ground observer systems. We must look to invention and technology for the answer. We need mechanical observers which will operate automatically in vast numbers on roof-tops, telephone poles, and the like, with but occasional attention from a traveling maintenance team. This is a problem well suited to our national genius for mass production of high quality, trouble-free items. A country which turns out millions of home radios and television sets should have little difficulty in producing a few hundred thousand mechanical eyes and ears of relatively modest performance.

LET us now examine briefly the requirements of the "nervous system"—the communications net which must interconnect all of the far-flung elements of the complete system. There are essentially two different problems—one of transmitting information or orders (which may be in many forms: pictures, voice, teletype) among various installations on the ground, and the other of communicating between a ground station and aircraft or missiles in flight. Speed, reliability, security, and low cost are all essential qualities of the network. On the ground the commerical telephone net meets most of these needs admirably. For talking from ground to air, we must resort to radio or one of its related forms of wireless communication. Wherever possible, the information should pass through a minimum number of human operators; men invariably introduce delays and inaccuracies.

On the other hand the desire to eliminate human operators must be carefully weighed against the introduction of complicated, expensive equipment which will be hard to maintain. Replacing a man with a machine inevitably costs us something. We must always keep a most careful eye out for "gadgeteering"—making procedures automatic which in the large view of the system could better have been kept manual. Whether we use a man or a machine depends on the answer to the question: "Does this function require judgment?" Theoretically purely repetitive, routine, or bookkeeping operations are best done by machines. When judgment is involved, particularly judgment based on intangible considerations which cannot be completely written down in advance, the trained human mind is still the only answer. Futhermore for some operations that could be performed more accurately and more quickly by a machine, the present version of the machine would be too big, too costly, and too complicated to make its substitution practicable.

In the design of mechanized air defense systems, it is easy to fall into another trap—that of replacing elements of the system, one man at a time or one function at a time, with automatic devices on a one-for-one basis. We must always remember that present-day human and manually operated air defense systems have evolved around the basic capabilities and limitations of human minds, eyes, ears, and hands. When we set out to design automatic systems, we must consider the total impact of the new techniques and devices and seek to employ them efficiently in their own frame of reference. The resulting arrangement of component elements should probably bear little resemblance to the original human-manual system. The caterpillar tractor is totally unlike the mule—yet both pull vehicles. We could have designed a mechanical mule, with ball-bearing knees and stainless steel teeth, but it would have been a thoroughly ungainly monster. The locomotive went through a brief period of being called an "iron horse," but it quickly assumed a much more functional shape. The analogy may seem far-fetched, but it is quite pertinent when one looks at the many efforts currently underway to mechanize the existing air defense system by bits and pieces, instead of going back to fundamentals and proceeding with a sweeping redesign that makes efficient use of new capabilities.

A good case in point is the modern, high-speed electronic digital computer, which can perform millions of arithmetic operations in a second, accepting its input data in the form of "yes-no" electrical pulses or "binary" numbers. Such machines have obvious application to air defense, but their use sets off a chain reaction of new requirements for data transmission systems, information-gathering devices, and the like. Today's radars, for example, are designed to deliver their information to the human eye through an oscilloscope tube indicator. How should they be redesigned to feed yes-no pulses to the input of a digital computer? This is a revolutionary change. It requires a complete re-examination and redesign of the radar all the way back to the antenna. It may even mean ending up with a sensing device so different that it cannot be called a radar.

To think in these terms is difficult. It requires constant mental struggle, because man is essentially conservative. It is much easier to make minute diverse improvements than to strike out boldly and imaginatively into uncharted territory. This is why the peacetime development machinery of the Air Force very seldom produces revolutionary new designs in major weapons systems. Ordinarily these emerge only under pressure of war, when the nation's finest minds are set to the task.

AFTER each major war the peacetime years are spent in the tedious process of improvement in detail. The result is the often-heard accusation that the military mind is always ready at the beginning of a new war to fight the last one perfectly. This phenomenon is of course not confined to air defense, but its consequences are perhaps more serious in air defense than in some other areas of military operations. In the first few hours of a war, air defense must brave the worst the enemy can offer. It must be qualitatively and quantitatively equal to the task, or it will fail completely. How can we, the Air Force, improve our development machinery *in peacetime,* so that topnotch air defense is on hand when the war starts? How can we see to it that the best technical minds are focused on the right problems, to say nothing of securing their services in the first place?

The first thing we must do is to seek out a number of top-level experts in each of the scientific fields concerned and induce them to devote their full time and effort to our problems. This sounds both obvious and easy, but the obstacles are great. Patriotism as a motive is useful, but not nearly enough by itself. Financial attraction helps. Good working conditions help, as do the inducements of prestige and fame and the way in which the problem is presented. We must blend all these ingredients before we can attract and hold a top-level group of scientists. This entails scrapping a number of the most cherished notions of the military, of civil service, and of government bureaucracy in general. We must violate the deepest prejudices of the "military mind" by giving this group of civilian scientists complete access to our problems and weaknesses and letting them eventually prescribe a cure. We must by-pass and violate normal channels of all sorts by allowing unheard-of liberties in accounting and dealing with public property. In giving inordinary support and credit to our select group of experts we must expect to alienate established technical groups charged with the drab and thankless task of maintaining the existing systems and making small improvements in them. Private industry has recognized this principle long ago and pays seemingly exorbitant fees for expert consultants, but they find the results well worth the cost.

Next we must give our "Task Force Brains" a suitable environment in which to do their work. We must stimulate their creative faculties in the proper direction, and we must convey to them the problems and troubles of air defense as realistically as we know how. They must at all costs be kept from degenerating into an academically-oriented laboratory group in which scholastic nit-picking replaces broad-gauge research and the end product emerges as fascinating but useless gadgetry. The continually recurring theme song of the group must be "Kill bombers—real bombers." The military facts of life, the realities of field conditions, the actualities of warfare, must underlie their every thought and action. This means that they must live in a real air defense system, set up experiments with live fighters and fly in them, deploy real radars manned by typical troops, send raw radar data with noise and clouds and all its natural defects over garden-variety real telephone wires rented at random from the local telephone company. We must mix with them people in uniform who possess operational experience, imagination, and enough education to speak their language, forming joint teams in which each person pulls his weight according to his abilities.

If we succeed in assembling "Task Force Brains" and providing it with a laboratory and an experimental air defense area, we shall have set the stage for the development of a radically new and vastly better air defense system. We shall have improved the present tedious and inefficient process of generating "military requirements" and getting these to the developing agency needlessly late, incomplete, distorted, and often unrealistic. We shall have acquired, as an additional by-product, a very useful tool for demonstrating the best and the newest in air defense doctrine to the operating command, and we shall have provided a place where new principles can be worked out under ideal conditions. We shall have taken a long step towards achieving the cooperation between scientific and military personnel so essential in modern war.

Selection and assembly of the group and the creation of a laboratory and a test system are still only parts of the answer. We have now provided them with a place where they can exercise their individual scientific talents and work fruitfully and efficiently toward their common goal. But we have not yet provided them with the necessary military background. Before the first development plan is ever written, we, the military, the career students of air war, must join with them in a careful exploration and analysis of the military problems of strategy and tactics. We must review with them the nature of the target systems we are defending, and examine the economic, political, and military geography of our country. We must jointly study such questions as, "Where are the enemy's bases? What are his most probable approach routes? Which of our targets is he likely to consider most attractive?"

It is probable that intelligent study of questions of this nature requires different disciplines than we have originally assembled or are normally found in sufficient numbers within the military. This may make it advisable to charter a different study group to delve into these questions and to collect and sift through the vast amount of material which must be examined in this non-exact science.

Finally we must review with them the different and often conflicting philosophies of conducting air defense which have evolved from military experience. Together we must determine which doctrines are applicable to the present problem, which truths are basic and which apparent truths are simply compromises of the moment, indulged in because of some temporary, technical deficiency in the available weapons. Much has been written and preached on perimeter defense versus heartland defense, centralized versus decentralized systems, close control versus loose control, and a host of other concepts. Formalized and traditional, these concepts are emotionally defended by their respective proponents. The specialized circumstances which surrounded their origin and early success have often been forgotten. It is imperative that we return to fundamental principles, strip them of their historical distortion, and apply them to the current problem.

LET us now look beyond the design and development stage of the new air defense systems and examine some of the inherent problems of its day-to-day operation. One of the most important of these has been referred to as the problem of the "learning curve." It is well known that any complex organization, such as an air defense system made up of many men and machines, functions best after it has done its job over a period of time and has refined itself by trial and error. Obviously the most important time for an air defense system to be at peak efficiency is just before the first raid. Unfortunately it is costly and difficult to simulate even an approximation of a wartime situation. Even though numerous maneuvers and exercises are held, the inevitable turnover of personnel within the system quickly vitiates the value of these exercises.

There are at least two possible alternatives which offer some relief. First, the air defense system can be given routine responsibilities in peacetime which are quite similar to its wartime activities. For example, the Air Defense Command installations could be made into the "Traffic Cops of the Air." If the ever-tightening restrictions on the behavior of civilian aircraft are to be enforced, there must be traffic police. The air defense system is ideally suited to this task. The routine responsibilities would keep up the skills and interests of its personnel. Continuous surveillance of friendly traffic will also make all-weather flying safer and possible under the worst weather conditions. Secondly, it is possible to introduce, by simulation and synthetic training devices, situations at various operating levels which have all the appearance of real combat. We can generate radar "blips" without the knowledge of the operators on duty. Such simulated enemy targets would then be tracked by the system just as though they were real, except that weapons would not shoot at nonexistent targets.

It is also of vital importance that maneuvers and exercises are not viewed entirely from the conventional point of view of "war games" of the type we had before World War II. It is of little import that an umpire ruled New York City "destroyed" or the first element of the Red squadron "shot down," to the credit of the responsible commander. It is far more important that the maneuvers we do hold are scientifically designed to give maximum training to personnel at all levels and to point weaknesses up clearly in equipment, tactics, or doctrines. There is a deplorable lack of accurate information about the performance of the systems we already have in operation, to say nothing of those yet in development. We must use the methods of operations analysis, and we must have organizations continually pioneering and testing new and improved devices.

Little is known, for example, about the real difference in effectiveness of an air defense system against the first raid, the tenth raid, and the hundredth raid. We should be able to make some rather accurate systems performance forecasts, even though we might not have faced the acid test of real combat. We can, of course, never predict the enemy's reaction to changes in tactics on our part, but we can employ mathematical tools such as "game theory," automatic high-speed computing machines, and simulators of various forms to discover a great deal about the nature of the problem. While game theory cannot tell us anything about a real enemy's actual moves and countermoves, it does provide a scheme for selecting the most profitable of several alternate courses.* It can be shown that in most cases there is a preferred course of action which gives the highest probability of success regardless of what the enemy does. It is also possible to construct a "mathematical model" which takes into account by mathematical symbolism many of the important variables in the air defense problem. Typical situations can be fed into high-speed computers and "played through" many times, each time varying some factor to determine its effect on the outcome of the air battle. But if these results are to be more than an amusing and expensive chess-game, it is essential that accurate data on the performance of various parts of the air defense system under different conditions are available. This is as yet an infant science, and the uncertainties and difficulties of translation into meaningful, realistic situa-

*[An explanation of the application of the theory of games to military planning is available in "Military Decision and the Mathematical Theory of Games," by Col. O. G. Haywood, Jr., USAF, Air University Quarterly Review, IV, 1 (Summer, 1950), 17-30. Ed.]

tions are great. Nonetheless a promising area is offered for further investigation and should be pursued.

THE question is often raised, "How good are our air defenses, and, assuming an all-out effort, how good could these be made to be?" There are probably about as many opinions on this subject as there are people who have thought about it. Informed observers of World War II have stated that the British air defense system, at its best, could never achieve an attrition rate of more than 15 per cent. This was good enough to decide the Battle of Britain in Britain's favor—but that was in the TNT age. In modern air war, when a single airplane can carry a weapon of mass destruction, the attrition concept of fighting air defense is obsolete. We must achieve an attrition of 80 to 90 per cent to assure ourselves of a chance for survival.

Let us look as closely as we can at the reason for the amazingly low performance figure of 15 per cent attrition reached in World War II. In *theory*, if all parts of the system had worked perfectly, the percentage should have been much higher. We find, on looking at case after case of actual air battles, that something always went wrong. There were mistakes, there were undue delays, aircraft aborted, radar failed, guns jammed, and people made bad guesses. It appears that if adequate safety factors had been built into all the equipment; if the rate of climb of fighters had been greater; if the range of guns had been longer, their aiming devices more accurate; the fighter pilot bolder; and the commander wiser, the Royal Air Force could have knocked down every German bomber.

We can do little to change people. By and large the Royal Air Force, and in fact all the Allied pilots, were well-trained and courageous. It is in equipment design and performance that we must place our hopes. There the technological genius of Western civilization must be focused—our genius of invention and production, and, finally, of organization. The problem of air defense is much more a problem of quality than one of quantity. World War II weapons and equipment are just not good enough to do the job, nor do we have enough of them. But to make more of the same would only comfort us with false security. The problem is one which must be attacked by an enlightened partnership between military men and the man of science, supported by the men of industry. Together they must achieve the big task of equipping the Air Defense forces which stand between us and destruction.

AF Cambridge Research Center

Photographic Reconnaissance in Korea

An RB-29 of the 91st Strategic Reconnaissance Group returns from a photo-reconnaissance mission, its camera magazines full of film exposed over North Korean targets. As soon as it lands, the many rolls of exposed film will be rushed to the laboratory technicians of the reconnaissance technical squadron, who will develop the film and make prints from it in a matter of hours. Then photo interpreters will scan the pictures for tell-tale evidence of the enemy's movements, his progress in rebuilding destroyed facilities, and his likely intentions.

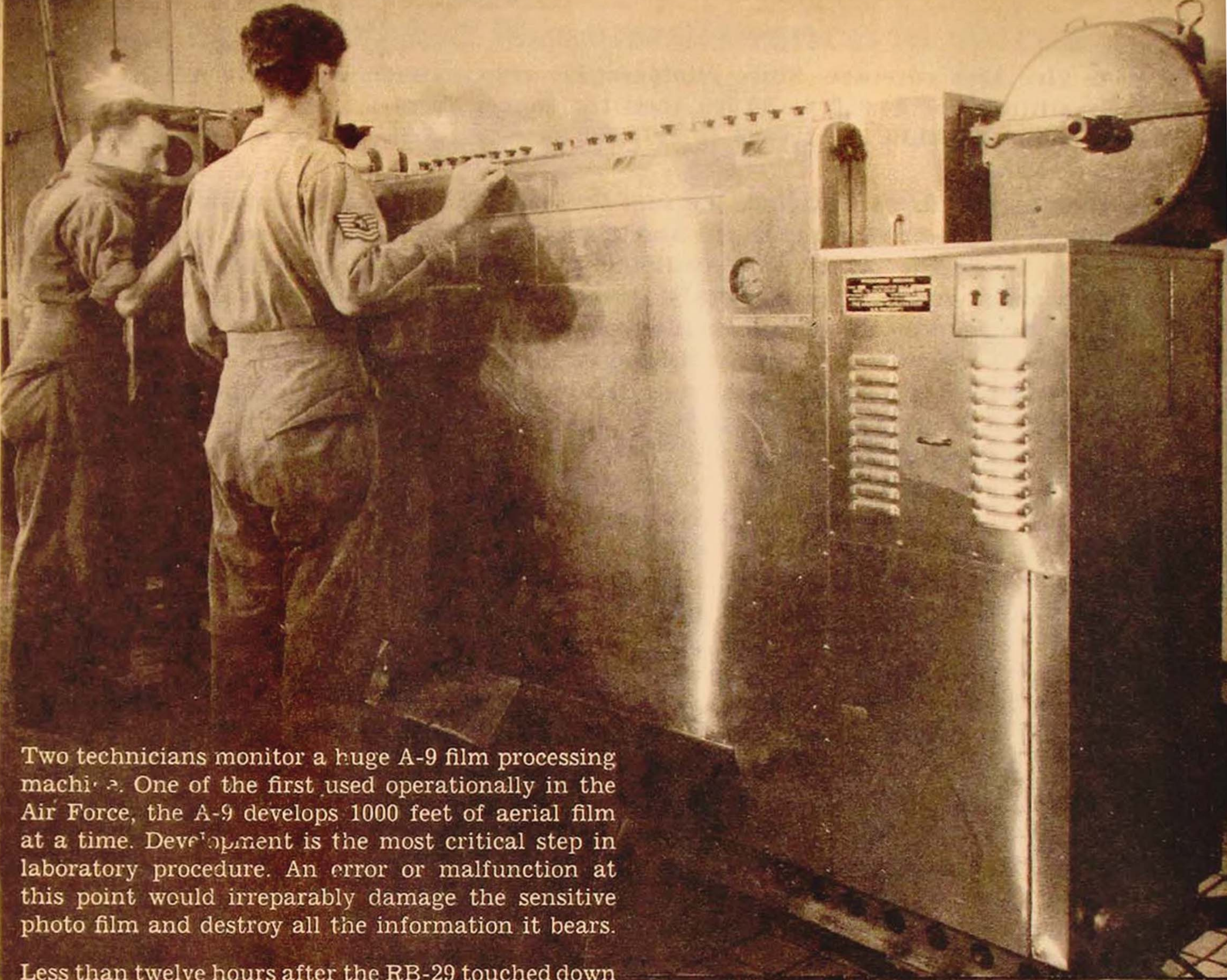
When military air power came of age in the Second World War, it compelled a similar development of its intelligence agency—aerial photographic reconnaissance and interpretation. In a war where bombers and fighter-bombers ranged over enemy territory to bomb industries and cities and cut lines of supply and transportation, the effectiveness of the air forces depended directly on their intelligence—the speed, accuracy, and completeness of their knowledge of enemy target systems. A radically new set of demands was imposed upon the gathering of intelligence. Aerial intelligence must have the same flexibility as the combat aircraft. Aerial photography was the answer. But its battle for recognition was not an easy one. Although the Army Air Corps had a series of aerial cameras in 1941, emphasis had been on mapping cameras and other short focal-length cameras which took pictures beautiful in quality and detail but too small in scale for detailed interpretation. This was only one of the problems when the U.S. entered the war and required extensive photographic reconnaissance.

By 1945 we had learned much about photographic reconnaissance and the interpretation of the photographs. We had learned that not just any aircraft was good enough for reconnaissance. Since the recon airplane usually went alone and into the deepest reaches of enemy territory, the only chance of getting home with its pictures was to outdistance any pursuers. This called for first-line fighters or bombers, stripped of their armament to give them the final edge in speed. We also found that not just any pilot could take aerial photographs. When a mosaic was flown, the lines of flight had to be accurately spaced and precisely parallel. While the automatic cameras were clicking away, flight had to be level and speed had to remain constant. Over each target notations had to be made of the altitude and time of day and a rough sketch had to be made of the flight pattern. After cameras with longer focal lengths came into general use, two cameras with 24-, 36-, or 40-inch focal length lens were usually set in each side of the nose so that their pictures would have about 40 per cent overlap. A six- or twelve-inch focal length camera took vertical shots at the same time to give area coverage. Since photographic reconnaissance aircraft usually flew at altitudes of 24,000 to 30,000 feet, the longer focal-length camera furnished pictures within the 1:6000-to-1:15,000 scale ratio necessary for detailed interpretation.

As soon as the aircraft landed, the film was rushed to the photographic section, where it was quickly processed and prints were made, developed, washed, and dried. When the prints were available, photo interpreters assigned to the reconnaissance squadron went quickly through the lot, looking for the "first-phase" or immediate-action information—a rough assessment of the damage done by a strike, movements of quantities of vehicles, trains, or troops, etc. Then the pictures were passed on to the "second-phase" section, where interpreters took note of a wider variety of matters. They checked percentage of damage done by a bomb strike, recorded the buildings destroyed and estimated how long the target would be inoperative. They reported on the amount of traffic in marshalling yards, the amount of shipping in a harbor or on a river, and the number and types of aircraft present on an airfield. Finally the "third-phase" sections studied these subjects individually, comparing the number of antiaircraft guns or radar emplacements with what the last run over the same target had shown, reporting on the serviceability of railroad bridges on all lines leading into a certain rail junction, and issuing complete reports on airfields, with the measurements and functions of each building, the number, size, shape, and type construction of aircraft revetments, the length, width, construction material, and condition of the runway, fuel dispersal facilities, etc. All this information was reported and also recorded on their record maps which are always kept up to date.

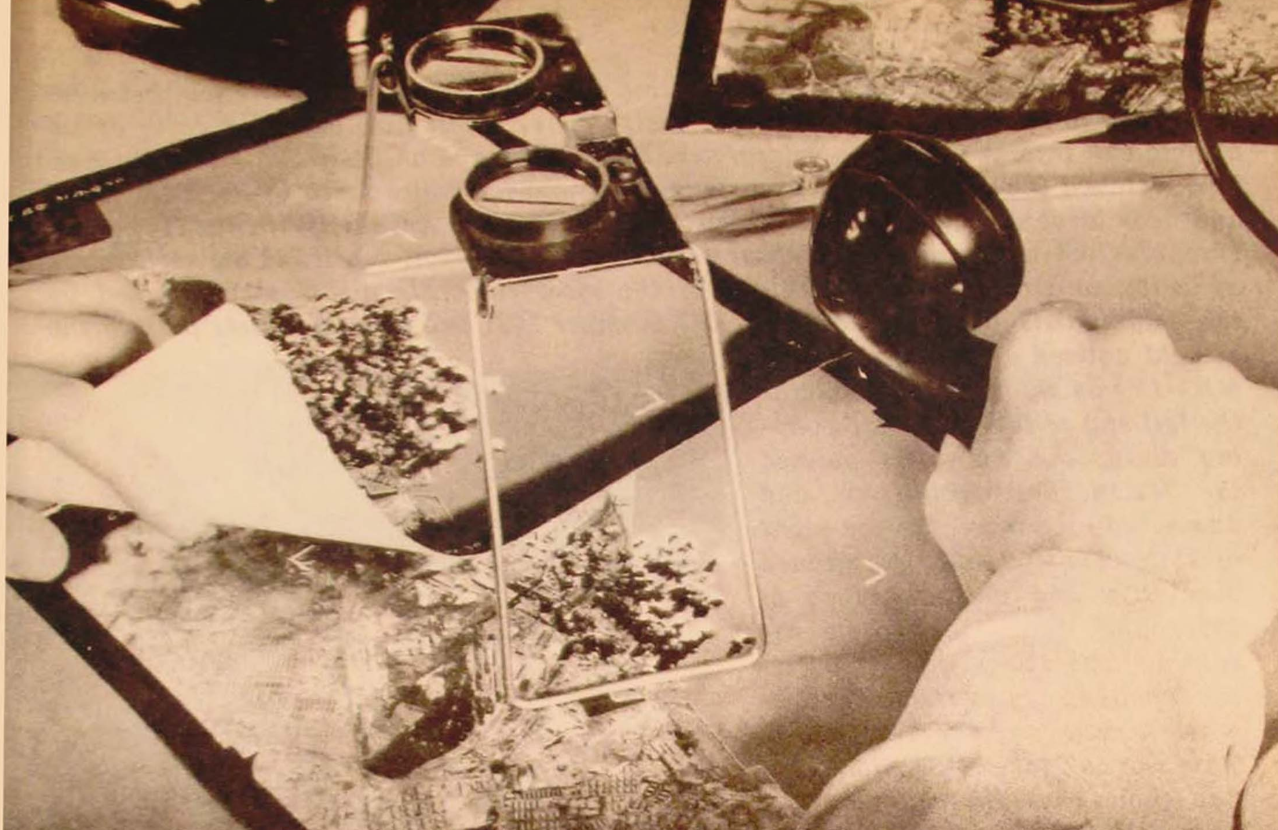
Although these "phases" were the main effort of photographic interpretation, there were allied activities of only slightly less importance to the Air Force. Detailed target folders and mosaics drew together all the information about an important target from intelligence reports, engineering journals, newspapers, and magazines and supplemented it with photographic analysis. The final mosaic would point out the critical buildings or area which must be destroyed, the height and thickness of the walls, the construction of the buildings, what the best approach route would be in terms of enemy defenses, what local antiaircraft fire could be expected, and where the batteries were located. For the low-level attack on Ploesti, Romania, the height of every smokestack was measured on photographs. Various special projects might also be assigned to the trained sections of interpreters. Periodically reports were issued covering the over-all German effort in some particular direction: the construction status of German airfields, what kinds of targets the Germans were defending most heavily with antiaircraft guns, a survey of all German barracks areas, a survey of the extent of damage to the oil industry, etc. In May 1944 interpreters went over 1:12,500 scale maps of the Normandy invasion beaches with a fine-tooth comb, checking the maps against the latest photographic cover, measuring the height of hedgerows, deleting individual trees and bushes, adding a gun emplacement here, removing one there, plotting the positions of underwater obstacles.

Much of the accuracy and detail of this interpretation came from the use of the stereoscope. When the interpreter looked through this device at the overlap area on two photographs, the slight change in the angle of the shadows caused by the distance traveled by the aircraft between snaps of the camera shutter caused an object to take on the third dimension of height. Stereovision not only clears up such ambiguities as hills and valleys in terrain photographs but adds exactitude to all forms of interpretation. Although a parked aircraft could be measured on any good photograph, stereovision can show something of its contours and make possible positive identification by type. It can strip away the camouflage of a bridge or a building by picking up the difference in height from the surroundings or by viewing in relief the tell-tale shadow cast by the object.



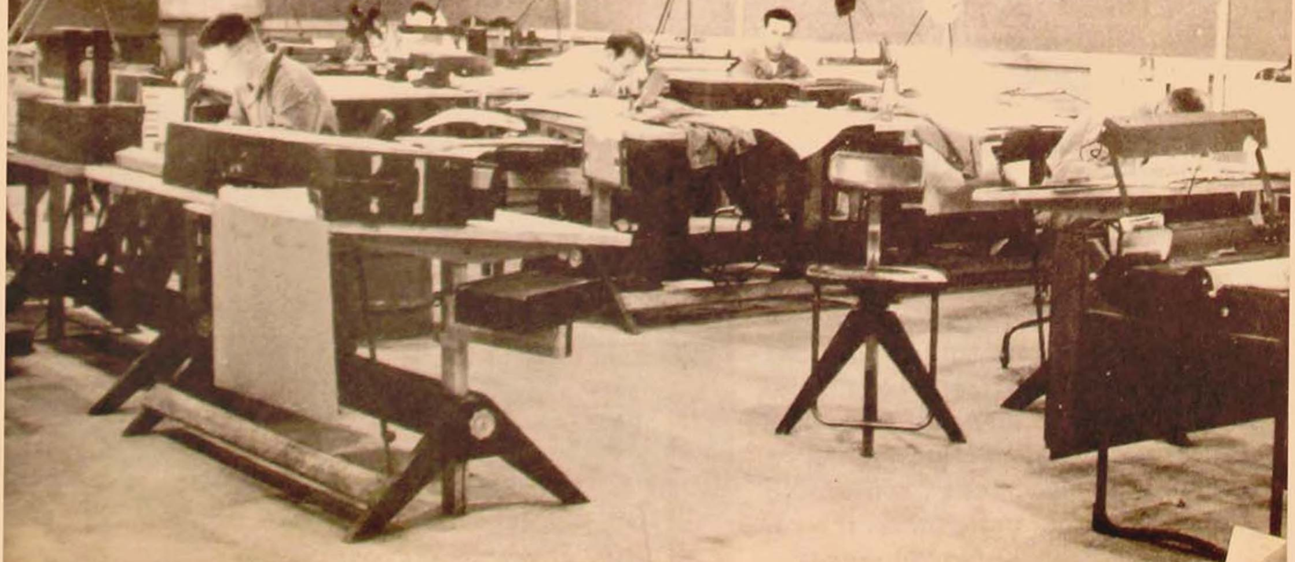
Two technicians monitor a huge A-9 film processing machine. One of the first used operationally in the Air Force, the A-9 develops 1000 feet of aerial film at a time. Development is the most critical step in laboratory procedure. An error or malfunction at this point would irreparably damage the sensitive photo film and destroy all the information it bears.

Less than twelve hours after the RB-29 touched down on the runway from its reconnaissance mission over North Korea, the contact prints made from its film are ready for the photo interpreters. The thousands of prints made by the "graveyard shift" are being checked and sorted as they come off the drier. An outline of the sortie's coverage will be plotted on a map overlay, with notation of the date, scale, and quality of the prints. These records serve the same purpose as does the card index to books in a library.

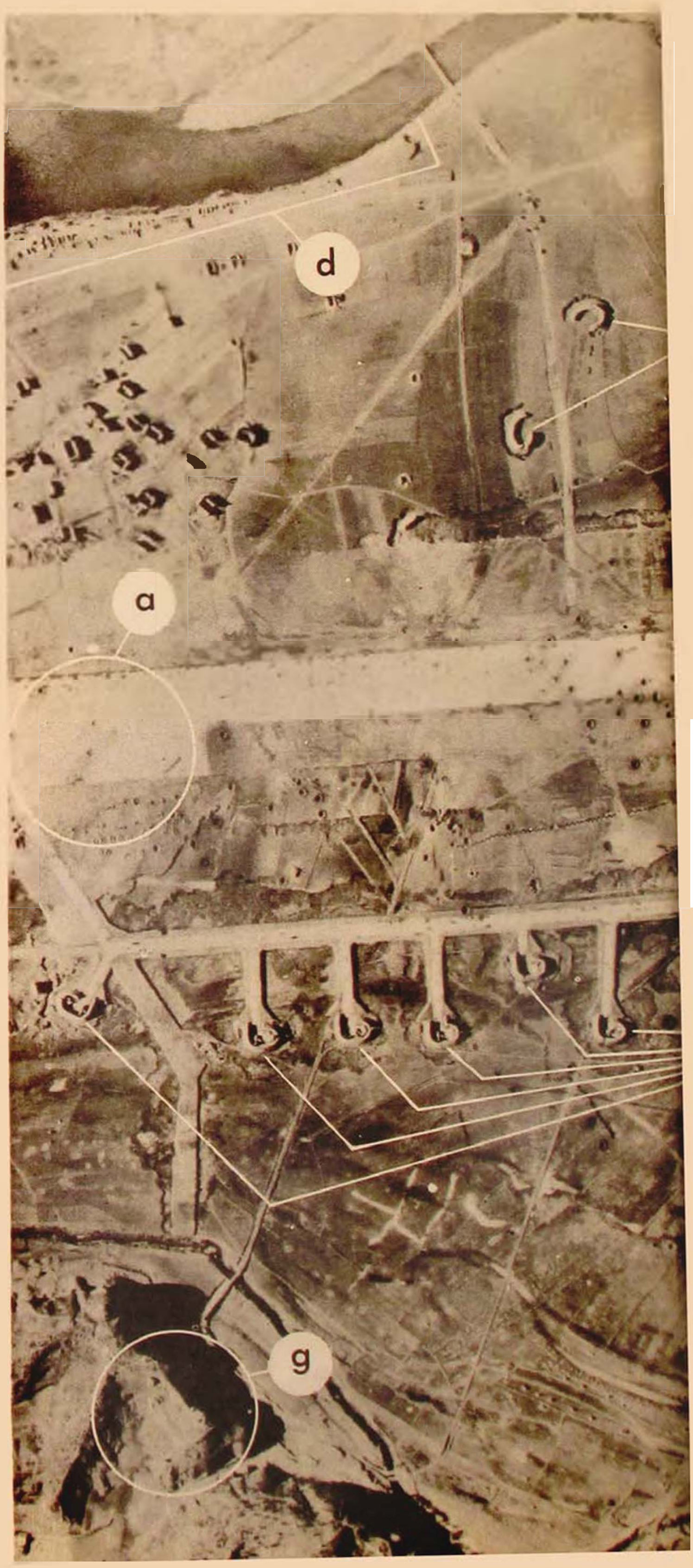


Certain pictures must be interpreted even more quickly than usual. Photographs showing the extent of damage by a bomb strike or movements of enemy shipping or troops must be scanned at once, and the information forwarded to the combat commands. These bomb-strike photographs are still wet from the washer. The interpreter had the prints before the last B-29 had landed from the attack on the copper and lead smelter at Chinnampo. He has finished "first phase" assessment of the damage inflicted by this heavy attack and is about to relay the information to Bomber Command.

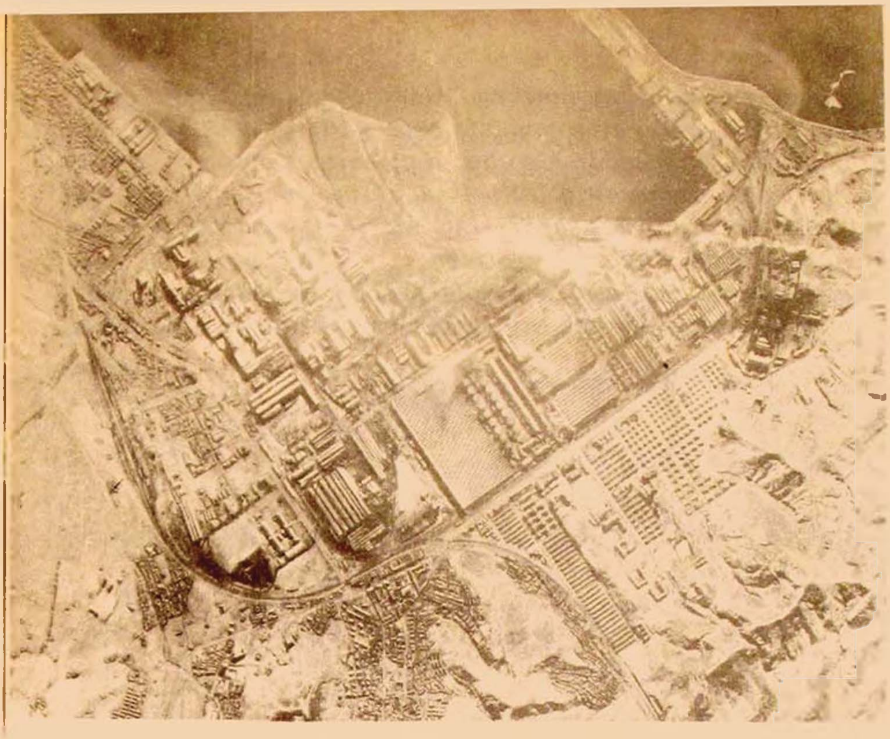
The major photo interpretation goes on in this brilliantly lighted room. Trained specialists closely scan each print in a sortie, pausing to align a pair of photographs and study a building or a shadow or a vehicle under the stereoscope. Training in what to look for, plus the advantage of "seeing height" under the stereoscope, enables them to observe and interpret more on a photograph than the average person would see. Through aerial reconnaissance the ebb and flow of the whole Communist military effort in Korea is reported to the combat commanders with speed and accuracy.



This post-strike photo-mosaic (the wavy line down the center marks the join between two prints to show the whole length of the runway) shows how one good cover of an airfield can inform the photo interpreter. Reconnaissance and patrolling aircraft had long watched the new Communist airfield at Uiju, a few miles south of the Yalu River and near large airfields at Sinuiju and in Manchuria at Antung. With its 7100-foot-long, 210-foot-wide concrete runway, its concrete taxi-strips, and its 40 big revetments of heavy construction, Uiju was one of the most elaborate airfields constructed by the Communists in North Korea. On 18 November 1951 two F-86 Sabrejets passing the airfield noticed a concentration of MIG-15's on the taxi-strips and at the left end of the runway. Swooping down, the Sabrejets gunned the MIG's, destroying four and damaging four more. On the night of 22 November ten B-29's droned over Uiju and unloaded tons of 100-pound bombs to pothole the runway and 500-pound air-bursting bombs to try to riddle the aircraft huddled in the revetments. This sortie, taken the following day, shows that the Superforts accomplished at least half their mission. Approximately 40 of the 100-pound bombs landed on the concrete runway, enough to make it completely unserviceable. The craters at the right end of the runway are already being filled in. Burn marks on the left end of the runway show where the four MIG's were strafed and burned by the Sabrejets. On the original photograph the mark to the left retains the swept-wing imprint of the aircraft burned on the concrete. It is not possible to tell from the photograph whether the aircraft in revetments were damaged by fragments from the air-bursting bombs. Close scrutiny does reveal 20 MIG-15's (b) tucked away in revetments. Several revetments contain two aircraft. This much information would be reported by the interpreter doing a "first-" or "second-phase" job of damage assessment. The photograph also contains a good deal of information which would be picked up by "third-phase" interpretation, for use in planning future attacks on the target. There are two light antiaircraft batteries (c) for local defense of the airfield. Each has three guns in emplacements, a fourth emplacement containing the command post, and several

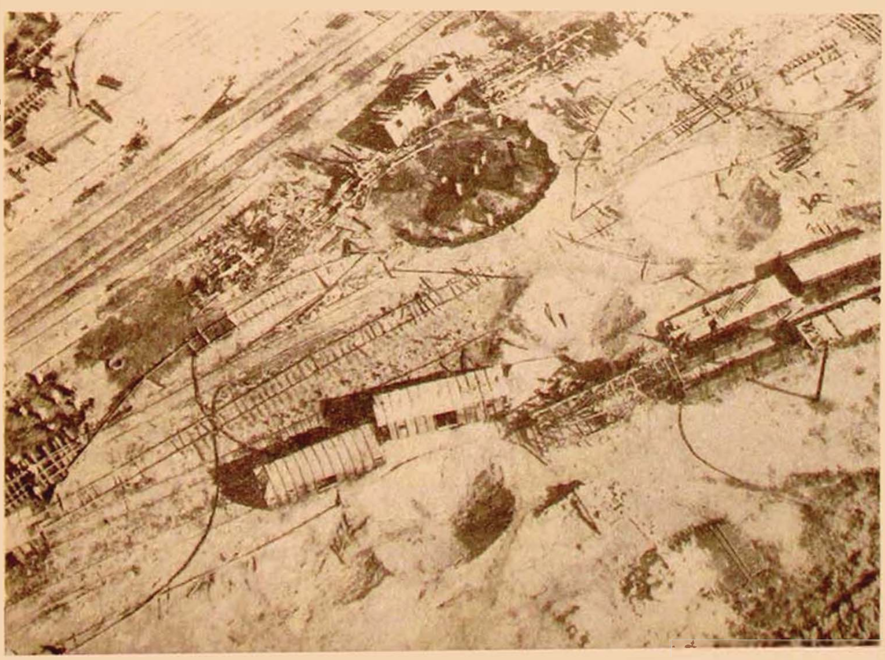


small shacks for housing the gun crew and ammunition. Along the bank of the creek at the upper left (d) a battery of field-gun emplacements covers the ground approach to the airfield from across the bridge. This group also has a command post in a revetment and housing for personnel and ammunition. Spotted at intervals all over the airfield, near the revetments and the runways, are personnel trenches and foxholes (e). Above the runway are abandoned aircraft revetments (f), less carefully constructed than the ones along the taxi-strips and probably never intended for permanent use. On a hill in the lower left-hand corner are emplacements for a radar unit.

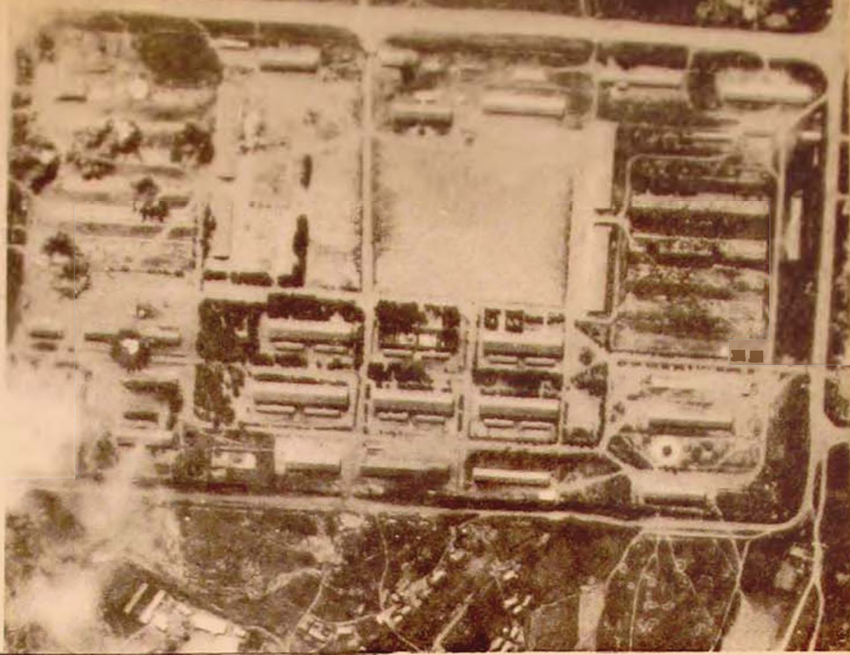


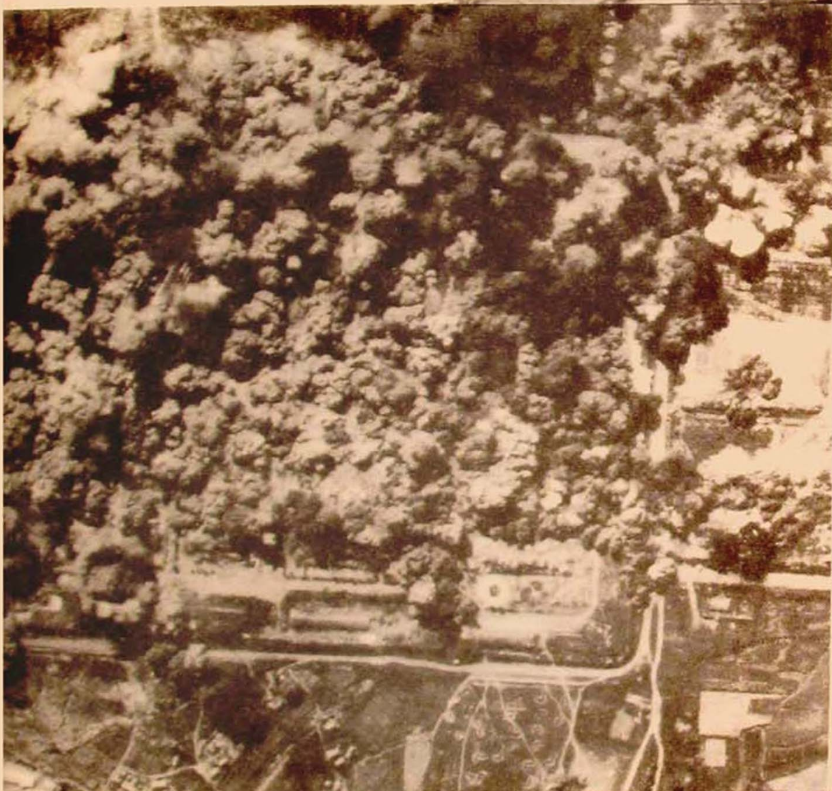
One of the ways in which the photo interpreter aids the planners of bombing missions is in the preparation of detailed target folders on important targets such as this nitrogen fertilizer plant at Hungnam, Korea, which among other things, processed nitric acid for explosives. The diverse bulk of information collected from civilian publications and other sources is collated and supplemented by detailed stereoscopic analysis of aerial photographs of the target. A diagram is prepared, showing the functions of each section of the target, indicating which buildings are vital to operations and tabulating statistics of their measurements, the materials from which they are constructed, the over-all dimensions of the target, and the amount of railroad trackage servicing it. Other types of information may include the size and location of forced labor camps in the vicinity, the position and location of antiaircraft batteries, and significant features of the surrounding terrain. All this data contributes to the efficiency of planning for combat missions.

Another important part of the photo interpreter's job is an accurate assessment of the damage done by bombing raids. On his verdict rests the decision to bomb that target again or turn to the next one on the list. This low-oblique photograph was snapped by an RF-80 flying post-strike cover of a B-29 raid on this North Korean marshalling yard. Although the complete yard is not visible on this photograph, the interpreter can report on the basis of it alone that all but two of the fifteen sets of tracks which can be seen diagonally across the picture have been knocked out. Five railroad cars were destroyed and six damaged. Swarms of laborers can be seen at work in the huge bomb craters, laboriously hauling baskets of earth to fill them in. The crater at the left of the picture is already filled in, and the ones in the top left corner and in the center are half finished. But there will be days of delay before rail traffic can be even fractionally restored.



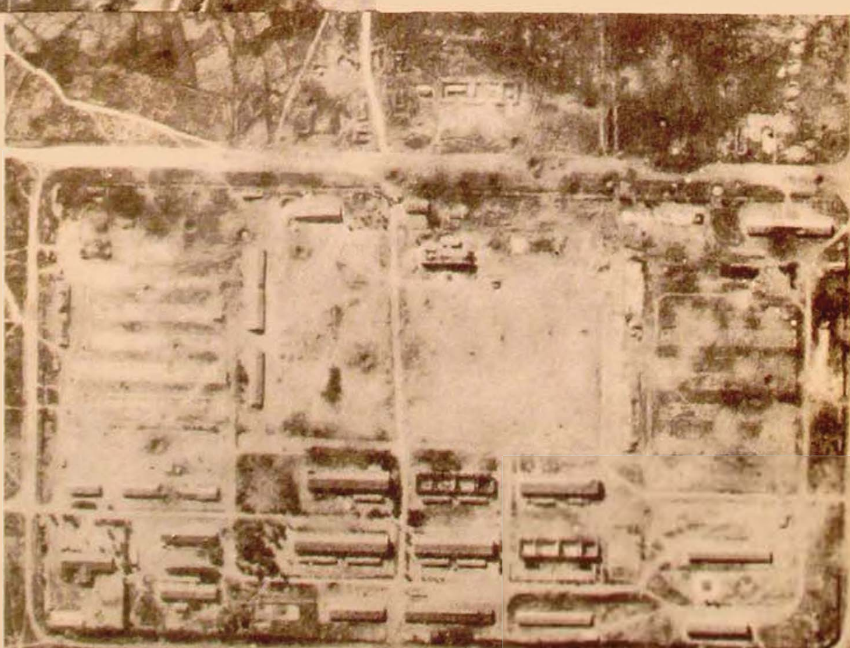
A lesson the interpreter must learn is not to judge the effectiveness of a bombing raid by the pattern of bomb bursts alone. This picture shows the barracks area at Mirim-ni just as the first bombs explode. Note that several buildings left and right of the quadrangle are already dismantled.

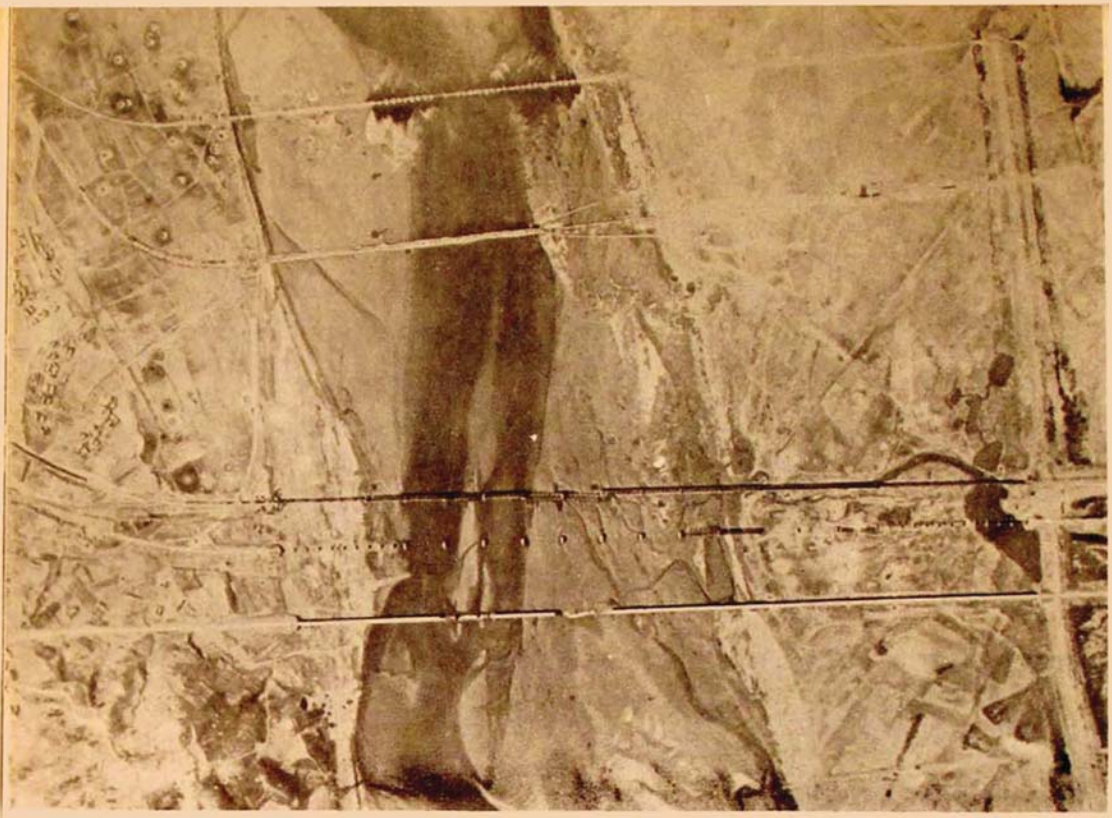




Here the raid is at its height. The bomb pattern is very impressive. Nine-tenths of the pattern has fallen within the perimeter road of the barracks quadrangle. The area seems completely blanketed. Destruction would seem to be fairly complete.

When the smoke clears away the post-strike photograph reveals that only five of the thirty large and medium-sized buildings in the quadrangle have been completely destroyed. Another six have suffered over fifty per cent damage. Although this means that over half the buildings are now useless, this attack should have had better results.





In addition to checking on targets before and after bombing raids, interpreters take note of the condition of targets every time cover is flown over them. Periodically special sorties cover a series of important targets in one category—airfields, or marshalling yards, or industrial plants, or major bridges. This enables the interpreter to keep track of the enemy's success in repairing previous damage. His reports in turn permit the combat commanders to space their attacks so that targets are kept inoperable but effort is not wasted on targets still out of commission. These three pictures, taken from May through October 1951, show several stages of operations to keep the highway and railroad bridges inoperable across the Chongchon River just

north of Sinanju. The railroad here is the main supply line down the east coast from Manchuria and is one of the few double tracked railroads in Korea. Originally there were two bridges, a double-track steel-trestle railroad bridge **d** *and a concrete highway bridge* **f**. *When both of these were knocked out early in the war, the approaches and concrete abutments for another railroad bridge were constructed* **e**. *It got no further than is shown here. Next came the pontoon by-pass railroad bridge* **b**, *which is still intact, although surrounded with bomb craters. A second pontoon bridge* **c** *is being constructed. Trackage has been laid about a third of the way across from the left bank. Two other bridges were projected but never built: a second highway bridge* **g**, *the approach for which can be seen on the right bank, and another railroad bridge* **a**, *with approaches off the picture above bridge* **b**. *This is the status in the first picture, taken early in May 1951 after a series of heavy attacks by B-29's had rendered all but one bridge* **b** *unserviceable. The second picture, released on 4 September 1951, shows an attack by 12 B-29's on the main railroad bridge* **d**, *which the Communists had just finished repairing, and the highway bridge* **f** *on which some repairs had been made. The 138 1000-pound bombs dropped on this raid put sections of both bridges into the river. The two pontoon bridges* **b** *and* **c** *have been previously bombed since the May cover, and whole sections have been swept away down river. Six weeks later, on 19 October, when the B-29's paid another visit to the Chongchon, they found the main railroad and highway bridges* **d** *and* **f** *still down. But in just six weeks the upper pontoon bridge* **b** *had been restored and an entirely new by-pass railroad bridge* **h** *was almost completed. This strike knocked the pontoon bridge down again, but this blow did not end Communist efforts to rebuild. Acting on photo interpretation reports, at least 28 attacks were made on this bridge complex between November 1951 and May 1952, in which 250 B-29's dropped a total of 2500 tons of 500 and 1000-pound bombs.*

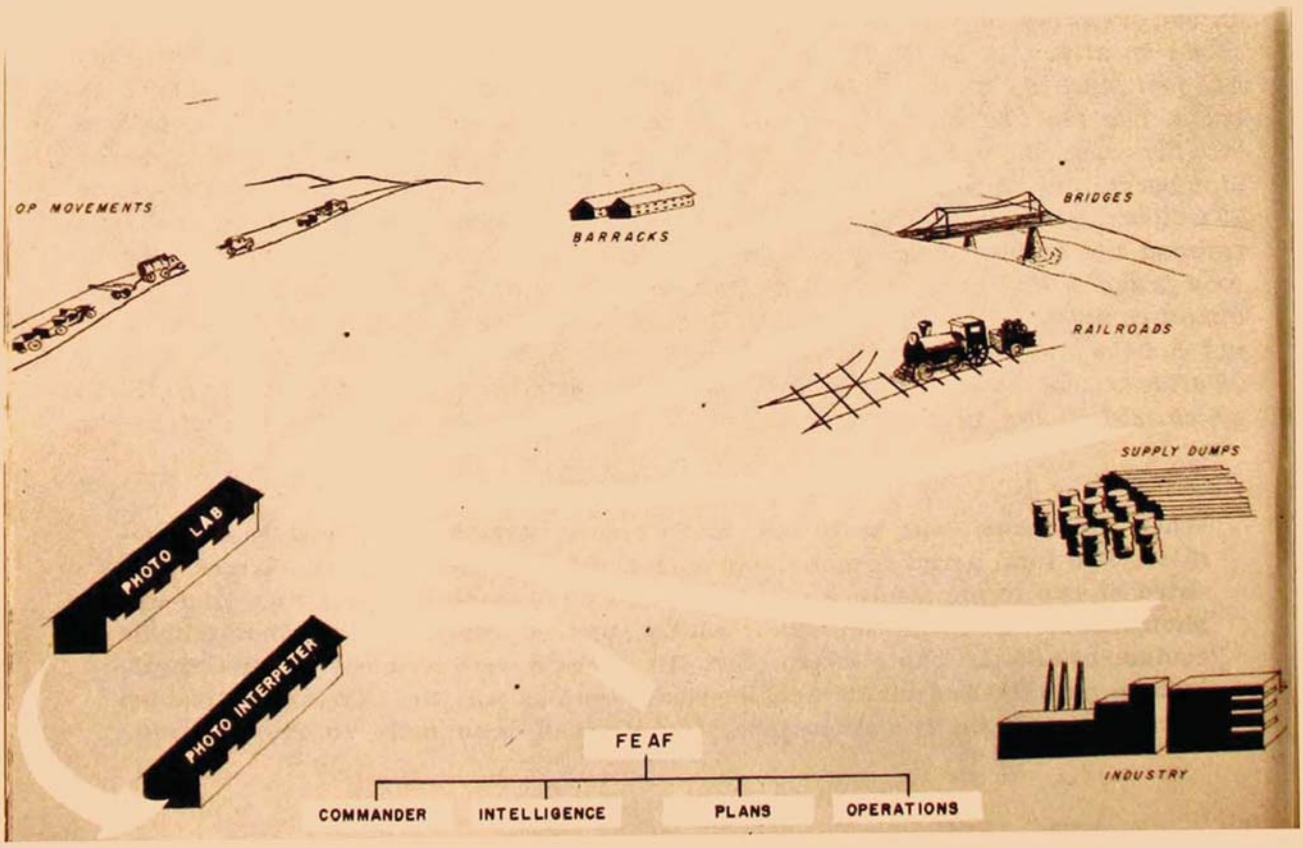
Early Korea

When the Korean war broke out, much reconnaissance know-how had evaporated. The total aerial reconnaissance establishment in Japan and Korea consisted of two reconnaissance squadrons, one photo-mapping squadron, and one photographic technical squadron, which supplied much of the photographic equipment and the photo interpreters. All of these were seriously understrength, both in materiel and manpower. Especially serious was the shortage of trained interpreters. When reconnaissance strength had been built up from nothing

during the Second World War, most of the interpreters trained at that time had been civilians of higher-than-average education and competence. The majority of them had returned to civilian life at the end of the war, and the few who were left had gone into other phases of intelligence.

Two other difficulties beset aerial reconnaissance in the early days in Korea. Many of the agencies which used reconnaissance facilities, both within the Air Force and without, had forgotten the arduously learned lessons of the past in the capabilities and limitations of aerial reconnaissance. Everyone expected prints the same day the sorties were flown. Users were reluctant to accept the interpreter's word for anything which they themselves could not identify on a photograph. Consequently there was a great demand for extremely large-scale photographs, or dicing shots—photographs taken at low levels and high speeds. Not only did this unnecessarily endanger the pilots and their aircraft, but it was a time-consuming demand upon undermanned squadrons already struggling to meet the requirements of normal coverage. A further difficulty arose from decentralized control. In the early days of inadequate facilities each operating agency attempted to create its own reconnaissance agency and use it for its own ends. The result was that there were gaps and overlaps in photographic cover. A Bomber Command RB-29 and a Fifth Air Force RF-80 would fly cover over the same Communist airfield in the same day, while another airfield 20 miles away was not covered at all. Or a Marine camera-equipped F7F and a Fifth Air Force RF-80 might fly near-collision tracks over the same area, as they did when both were photographing the Wonsan landing operation.

Most of these early difficulties were substantially remedied. Supplies and personnel became plentiful. Other agencies regained their perspective on the uses and abuses of aerial reconnaissance. Theater reconnaissance requirements are now coordinated through Headquarters FEAF. [Information about FEAF reconnaissance supplied by Lieutenant Colonel Richard A. Ariano, Directorate of Reconnaissance, Far East Air Forces.]



Human Problems in Escape from High-Speed Aircraft

Dr. Harvey E. Savely

JET aircraft, with their speed and high altitudes of flight, have put severe demands on designers and aero-medical researchers to find practical methods of human escape in emergencies. USAF interest in the problem dates back about seven years. Until the closing months of the Second World War only a few prophets in this country had foreseen the need for ejecting men from airplanes, and they went unheeded in the wartime preoccupation with the present. Thus the progress made by the Germans in escape devices for their aircraft—notably in jettisonable pilot's seats—surprised both engineers and aero-medical specialists. Since our own entry into jet aircraft development, the advances made in the speeds and altitudes of flight have constantly pushed our aero-medical researchers to keep abreast with the present and to anticipate future human problems in jet flight.

To the Air Force the question of immediate importance is always the same. Does present escape equipment meet the contingencies of present-day jet aircraft? Even here some confusion has arisen because opinions differ on the criterion for performance of escape equipment in relation to the optimum capability of the airplane for which it is designed. In this article it will be assumed that escape mechanisms must be designed to function at the maximum speed and altitude of the airplane. This assumption is sometimes the subject of heated debate with good arguments on both sides, and compromises with the principle may be necessary; but we advance by striving toward seemingly impossible ideals. It also seems generally conceded that, as Heimburger[1] pointed out in his discussion of jet bomber operations, aircrew effectiveness requires confidence in sound escape provisions. Now, what are the problems that face the biologist on the team of scientists who seek the best means of high-speed, high-altitude escape?

In the first place the characteristics of the human body are, for all practical purposes, fixed. There is little hope that any major changes can be made in this "machine." It must be studied to see what its functions are and what are its functional and physical limitations. Then the engineer can take over and design various mechanical aids to make up for the biological deficiencies.

One such mechanical aid is the automatic parachute which is coming into service. It removes the chief fear of high-altitude escape: the hesitation to permit free fall to below 20,000 feet before opening the parachute. The aircrewman has been acutely aware of the difficulty in judging altitude and has feared that if he lost consciousness, he would not regain it in time to pull the ripcord. But this automatic device makes escapes from as high as 40,000 feet survivable even without oxygen equipment and in spite of a brief period of unconsciousness.

Above 30,000 feet oxygen is required during a free fall to maintain consciousness. Up to about 50,000 feet adequate oxygen is furnished by the standard-pressure breathing equipment, which is capable of delivering oxygen at a pressure of about 20 millimeters of mercury (mm Hg.),* or 1/38 of atmospheric pressure at sea level. Oxygen forced into the lungs under pressure at this rate is just enough to maintain a person in a static position in useful consciousness for a few minutes—presumably enough time either for descent to lower altitude or for actuation of escape devices. At best the situation is marginal.

To maintain useful consciousness above 50,000 feet when cabin pressure is lost, some additional method of supplying oxygen under pressure is required. The most obvious is to enclose the man in an inflatable garment similar to a diver's suit, applying pressure to the whole body and thereby replacing the cabin pressure with suit pressure. This method was first brought to general attention by the physiologist Haldane[2] in 1922. During World War II, considerable work was done on such suits by all the principal military powers. Postwar developments in Russia have been discussed by Kromushkin.[3] In spite of the attractive simplicity and physiological logic of the idea, its translation into a practical garment has met with difficulties. Inflation pressures required for survival above 50,000 feet are so high that the suit becomes rigid, seriously restricting arm and leg movement. And since it would be used only in sudden emergencies, such a suit needs to be worn completely closed

*Throughout this discussion pressures will be expressed in millimeters of mercury (mm Hg.). One inch of mercury is equal to 25.4 mm Hg. One atmosphere is either 30.4 inches of Hg. or 760 mm Hg.

and ready at all times. This introduces problems of ventilation to remove body moisture and to control body temperature. On the other hand it is relatively easy to combine the function of an emergency flotation suit with such a garment. Complete suit pressurization, since it replaces cabin pressure, also can prolong flight without descent following an emergency loss of cabin pressurization, a feature of considerable importance when the mission range is critical.

There are other avenues of attack on the problem of survival at high altitudes.[4] Since the lungs exchange oxygen and carbon dioxide between the blood and the atmosphere, it is natural to ask "why not pressurize the lungs alone?" This is done by the standard-pressure breathing equipment. The lungs are inflated by oxygen supplied under pressure from the mask, and exhalation must be forced against this head of pressure. Because of leakage through the seal of the rubber mask, the upper limit for this method is an increase of pressure of about 25 mm Hg. in the lungs. This pressure will maintain the body at 44,000 feet in a condition equivalent to that achieved by breathing 100 per cent oxygen without pressure at 40,000 feet. Even if higher pressures could be maintained in the mask, they would be to no avail. Pressure to the nose and mouth alone results in painful distension of the unprotected eardrum and pain in the region of the eyes due to increased intraocular tension. It is therefore clear that if a system of high pressure breathing is to be useful, some radically new approaches are required to circumvent the physiological difficulties.

The problem may be at least partially solved by high-pressure breathing helmets which, by including the eyes and ears as well as the nose and mouth, would make it possible to supply oxygen at the pressures from 40 to 100 mm Hg. required in the range between 45,000 and 60,000 feet. But these pressures produce overdistension of the lungs; the unprotected lungs will rupture at a pressure of 40 to 60 mm Hg. There are several possible ways to prevent such distension. The most obvious would be a counter-pressure bladder over the chest and abdomen. In practice this has the disadvantage of making movement and bending awkward. Another method is the use of a tight, moderately-elastic nylon vest, which permits application of very high breathing pressures but prevents overdistension of the lungs.

The effort involved in more prolonged high-pressure breathing may be eased by the use of an intermittent-breathing valve.

With a continuous-high-pressure valve, the crewman must voluntarily exhale with enough force to raise the mask pressure by 4 to 5 mm Hg. for nearly one second during exhalation. In contrast, intermittent-pressure breathing abruptly drops the pressure after a brief "grunt" to trip the cycling mechanism, allowing a passive exhalation. For example, a breathing pressure of 110 mm Hg. would fall to about 90 mm Hg. during exhalation and then build up rapidly during inhalation to 110 mm Hg. Tests point to the possibility of increased ease of respiration by this method without significant loss of mean mask pressure.

A special helmet and an elastic vest protecting the trunk against overdistension, together with some provision to make respiration easy, will permit high-pressure breathing at 70 to 100 mm Hg. and provide for adequate oxygenation of the blood up to about 60,000 feet. But use of such a combination for more than a few minutes leads to unconsciousness. The clue to this collapse lies in the distension of the veins of the arms and legs as a result of the marked increase in pressure in the trunk of the body. The venous and capillary bed in the limbs will distend rapidly during the first 30 to 60 seconds of pressure breathing. Such a pooling of blood reduces the effective volume available for circulation. The most that can be spared without endangering life is 25 per cent of the blood volume, or 1400 cubic centimeters in an average man. In the seated posture the incidence of collapse is high for a loss of even 500 cc—the amount of blood transfusion. In addition to the pooling of blood the increased pressure in the capillaries leads to loss of fluid from the blood into the tissues.

Studies have shown that a loss of up to 1000 cc of blood volume can be accounted for by this dual reaction of pooling and escape into the tissues, an amount which few could spare in the seated posture without collapse. The solution to this difficulty is pressurization of the limbs. If this is done, the high-breathing pressures can be tolerated. permitting ascent to altitudes of 60,000 feet and insuring survival during escape at altitudes up to 100,000 feet, where the atmospheric pressure of 8 mm Hg. Tests point to the possibility of increased ease of logical purposes, practically a vacuum. The parts of the body that are not pressurized, such as the hands and knees, do not present enough area to seriously endanger the individual who is exposed for less than thirty minutes.

Suits embodying the principles just discussed have been constructed. It is certain that they will have to be modified considerably as routine use of the complex equipment furnishes a standard of criticism. Since the need for an emergency pressure suit is likely to be as infrequent as for a parachute, comfort when the suit is uninflated is of prime importance. Likewise, since it is a life-saving piece of emergency equipment, comfort during its actual use is minor in comparison to the vital need for reliability. It is not yet possible to say what the final form for such equipment may be, but it is now reasonably certain that equipment can be made which does not unduly restrict the flyer and which will function in the various emergencies that may be encountered. Further it appears that these devices can be integrated with the crash helmet, anti-g suit, and survival and flotation gear without undue loss of efficiency and that they can be constructed to withstand airblasts approaching those of sonic speeds at sea level.

IF we accept an emergency pressure suit as providing for survival in the region above 50,000 feet, and standard oxygen equipment for the region below this altitude, we may now examine the human factors involved in getting out of the airplane and surviving the initial shock of the airblast. The problem here is one of body mechanics. We are not concerned with subtle points of physiology but simply with the force we can apply to the body without causing damage. The Germans first tackled this problem during the development of their ejection catapults.[5] On test towers they subjected volunteers to ejections having peak accelerations in the order of 20 to 25 g's and observed some instances of back injury. Unfortunately their acceleration records are not too reliable. Their conclusion, which the U.S. Air Force accepted, was that an average of 20 g's for 1/10 second, peaking to 25 g's for .01 second or less, should be adopted as the criterion for an upper limit in catapult development.

After World War II there was active investigation of catapults and their effects on man by the Martin-Baker Company in England, the U.S. Navy at Philadelphia, and by the U.S. Air Force at Wright-Patterson Air Force Base. The most significant new principle established by this activity is that the rate of powder burning is a factor in human tolerance of a given catapult length and ejection velocity. In other words it revealed the most efficient acceleration time for producing the required velocity without exceeding the maximum acceleration capability of 20 g's.

In the early development of catapults emphasis was placed on making the initial rise in acceleration as rapid as possible through the use of rapid burning powders. This would seem to make the most efficient use of the catapult length in producing the required ejection velocity. But in practice it was found that such powder combinations produced a high initial thrust, which produced an interaction between the seat and the man, exposing him to high peaks of accelerations. (Figure 1)

Obviously catapults which developed their thrust gradually were required. Test ejections established that the rate of pressure build-up in the catapult should cause a rate of increase of acceleration no more than 200 g's per second and preferably below 150 g's per second. The M-1 catapult currently used in

> Acceleration is measured in g's, or units of gravity. For example a 180-pound man subjected to 6g's weighs 6 x 180 or 1080 pounds. This increased weight affects all parts of the body, and is felt whenever there is a change in velocity, velocity being defined as a change in either speed or direction. Thus acceleration is the rate of change of velocity. Physiologically the effects of acceleration are chiefly on the blood when g pressures are exerted for prolonged periods of several seconds or more. Since acceleration has the effect of increasing the apparent weight of the blood, the circulation is embarrassed, and this leads to the symptoms commonly noted. Positive or head-to-foot pressures force the blood from the head toward the feet, causing blackout. Negative or foot-to-head pressures drive the blood to the head and cause redout. Chest-to-back pressures drive the blood the much shorter distance transverse the body, which allows much higher pressures to be tolerated. Abrupt accelerations lasting for less than a second can be tolerated at much higher levels because the limits are set by the mechanical strength of structures in the body.

fighter-aircraft was then developed. This device makes it possible to obtain a minimum of 60 feet-per-second ejection velocity for peak accelerations of less than 15 g's. Since some of the man's peak velocity is a result of the elasticity in the man-seat system (as explained in Figure 1), it seemed during early experimentation that use of seat cushions would be injurious, but the subsequent reduction of the rate-of-thrust build-up in the standard catapults permits a four-inch-thick foam rub-

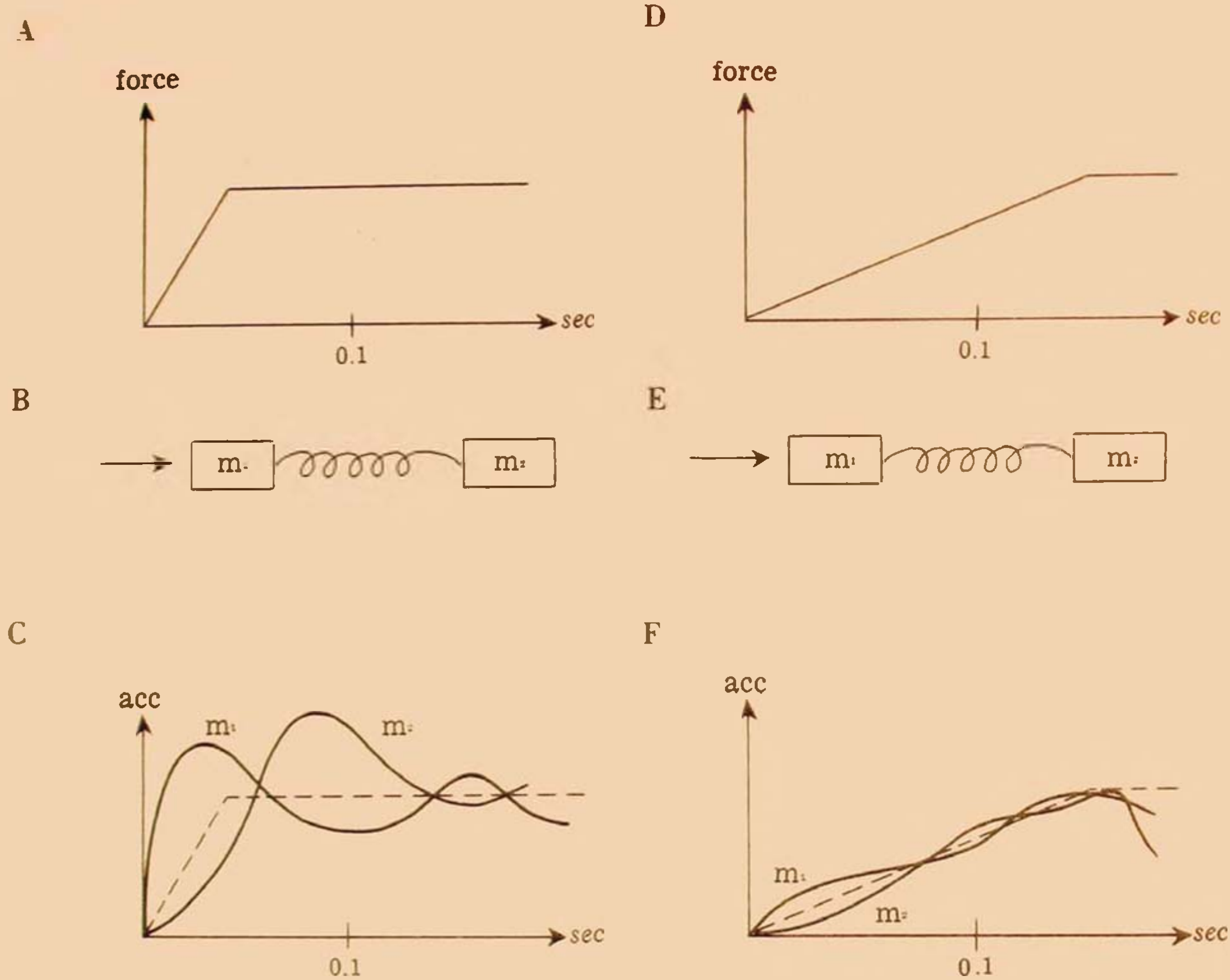


Figure 1. A diagrammatic illustration of the dynamic effects of the rate of application of force to the ejection seat. Ejection seat catapults which have rapid powder burning produce a steep rise in the force-time diagram applied to the seat as shown in A. The dynamic effect on the man-seat spring system, represented diagrammatically by B, where m_1 is the seat coupled to the man, (m_2) by various degrees of elasticity and damping, is shown in C. The oscillations of the acceleration curves on the man and seat show that they did not move off together, but underwent motion with respect to each other which intensified acceleration of the man. This interaction between seat and man can be avoided by slower application of force as in E, which does not excite the man-seat spring system to such a degree and produces accelerations on the man, (m_2) which are not excessive and which permit higher ejection velocities.

ber cushion to be used without a significant change in the acceleration-time diagram.

Many aspects of ejection that caused concern in early development have not proved to be serious. One was the positioning of the feet on the footrest. At one time an interlock on the footrest was proposed, so that the catapult could not be fired until the feet were in proper position. In actual emergencies feet frequently do not get on the footrest, but the most severe result has been bruises on the calves of the legs. This result has been confirmed on the ejection seat tower. A footrest is still considered desirable for better body support, but it could be omitted under special circumstances. Similarly the headrest and proper positioning of the head have not been a problem in escapes with the present catapult. The armrests are useful for bracing the body and allowing the arms to carry part of the ejection load that would otherwise be imposed on the vertebral column, but as peak acceleration has been kept well below injury levels, need for armrests at speeds less than 500 miles per hour is questionable. Larger catapults now being tested impose slightly higher acceleration on the man, but human limitations to the ejection process do not appear to impose any barrier to their use. In fact the ejection itself seems to be the easiest part of escape when the effects of deceleration and air-blast are considered.

The deceleration of the seat, which begins once the seat enters the slip stream, may approach or exceed the limits of human tolerance. To determine human tolerance to high decelerations, studies have been made on a linear decelerator at Edwards Air Force Base.[6] This device produces a predetermined deceleration rate on a cart that is propelled by rockets into a set of brakes. Fifty-four tests in the forward-facing position with this device have shown that man can tolerate at least 45 g's if he is supported by a relatively simple crash harness. Considerably higher deceleration presumably could be survived, but perhaps with some injury.

The rate of application of force to the body appears to have significant bearing on the results of the deceleration (Figure 2). It will be recalled that 150 to 200 g's per second was a critical range for forces acting vertically from seat to head, whereas for forces acting from chest to back the critical range appears to be from 500 to 1000 g's per second. The human body can survive comparable deceleration in the backward-facing position. This information clearly shows the possibility of a man surviving shocks of greater magnitude than had been hitherto supposed.

But escape from the aircraft of the future might involve decelerations lasting from one to two seconds rather than tenths of seconds, that is, sudden velocity changes in the order of 500 to 1000 m.p.h. rather than the 75 to 150 m.p.h. studied on the

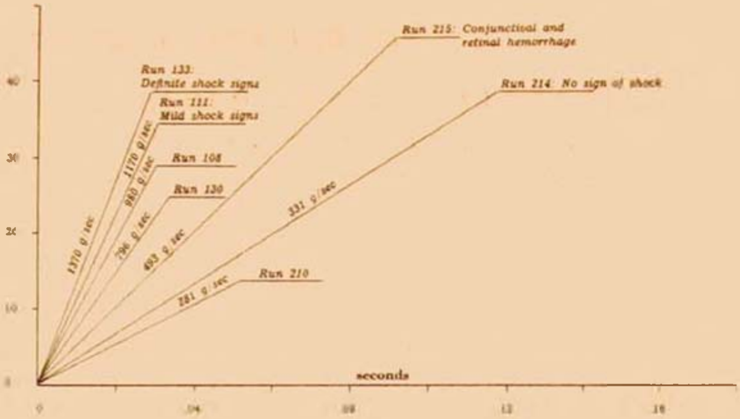


Figure 2. A comparison of the effects on human volunteers of experimental deceleration-time patterns of different slope. Abrupt application of the decelerative force produces a steep rise in the deceleration-time diagram. The degree of slope is expressed in g's/sec. The more severe symptoms produced in run Nos. 133 and 111, as contrasted to run Nos. 214 and 215 are attributed to dynamic responses in the body initiated by the rapid onset of acceleration. The curves show only the first portion of the deceleration produced on the deceleration sled by the brakes. Accelerations measured on the man would show various degrees of overshooting above these values, as explained in the diagram in Figure 1 for rate of application of force in seat ejection. The term g/sec on each curve indicates the slope or rate of change of the curve.

decelerator (Figure 3). Whether increases in duration of this magnitude can be withstood is a moot question. Already some evidence shows that at about 40 g's shifts occur in the circulation of blood which can cause minute hemorrhages. As deceleration time lengthens, damages of this sort can be expected to increase. Since direct methods for attacking this problem are not immediately available because of the great changes called for in velocity, indirect methods are being sought. These problems in deceleration cannot be solved simbly by adopting some form of capsule protection. The improvement must result in a lower deceleration which is reliably directed transverse to the body. Thus the capsule must have a low drag-weight ratio and high stabilization. If this requirement is not adequately met, the man's deceleration may be higher than

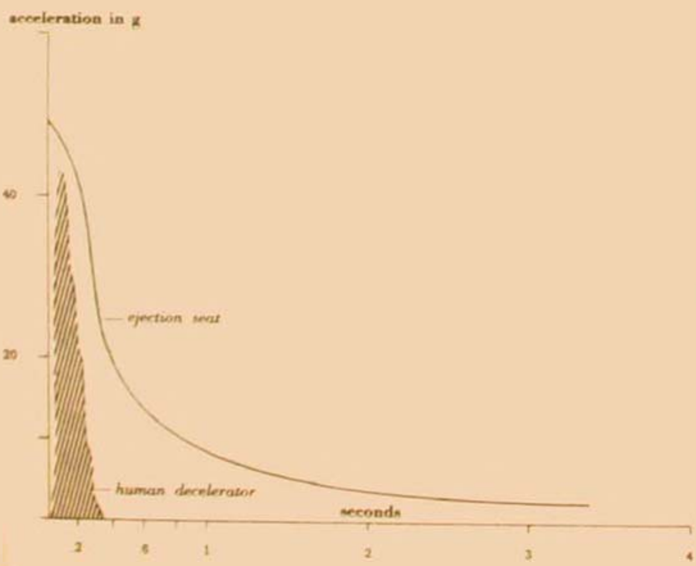


Figure 3. A diagrammatic comparison of decelerations which have been withstood experimentally on the decelerator by a number of human volunteers (shaded curve) with the deceleration of greater magnitude and duration which may be expected upon ejection from aircraft flying at speeds in the transonic or supersonic range.

if he had been ejected into the airstream in the usual fashion.

While undergoing the linear deceleration, it is possible for the ejected seat and man to rotate about their combined center of gravity in one or more planes. This complex motion makes it difficult to apply knowledge gained from the human decelerator. The physiological effects of rapid tumbling alone are being studied separately, since this condition may apply to a man falling a considerable distance in an unstable seat or capsule. The laboratory device used is a small centrifuge, eight feet in diameter, upon which a man or experimental animal can be rotated at up to 200 revolutions per minute to test physiological limits. The combined effects of tumbling and high acceleration will be studied on the Navy centrifuge at Johnsville, Pennsylvania. Stabilization of the seat is obviously desirable to prevent tumbling. Meanwhile knowledge of human limits is needed to set realistic design criteria.

THE effect of windblast on the man and his personal equipment during escape by seat ejection requires additional attention, for it may limit this mode of escape. Wind-tunnel tests have been made with unprotected humans under simulated conditions of up to 425 m.p.h. for normal bail-out and at 470 m.p.h. (indicated) in test seat ejections, and other tests have directed blasts of air on men protected by oxygen masks and visors. Blasts of sonic speeds have been directed at a dummy wearing an A-13A oxygen mask and the USAF P-3 helmet (which is equipped with a visor) without failure of equipment.[7] If the tissues of the face and body are protected from the direct tearing force of the airblast, the speed limit for bailout is likely to depend on the amount of deceleration the body can stand rather than the amount of windblast.

The speed limits of upward ejection are likely to be fixed by the velocity necessary for a man to clear the stabilizer of the aircraft rather than by human tolerances. It appears already that he must be ejected at about 600 m.p.h. to clear the vertical stabilizer in some airplanes. One solution is to eject seats downward. Ejection velocities of 40 feet per second can be attained with an acceleration of less than 10 g's on the man. This is quite acceptable, as shown by experience on a downward-ejection seat test tower.

Seat ejection may be compromised at high speeds by turbulence, vibration, and noise following jettisoning of hatches, as pointed out by Heimburger.[8] This potential escape hazard requires further evaluation by engineers and physiologists.

The high speeds predicted for future aircraft are usually associated with high altitudes, so that although the Mach number may be as much as two or more, the dynamic pressure in the thinner air and therefore the deceleration on a man may be no more than at high subsonic speeds in the denser air near sea level. Thus there is reason to believe that the conventional seat ejection equipment may be useful for escape at Mach 2 at 50,000, or even at higher altitudes and greater Mach numbers. These are points which are most in need of clarification, both in aero medical and engineering studies.

The problem of protection against cold does not appear to be serious. In free-fall descents from over 42,000 feet Major Vincent Mazza[9] found that medium-weight winter flying clothing was ample protection. The condition would naturally be quite different for open parachute descent, but that is ruled out for a number of other reasons than cold. Exact studies have not been made, but it is fairly safe to predict that Mazza's exposure time could be doubled without serious difficulty. This would mean that free-fall from at least 80,000 feet should be feasible as far as cold is concerned.

There has been considerable enthusiasm over the possibilities of escape by pods, capsules, or jettisonable nose sections. Escape by such means offers a number of advantages, such as better insurance of a supply of oxygen either through pressurization or avoidance of damage to oxygen equipment from air blast, reduction or elimination of the temperature problem, the possibility of simplifying personal equipment for comfort and efficiency of the flyer, and increased facilities for survival after landing on land or water. The U.S. Navy has sponsored work which shows considerable promise in this field.[10] But as promising as such progress is, it can have no effect on the aircraft now flying or those of the near future. From past experience we can expect further developments in the performance of current models of aircraft for another five years. During that time seat ejection is likely to remain the only method of escape from most aircraft which operate in excess of Mach 1 at altitudes above 50,000 feet. Therefore the challenge to physiologists and designers remains to achieve the best possible protection for the man in seat ejection while, at the same time, perfecting capsule methods of escape for future models.

In the last few years we have come to realize time and again that the human body is an amazingly tough "machine," given proper protection and support. If this ruggedness can be fully exploited, we have good reason to expect that escapes by the conventional seat ejection as well as by ejectionable capsules can be made at speeds and altitudes far in excess of those now commonly thought to be dangerous.

Wright Air Development Center

NOTES

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[8]D. C. Heimburger, **op. cit.**
[9]Vincent Mazza, "High Altitude Bailout," **Journal of Aviation Medicine**, XXII (No. 5, 1951), 403-407.
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In My Opinion . . .

PYRRHIC VICTORY?

Colonel R. C. Weller

A witness testifying before a Congressional Committee had this to say: "The testimony before this committee thus far has been concerned largely with the B-36 program. As I have told you, I believe the issues before you are much broader and more important. The B-36 has become, in the minds of the American people, a symbol of a theory of warfare—the atomic blitz—which promises them a cheap easy victory if war should come. Consequently the American people, and indeed the whole world, will take your final action in this investigation to be the approval or disapproval of a theory of warfare which, I am confident, is not generally accepted as sound by military men."

Before examining this testimony it would be well to resolve the taunting phrase, "cheap and easy victory." The B-36 *is* a symbol of a theory of warfare. It is the symbol of the theory of air power, but this theory cannot be, on any evidence available today, construed as an atomic blitz which promises a cheap and easy victory.

As for the B-36 itself, it is simply a large bomber capable of carrying very heavy bomb loads over long ranges in all kinds of weather. The fact that it can be shot down is no more startling than the assertion that a cruiser or a carrier can be sunk. Actually the point of view this testimony reflects is less concerned with the B-36 than it is with the theory of war the B-36 represents. The witness went on to say: "The plane itself is not so important as the acceptance or rejection of the theory of the atomic blitz warfare which it symbolizes."

If it is permissible to substitute for "atomic blitz warfare" an equally brief but more accurate definition of the theory of warfare which the B-36 represents—that *air power applied directly against the source of a nation's strength is decisive in war*—then it can be said that the witness rejects the theory of air power.

In this theory of war which the witness referred to as cheap and easy atomic blitz, he foresees that "A war of annihilation might possibly bring a pyrrhic military victory but it would be politically and economically senseless. In my opinion the American people, if they were well informed on all factors involved, would consider such a war morally reprehensible."

One may see this as a seer, but he cannot see it as the inevitable result of the application of the theory of air power. There have, in fact, been all too few examples of the strategic concept at work from which one might draw conclusions. Those examples which do exist lean very much in favor of the theory.

The Japanese war is perhaps the best example of a successful strategic air campaign. It was not planned as such but rather came to pass as the situation in the Pacific developed and the art of strategic bombing was perfected in Europe. The situation in Japan in the late summer of 1945 seemed painfully formidable. The Japanese were in complete possession of their homeland. They had an armv completely intact and well stocked with supplies, ready to fight an invader. But instead of having an amphibious invasion force to sink its teeth into, the Japanese Army found itself completely ignored by air forces exploiting the theory of air power. These very same American air forces, both Army and Navy, had defeated the Japanese fleet and most of the Japanese Air Force. There was no longer any effective opposition in these elements of Japanese power. What strength remained to Japan was vested in her army. Theoretically the Japanese need not have surrendered until they were invaded and the last remnants of their army defeated. Indeed invasion is the classical prediction of what is necessary to achieve victory.

Certainly the United States was faced with either invading or annihilating the enemy. It is at this point that one must pause to ask the hypothetical question so confidently answered by the statement of the witness. Would the American people have called off the bombing raids in favor of a ground invasion on the grounds that bombing the Japanese into submission was morally reprehensible?

The witness was wrong insofar as history is concerned, for the American people then looked upon the bombing of Japan with grim satisfaction mingled with pity for an enemy whose conduct they believed scarcely deserved the sentiment. The witness was twice wrong, for he regards a strategic air campaign as inevitably leading to annihilation. The fact is the Japanese chose not to be annihilated. Asking only that their emperor be spared, they surrendered when the situation became hopeless.

This surrender should not be surprising to anyone. History is filled with examples of divisions, corps, and even whole armies which have surrendered when all hope of victory was past. Naval ships have struck their colors when they were too battered to fight back. It is a natural behavior of man and is quite predictable. The difference between the examples of history and modern war is the advent of total war, which throws the entire resources of a nation into the fight. Total war has broadened military objectives, so that nations can now be faced with the choice of surrender or annihilation while their armies are still intact in the field. The Japanese government reacted in precisely the same manner as the captain of a ship or the general of an army in similar circumstances.

The great significance of this lesson is that few peoples have ever been indoctrinated with a greater hatred for the enemy than the war lords of Japan instilled in their soldiers. Yet the strategic air campaign was climaxed not by self-imposed annihilation but by surrender in the orthodox manner.

The Japanese war was not a war of annihilation, since the Japanese chose not to be annihilated. But was it a "pyrrhic military victory both economically and politically senseless"? Proof for such a contention must demonstrate how the Japanese might have been defeated at less cost and with greater political gain.

It is no secret that the United States had plans for the ultimate invasion of Japan. That much was saved. But what if the war in the Pacific had had to be fought without the influence of the strategic air campaign or the four-engine bomber and had to be climaxed by a Normandy-type invasion, followed by a war in Japan! Does this produce a vision of a cheaper victory? What greater political gains could have followed such a war? The very plan itself, though never used, was the cause of concessions to the U.S.S.R. which today we deeply regret.

The Japanese have renounced war. Under American leadership they have tried to adjust themselves to democratic principles; they are aligned with the free world against Communism. Could some form of military victory other than that which was achieved have produced greater political results?

Is it not reasonable to conclude that American air power, supported by surface forces and applied directly against the source of the Japanese strength, defeated Japan? Is it not true that the victory was not pyrrhic nor won at too great a cost, since it saved the lives of many men who might otherwise have died in the invasion? Can it not be said that Japan was not annihilated and that the theory of air power as applied here did not lead inevitably to annihilation? Is it not possible to conclude that the victory was not morally and politically senseless, since Japan is a good ally and has cost little in terms of rehabilitation and current political problems? And, finally, can we not say that the American people did not regard the bombing of the Japanese as morally reprehensible, but rather, as justifiable retaliation?

If one chooses to argue that the theory of air power, while not wrong in principle, is impractical of achievement, it might be possible to follow his logic. But when one argues not so much against the means, the airplane and the atomic bomb, as against the principle, he loses himself in the wilderness. Anyone who argues against the principle of destroying an enemy's source of military power must willingly accept a war in which the full weight of the enemy's productive ability lies with impunity squarely behind its armed forces. When these armed forces are preponderant in every respect, there can be only one solution. Such forces must be matched at least to the degree that mass is not critically in favor of the enemy.

To match mass with mass, the United States and her allies would have to produce up to 200 divisions, supported by some 15,000 to 20,000 aircraft and by sufficient naval forces to insure logistical support. Desirable as this may be, no one has been able to show just how democratic economies can afford such forces as a means of deterring war.

But even if all this were done, our witness raised additional points which backfire. He said: "In planning to wage war, if we are forced to fight, we must look to the peace to follow. We must know what kind of a peace we wish to have and what price we are willing to pay to achieve it."

It is true that if we fight a war we must have a purpose, an objective, and foremost among such objectives must be a stable economy and a system of free enterprise. A system of free enterprise is dependent upon the degree to which government controls it; and the degree to which government controls free enterprise is dependent upon available resources, both human and material. The less there is, the more government must control, in order to allocate goods for the general welfare.

This is the very problem we face today. How to raise hundreds of divisions, arm Europe, build 20,000 aircraft, construct supercarriers, and still not divert industry from a free choice of what it will make and what it will charge. To a degree free enterprise remains, but armaments lag. No nation can support both full armament and unrestricted industrial enterprise in peace, or in cold war such as we have today. And it is clearly impossible to approach these national objectives if we choose uneconomical forces to deter the Soviets.

In a fighting war of global proportions it is even more difficult to reconcile certain views on military strategy with the purpose for which military strategy is created. Our witness objected to an assault upon the enemy's source of power. He recognizes as valid only precise military targets. Thus he frees Soviet industry from attack and wishes to focus our firepower upon Communist manpower armed with tanks, ships, and airplanes.

Armies, fleets, and air forces would become the things which must be destroyed, and our military forces must be built toward this end. The decision will then rest with the ablest tacticians in the field, and for the field general to win he must be supported with every ounce of industrial power. One sees war spreading to every corner of the globe, expanding in every element, until each exceeds a whole series of wars of yesterday. And while they struggle, each to master the other by superior generalship and admiralship, the gigantic industries behind them, untouched by war, continue to spew forth the means essential to the portrayal of their battle skill. The surface field of battle is thousands of miles deep and thousands of miles wide. There is ample space for maneuver, for the ebb and flow of battle. Unless a surface blitz takes place, great armies will surge back and forth like the tides. But they must be fed the munitions of war until the master tactical stroke is achieved.

Even in such a war it is impossible to reconcile the peace we wish for with the price we would have to pay.

It is quite possible that war and national objectives have become forever incompatible. Certainly a war fought after the manner of World War II is irreconcilable with a goal of postwar economic stability. But it is not the business of strategists to accept this as inevitable. On the contrary it is their business to delve deeper into the theories of war which can and do change with each new development of weapons of mass destruction. These weapons cannot be wished out of existence. They are here and developing daily. They will exert a profound influence on war, and the successful military leaders will be those who have the foresight to develop new methods for exploiting the advantages they offer.

The witness may have been right when he argued that the B-36 is too vulnerable, useless in defensive, and inadequate on the offensive. He may have been right when he argued that a supercarrier is essential for the development of naval power. But he was wrong when he argued that Soviet industry is not a legitimate military target. Unless the Soviet source of military power is crippled effectively and at the outset of war and unless our own industry is preserved, both in peace and war, the witness's fear of a pyrrhic military victory, politically and economically senseless, will come to pass.

Air War College

AIR FORCE INFORMATION AT THE GRASS ROOTS

Colonel Thor M. Smith

There is a serious Air Force need for information "outposts" in the principal metropolitan areas of the United States.

This statement is made with the full knowledge that Air Force Public Information activities are currently being curtailed because of budgetary complications. Nevertheless most civilian experts (as well as ranking Air Force officers) are frank in their opinion that the United States Air Force needs more and better information service—not less.

There are several fundamental reasons why "outposted" spokesmen for the Air Force are necessary. Primarily, public opinion forms at the grass roots level. Any subject of general interest is influenced by opinion-forming media such as newspapers, magazines, radio, motion pictures, lectures, and civic leaders in various communities. A large proportion of these centers of influence throughout the nation have no direct contact with Washington or Air Force Headquarters. Yet through them the citizens seek responsible knowledge of the Air Force which they have created and which they govern by their elected representatives to the Congress. In no small sense a public correctly informed about the capabilities of air forces and, in particular, about the capabilities of its own air force is an essential element of national air power.

Information about the Air Force is less available to the public in this respect than information about the Army and Navy. Air Force commands within the United States are established on functional lines rather than within geographic areas of responsibility. Many large Air Force installations are remote from the larger population centers, and even then are subject to different chains of command.

Editors and writers (other than those in Washington) find it difficult to establish easy and quick contact with an authoritative Air Force spokesman on broad policy matters of regional or national interest. Junior public information officers on bases tend to refer policy matters to a higher headquarters. Frequently this tendency also exists among wing commanders.

Close contact with the public (and public opinion forming media) requires a physical proximity to centers of population. The San Francisco area provides an example. Headquarters of the Sixth Army is located at the Presidio of San Francisco, and public information is the responsibility of a full colonel. Headquarters of the 12th Naval District is also in San Francisco, and public information is the responsibility of a Navy captain.

In contrast, the closest Air Force installation is Hamilton Air Force Base, twenty-five miles to the north, which houses Headquarters of Fourth Air Force and also Headquarters, Western Air Defense Command. Travis Air Force Base is forty-five miles to the east, and bases a strategic bomb wing, a reconnaissance wing, and MATS units. There is no *single* Air Force commander in the San Francisco area to whom editors and civic leaders can turn for authoritative comment or interpretation of Air Force matters. Both Hamilton and Travis are sufficiently far away from the center of population to preclude frequent and convenient access to high-ranking officers when critical problems arise concerning Air Force policy or Air Force relationships with the civilian populace.

Paul Garrett, Public Relations Director of General Motors, has said that "Public Relations is finding out what people like and doing more of it; and finding out what people dislike and doing less of it." Perhaps this is an over-simplification of a very complicated activity in human relations, but it points up a very basic distinction of sound public relations activities by an agency of the government, such as the Air Force. Properly and more exactly the responsibility of the Air Force is public *information*—the responsibility to report correctly, and as fully as the national security permits, on all its activities. Further, a much greater responsibility exists to make adequate reports to superior authority (the public) than the business objective of merely pleasing the public for business good will. When viewed in this larger sense, USAF Public Relations is falling short of its full potential in the field.

The Department of the Air Force directive on the subject of public relations sets up three objectives: (a) staff counsel, (b) Air information, (c) civil liaison. In all echelons the formal dissemination of information (that is, news releases) is more heavily stressed than the other two activities. Under "Staff Counsel," the directive states: "This aspect of the program is based on the policy that the interests, attitudes and reaction of the public will be taken into consideration in the conduct of all Air Force activities." Under "Civil Liaison," the directive further states: "This aspect of the program is based on the policy that harmonious relations with the civilian population will be maintained."

Further, the report of the President's Air Policy Commission (headed by Thomas K. Finletter, now Secretary of the Air Force) states the responsibility this way: "This Commission does not believe that we will ever have an adequate Military Establishment unless the people of the country know fully what the international military and political situation is, what kind of military force is necessary if we are to be ready for that situation, and how much it will cost to have this force. With these facts before them they may choose, with full knowledge of what they are doing, whether they will or will not pay the bill. . . . Not to tell the people the military facts they are facing would not only deny to them what they are entitled to know, but also would make it impossible to have an adequate preparedness program."

It is submitted that such a large and important mission cannot be accomplished solely out of Washington, D. C.

How, then, can these phases of Air Force Public Relations be strengthened throughout the United States?

One method would be to select and train a special group of senior officers to act as qualified Air Force spokesmen in principal metropolitan areas. Officers assigned to this special duty might be likened in importance to Air attaches at an overseas embassy. They would be special representatives of the Chief of Staff, USAF, and have direct access to both USAF Headquarters and all lower echelons within the United States.

The mission of these representatives would be two-fold. On the positive side, they would move the Air Force (its policies and its program) closer to the people. Rather than waiting for specific queries, these officers would take the initiative in a program of informing editors, writers, broadcasters, civic leaders, and others who influence and reflect public opinion. On the negative or preventive side, these same officers would be in a position to sense and understand shifts in public opinion and report any general misconception on essential matters to USAF Headquarters.

The current good faith of public opinion in the Air Force is built on a sound foundation. It has been achieved through the successful accomplishment of Air Force combat missions—World War II, the Berlin Airlift, and the Korean Campaign. On the other hand, adverse public opinion occurs from time to time, within small areas of controversy and misunderstanding, such as inter-service rivalries, air crashes, service morals, segregation, flying pay, and the behavior of uniformed personnel while off duty. These troubling conceptions, unexplained or uncorrected, can (and frequently do) build a backlog of ill will against the Air Force that may wrongly affect decisions that the public must make concerning matters more vital to the national security.

Some complications might develop in activating such a program because of the fact that the Air Force does not have enough senior officers who are qualified for public information duties. During World War II most public relations officers of high commands were AUS officers, already qualified by civilian experience. Most of them separated at war's end, and recent training in this field has largely concentrated on junior officers and enlisted men for assignment at lower echelons.

However this problem of insufficient qualified manpower is not insurmountable. Although desirable, experience in public relations need not be a requirement for duty as Special Representative or spokesman. Far more important are such personal characteristics as these: adequate educational background, adequate command or combat experience, thorough knowledge of national defense and foreign policies, intellectual and personal integrity of the highest order, personality that people respond to, combined with an ease under all normal social situations which enables articulate and persuasive address, and Air Force rank not lower than lieutenant colonel.

Selection of officers for these important assignments should be on the foregoing basis, plus the desirability of choosing those who already have a knowledge of the metropolitan area where they are to be assigned.

Following selection and assignment, this group should undergo a short training period which would include complete briefings on all National Defense and Air Force policies. It would be explained to these selected officers that their mission would be a qualitative rather than a quantitative one. As an example, the editorial attitude of a newspaper toward the Air Force is much more important than the amount of news space devoted to the Air Force by that same newspaper. Routine public information activities would remain in the hands of base and command PIO's.

Upon arrival at the assigned metropolitan area for duty, the special representative would start analyzing all elements and channels of public opinion in order to determine which ones were favorable or unfavorable to the USAF—and why. Then he would purposefully cultivate contacts with all publishers, editors, city editors, feature writers, columnists, broadcasters, lecturers, civic leaders and all others who are good channels to public opinion in the assigned area. His first call need only identify him as an *authoritative Air Force spokesman.* On succeeding calls he might give "on the record" briefings and answer specific questions. The latter is important. There are always controversial subjects regarding Air Force policy arising, and this contact would provide the opportunity for a positive and forthright statement of the Air Force position, together with a favorable atmosphere in which to clear up any misunderstanding of the specific problem of the moment.

Obviously it would also be necessary for this Special Representative to maintain close liaison with the commanders and the public information officers within the area of his responsibility. But what is more important, he would maintain constant contact with the USAF Director of Public Relations and all Special Representatives in other metropolitan areas. Conference telephone calls could be used in emergency situations.

The Air Force mission requires a relationship with the public. It is essential for the good government of the Air Force that this relationship have high-level policy guidance in many places of our broad land outside of Washington. This is one suggestion of how the job might be done.

Air War College

Air War in Korea: V

THE INSTALLATIONS SQUADRON IN KOREA

MAJOR LEONARD B. REPPERT

THE installations squadron, a new type of unit peculiar to and developed within the Air Force, is receiving its first field test in Korea. Before World War II, and within the Zone of the Interior during the war, all Air Corps construction and maintenance of real estate facilities was performed by the Army's Corps of Engineers. Construction battalions or contractors handled construction under the supervision of the district engineer organizations. Maintenance and utility operations were performed by the post engineer organizations under the direct technical supervision of Army Service Forces or the district engineer. The post engineer organization was composed largely of civilian engineers, craftsmen, and technicians and was not in any sense a field unit.

During World War II the engineer aviation battalion entered into field service for the first time. In conjunction with engineer construction battalions and engineer maintenance companies the engineer aviation battalions performed the construction and heavy maintenance work for combat zone air bases. But constant demand for new construction prohibited their use at air bases for day-to-day maintenance work. It readily became apparent that an Air Force unit in the field required an entirely different level of development and support than that required for a ground unit. Aircraft traffic surfaces require continual maintenance for sustained operations. Facilities for aircraft maintenance represent a major construction requirement. Navigation aids, flight controls, and complex communications facilities are a necessity wherever the Air Force conducts its operations. In reality even the most advanced combat air strips bear more resemblance to an established base than to a typical army combat-zone camp. Therefore early in 1945 the structure of the air service group was reorganized to include a utilities section. This section was manned and equipped to perform minimum buildings and ground maintenance, utility operation, and fire fighting. The fluid conditions of the war and the cessation of hostilities prevented adequate evaluation of this unit.

After the war the maintenance responsibilities on occupation force air bases soon exceeded the resources of the utility section personnel and equipment. And when combat units returned to the Zone of the Interior, they moved to established bases maintained by post engineer organizations. On such bases utility section personnel were assimilated by the post engineer organization, or otherwise lost identity. Thus both at home and abroad the utility section soon became obsolete.

To supplant this defunct organization, the tactical installation squadron was organized as a support element in the wing-base plan. The mission of this unit, as stated in applicable tables of organization and equipment, is to maintain and repair airfield traffic surfaces, buildings, and grounds; to operate and maintain base utilities, including field lighting; to provide structural and crash fire protection; to train auxiliary fire fighters; and to provide organizational maintenance on assigned powered ground equipment. Personnel and equipment allowances are based on this assigned mission. In actuality the functions performed by the installations squadron in Korea are more clearly described in AFR 20-42, which sets forth the organization under the command of the air installation officer. The over-all scope of its duties has been much greater than its assigned mission. Additional functions performed have been real estate procurement, management, and disposal; extensive rehabilitation, alteration, and restoration of buildings, grounds, and utilities; and new construction of buildings, ground facilities, and utilities, regardless of geographical location.

In the Korean war the type of work done at any one time was dependent upon the scope and nature of tactical operations. Initially the staging operations of tactical units were supported. During the second phase, operational facilities were provided on a rapidly growing list of advanced air fields. And at present, airdromes are being stabilized to sustain maximum operations.

During the early phase of the war individuals or small detachments from installation squadrons throughout the Far East Air Forces were ordered to Korea in support of staging operations conducted by the tactical elements of various wings. In most instances the installations detachment on any one base consisted of 10 to 25 airmen technicians with an officer or non-commissioned officer in charge. Only the minimum hand tools, trucks, and crash fire-fighting and water-purification equipment were shipped in.

At this time all flying operations were being conducted from the few sod or poorly surfaced strips which the Japanese had constructed for light airplanes. Airfield traffic surfaces and drainage systems had deteriorated and required immediate heavy maintenance, since unfavorable weather made the landing areas completely unusable.

The few Engineer Aviation units available made hasty repairs and laid pierced steel plank surfacing. These units were then diverted to the development of alternate and additional landing strips within the area held by U.N. forces. Routine airfield maintenance became the responsibility of the air installation organizations.

Shortage of equipment and military personnel made it necessary to use native labor for repair and maintenance work. Through the assistance of the Korean Military Advisory Group and local officials, thousands of local laborers were employed. The amount of construction and runway-fill materials provided by the steady procession of A-frame carriers and ox carts proved to be the deciding factor in keeping several runways operational throughout the first months of the war. With the end of the rainy season and temporary stabilization of defense lines, additional development became feasible. Minimum operational, maintenance, administrative, and housing facilities were constructed at several bases. On two principal bases the commercial electric power systems were extended and on-base primary and secondary electrical distribution systems were designed and installed. Building design in general followed standard patterns for theater of operations type building but was modified to utilize locally

Installations squadrons maintaining advanced air strips depended literally on man power. Thousands of Korean laborers filled in bomb craters and dug drainage ditches with the immemorial pick and shovel, tugged crude rollers to pack runway surfaces, smoothed off construction sites and filled in roads, put up tents, and stacked countless sandbags for fortifications and revetments. In addition to contract labor the average installations squadron was augmented by 300 to 400 South Korean laborers, craftsmen, technicians, and engineers.

available materials. A total of approximately 500,000 square feet of floor space was provided on these two bases. As a matter of interest, the cost of these buildings, including planking and electric wiring, ranged for $0.85 to $1.05 per square foot.

This construction work under primitive conditions presented many unusual and interesting problems to the installations officer. Detailed standard-construction plans were not available, nor were sufficient personnel available in surveying, design, or drafting to prepare complete plans for emergency rehabilitation or construction. A heel-mark or a stake in the ground represented the starting point for several extensive construction jobs. Paced distances lined up subsequent structures with the first one. A five-foot staff, conveniently marked at three and four feet, was in constant use by the building supervisor in laying out or checking the accuracy of concrete footings and floor plans. It was exceedingly difficult to convince experienced Korean construction supervisors that the light and quickly constructed frame-and-truss structure of theater-of-operations type buildings was preferred over the heavy post-and-stringer type normally used in Korea and throughout the Far East to withstand earthquakes and typhoons. This basic variance in design strength produced numerous other construction details which were strange to Korean personnel: windows and doors could not be framed by weight-supporting members; girts and purlins were required between studs and rafters; corner bracing, knee bracing, and diagonal bracing was necessary to insure stability. The usual rubble-base concrete with a skim coat of cement slurry used by the Koreans is fairly satisfactory for non-weight-bearing surfaces, but it was difficult to convince the workers that a compacted base and monolithic concrete floor had to be used in shop and maintenance buildings.

These are only a few of the factors which complicated construction projects that employed Korean craftsmen. Similar difficulties were experienced in plumbing and electrical work. As a result minute and constant inspection and supervision were required of installations personnel to enforce proper construction. The mission of the installations squadron, as presently established in the T/O&E, does not include adequate qualified personnel for inspection and supervision on this level. But in most units a few qualified construction supervisors were available, and by breaking down the inspection functions to specific categories it was possible to train additional supervisors.

By the time of the Inchon landing complete wing operations were being conducted from several Korean bases. Installations detachments could then be moved to Korea, and personnel and equipment were steadily increased to support increasing operations. Average squadron strength was approximately 40 per cent of T/O&E strength (60 airmen and 2 or 3 officers). Large construction programs were in progress on all bases, and the flow of critical construction materials (those materials that were not available from any source in Korea) had started. This was the air installations situation when the second phase of operations began.

WITH the rapid drive of U.N. forces northward along the east and west coasts of Korea, advance elements were more and more difficult to support. Numerous airfields and airfields sites were captured and were hastily prepared to support tactical and cargo operations. This expansion was rapid, and all possible means had to be employed to provide necessary facilities. Reconnaissance for additional airfield sites followed directly behind, and in some cases preceded, the ground advance. Army combat or construction engineers and detachments of aviation engineer units rough-graded landing areas directly behind the front. Installations squadron detachments moved forward, and in some cases completely rehabilitated landing areas, a task well beyond their resources. Installations sections were incorporated in highly mobile air base units which were to occupy and maintain advanced combat strips. Korean labor crews were utilized to the maximum and accounted for the major portion of work on several strips.

In a very short time the bulk of the close-support missions were being flown from these advanced strips. Installation effort, initially restricted to development of airfield traffic surfaces, soon had to be spread to construction or rehabilitation of supporting operational facilities. Fortunately the weather and condition of the terrain during this period were very favorable. There was very little rain, and sod strips sustained heavy operations with unusually light maintenance. In some areas the ground remained frozen for long periods. The worst conditions occurred where alternate freezing and thawing required recompaction of runway surfaces after each thaw.

By this time most installation squadrons were split among as many as four different installations: a permanent base in Japan or elsewhere in the Far East, an operational base in South Korea, and one or more combat strips nearer the front. Consequently only minimum maintenance and field-type facilities could be provided in the forward area. At one place, however, facilities were rehabilitated or constructed on a semi-permanent level. A commercial electric generating plant was repaired, and distribution lines were extended to service an operational airfield, Fifth Air Force headquarters, several Army installations, a water supply system, and some essential civilian consumers.

Operations in North Korea were complicated during the larger part of this period by the lack of a standard measure of exchange. The North Korean *Won* was scarce and was considered worthless by most local laborers and contractors. The South Korean *Won* was not authorized for use until late in November 1950. As a result most of the local material and labor was paid for from commandeered Communist government stocks of rice, millet, or other produce.

By the time of the evacuation from North Korea several completely operational fields and facilities for a combat Air Force headquarters had been constructed north of the 38th parallel. A proposed location for a combined United Nations Occupation Force Headquarters had also been rehabilitated and was ready for occupancy. Engineer troops, supplies, and equipment had been moved to operational sites to improve or construct runway facilities for all-weather operations. Fortunately, the development of operational facilities on South Korean airfields had been continued. Uninterrupted combat operations were thus sustained throughout the evacuation of North Korea.

FOLLOWING this constriction of the operational area, installations squadrons, formerly dispersed over several fields, were now concentrated on one or two airfields. The Engineer and Installations policy, based upon revised tactical plans, was to improve the airfields in South Korea to sustain the heaviest possible operations. Housing, administration facilities, operational and maintenance facilities, and utilities systems were to be developed in consonance with this stabilized phase of operations.

The first step in this development plan was the standardization of types of facilities to be provided. Buildings were designed to meet all foreseeable uses, and detailed drawings were prepared. General construction specifications were disseminated to govern quality of materials and to establish good engineering practices and methods. Preliminary master plans were then laid out. Priorities of construction were established, providing first for adequate operational facilities and then for a gradual increase in other base facilities to meet an established aggregate. Included in this aggregate are hospitals, chapels, theaters, post exchanges, clubs, recreational buildings, and all other facilities normal to the average mobilization base in the United States.

Long-range requirements for materials were compiled, and delivery was scheduled to meet the plan of gradual development. Modification of previously established standard plans and specifications was comparatively simple, as both follow closely the standard practice of theater of operations construction. One major planning revision was the use of prefabricated structures for all future housing.

As a result of this program approximately 200 standard prefabricated buildings have been or are being erected on Fifth Air Force installations in Korea. Approximately 3000 winterized tent frames have been erected. Approximately 100 portable airplane sheds have been or are being erected. These sheds are heavy steel cantilever structures 32 feet x 55 feet and are erected in line (that is, a double structure is 64 feet x 55 feet; triple 96 feet x 55 feet) to provide the size of maintenance facility desired. The equivalent of approximately 500 modified 20 x 100 feet theater-of-operations-type building have been constructed. Costs of prefabricated structures have ranged upward from $1.30 per square foot, dependent upon modification from standard design, type of prefabricated building used, and amount of plumbing or electrical installation. An average monthly expenditure of $400,000 at seven major installations indicates the extent of work. These figures exclude maintenance and operating costs. It is estimated that 2,500,000 square feet of existing structures have been repaired or remodeled to meet Air Force requirements. This work includes everything from very minor repair to increase storage space to practically rebuilding bombed-out masonry structures, installing plumbing, heating, and electrification to provide administrative space, mess halls, or billets.

Utilities construction parallels building construction. On all major bases permanent water sources have been established. Sometimes expansion and extension of existing commercial water systems in nearby towns or cities sufficed. Rivers or reservoirs have been used and wells have been dug to provide for centralized latrine and shower facilities, mess halls, hospitals, clubs, and airplane and vehicle wash racks. High initial contamination in all but a few of these systems makes the water unsuitable for many uses. Improved filtration and purification plants have been constructed on some bases. Major systems were designed and built to provide 300,000 gallons of water per day. Separate field water-purification sets provide potable water for cooking and drinking.

Maximum use has been made of any available commercial electric power sufficiently reliable to justify rehabilitation. This has entailed a study of the complete Korean electrical generating and transmission systems. Many revisions have been made in substation equipment and operating methods. Complete substations and on-base primary and secondary distribution systems have been constructed on all major bases. In some locations the source of power is as far as six miles from the base. On-base primary distribution alone often exceeds six miles of pole line.

Portable generators under continuous operation in Korea have required extremely high maintenance. Parts supply has been critical. To minimize the depreciation of this equipment, centralized generator plants have been established at the base substations, and generator output voltage has been stepped up to primary voltage for distribution, affording a much more economical utilization of generated electricity during commercial power failures. Large diesel-driven permanent power plants have been installed at several major bases, a major project in itself. Equipment cost is estimated to be in excess of $100,000. The complete unit weighs 27 tons and requires precise and detailed base preparation. Operation of these units releases critical portable generators to mobile units or units in areas not serviced by the commercial power distribution system.

Until recently all airfields in Korea were lighted at night by portable airfield lighting sets. In a region beset by ground fogs and generally unpredictable weather conditions, these low-intensity sets have not been completely satisfactory. Installation of medium or high intensity sets has been scheduled for all major airfields in Korea. Several of these sets have already been received and installed in the most critical locations.

Road construction has been a major problem in Korea and will be a continuing requirement for Air Force combat units in any active theater. The need for normal access roads, perimeter roads, and interior service roads was anticipated, and the requirement was met by Engineer and Installations units without undue difficulty. An unforeseen and much larger task was providing access roads to sites for Shoran beacon units, aircraft control and warning squadrons, and radio relay detachments. These stations must be on top of the highest mountains in their vicinity, and heavy traffic must travel the roads to them in all kinds of weather. In some of the western states of the United States a rule-of-thumb estimate for such road construction is a million dollars a mile. Several such roads have been built by the Air Force in Korea, varying in length from three to eight miles. They did not cost a million dollars a mile, but neither are they Stateside highways. These same units have presented some difficulties in housing and utility construction on their remote sites. Experience has proved that the construction and maintenance work assigned to an installations squadron in a combat zone will include one or more such off-base installations.

The accretion of attached units to a wing has also contributed to the excessive work load of its installations squadron. These units, which are not included in the T/O&E wing structure, may have a composite strength approaching that of the wing itself. They may include, but are not limited to, signal construction units, weather and Air and Airways Communications System (AACS) detachments, antiaircraft battalions, engineer battalions, air rescue units, ammunition supply squadrons, AC&W, radio relay, and Shoran beacon units, air terminal detachments, and medical evacuation platoons. Generally these units have very specific requirements for their operational facilities.

But new construction has been only one activity of the installations squadrons during the third phase, or "stabilized" period, of operations in Korea. Maintenance, utility operation, fire protection, and service functions have increased comparably.

Making every effort to comply with criteria for "austerity" construction and directives on conservation of material and resources, installation squadrons have steadily improved living conditions on all Air Force installations. Shelves, tables, clothes racks, and reading lights have appeared in living quarters. The post exchange, special services, and the Red Cross have arrived; their stocks and services have improved and their facilities expanded. Officers' quarters and operational facilities are more adequately equipped. Concrete, duck board, and even flag-stone walks have been laid.

Crews are at work twenty-four hours a day maintaining runways, taxiways, and hardstand surfaces. Airfield traffic surfaces are inspected and policed constantly to discover failures and to keep areas clear of stones, cans, paper, and other debris. Drainage ditches are kept open and runway shoulders properly shaped. Various means of dust and erosion control are being employed, including asphalting and oiling roads, seeding, and mulching ground areas and riprapping ditch, bank, or road cuts.

Utility services have improved not only by more adequate systems but by better-trained operators, more efficient use of equipment, and more adequate maintenance. Fire protection and prevention services are also greatly improved. This stabilized period has allowed time for training of Korean personnel to augment military fire-fighting personnel. Fire extinguishers, sand boxes, and water barrels are located in or near every building or other fire hazard. Area fire marshals, fire wardens, and emergency crews have been organized. At most locations full allowances under Tables of Organization and Equipment plus some Table of Allowances equipment have been received. Stability of the tactical situation has permitted increased maintenance of this equipment. During the past eight months a very active insect and rodent control program has been in effect. Dining halls, hospitals, latrines, and other buildings now have window screens. DDT treatment has been widely extended by use of hand sprayers and by fogging and spraying with both T/A ground equipment and aerial spray.

The average air installation squadron has been augmented by 300 to 400 Korean laborers, technicians, craftsmen, and engineers. During the fall of 1951 manning of the squadrons jumped from approximately 70 per cent to 100 per cent of authorized strength. All personnel, military and Korean, had learned their duties and were performing them better. Supervisors had become familiar with their responsibilities and routine assignments. The same improvement was noted among Korean contractors performing work under the supervision of the air installation officer. They had gained experience with each succeeding job. But the use of contractors has several detracting features. Besides the initial increase in cost of construction, it has become increasingly difficult to retain permanent maintenance crews. Even though work on contracted projects is sporadic, the higher wages offered by contractors have enticed skilled workmen from the installation officer's crews. In some areas an actual decrease in construction potential has resulted.

There has been considerable improvement in the engineer supply system.

which in turn has resulted in better quality construction and maintenance. Several major construction projects originally built with local materials have already required complete replacement. Locally available lumber, used throughout early construction, was uncured and of such poor grade that structures in which it was used deteriorated very rapidly. In the past few months stocks of American or Japanese construction materials have been sufficient for most building.

The conditions described in the preceding paragraphs are generally true for the installations squadrons in Korea. But same level of construction and maintenance is not possible on installations operated by non-T/O&E air base squadrons. The installations section is not as well manned or equipped as the installations squadron, nor are the other support elements, such as supply or motor vehicle maintenance, capable of the level of service achieved on a wing-base airfield. Generally bases operated by air base squadrons are considered more temporary than the major airfields, in spite of numerous examples demonstrating that they warrant a high degree of maintenance. Two such air bases are now engaged in staging operations equivalent to that of a T/O&E wing. Another base is sustaining cargo, passenger, and administrative traffic comparable in volume to that at a wing-base. Yet construction completed or in progress on these stations ranges from 30 per cent to 70 per cent of an average wing work load. The maintenance necessary on runways and other airfield traffic surfaces is essentially the same as for a one-wing base. Housing and utility maintenance varies directly with station strength. This disparity has been somewhat remedied in current T/O&E's for installations squadrons, which provide a special augmentation for sustained separate squadron operation.

The general construction and maintenance activities of the installations squadrons have been described. But a clearer view of their actual operations may be had from a breakdown of a typical squadron in Korea. The management section is authorized two officers and seven airmen and usually has two officers, ten airmen, and four Koreans. This section supervises all squadron functions, handles squadron supply and administration, initiates and follows up repair and utilities (R&U) supply and equipment requisitions, keeps all records, and submits all reports. The three additional military personnel are an R&U supply clerk, a cost clerk, and a clerk typist. The Koreans are supply helpers and clerk typists. Approximately 60 per cent of the section's work directly concerns new construction.

The Engineering section is authorized one officer and three airmen. Usually it has one officer, eleven airmen, and 24 Koreans. This section performs all surveying, design, and drafting work, estimates all projects, establishes requirements for construction materials, and conducts construction inspection. Qualified technicians from all shops and other operating sections are assigned to the section to assist in preparing design specifications and estimates of civil, standard, electrical, and plumbing portions of major projects. Korean engineers, draftsmen, surveyors, construction supervisors, and typists are employed wherever possible. Construction projects account for 85 per cent of the work of the section.

The R&U section is authorized 49 airmen and usually has 43 airmen and 100 Koreans. This section does all shop work; operates and maintains utilities, buildings, and structures; and handles any new construction not done under contract. Normally 8 to 10 airmen and 20 to 25 Koreans are on night duty as shift operators of power equipment or other utilities or for work on construction or maintenance jobs.

The roads and grounds section is authorized 28 airmen and usually has 24 airmen and 200 to 300 Koreans. This section maintains airfield traffic surfaces, drainage systems, and grounds; prepares construction sites; handles concrete or asphalt construction; and, in coordination with the heavy equipment section, makes all road repairs. Normally 4 to 6 airmen and 50 to 80 Koreans are on night duty in maintenance of airfield surfaces or construction work that is not feasible during the day. Koreans are used principally as laborers. Approximately 30 per cent of the effort of the section is devoted to construction projects.

The heavy equipment section is authorized 13 airmen and normally has 18 airmen and 8 to 10 Koreans. This section maintains and operates all heavy construction equipment, loads and transports bulk R&U materials, operates rock crushers, and furnishes sand, gravel, or fill for construction work. Koreans are employed as mechanics or laborers. Some night work is scheduled for hauling material for runway maintenance of construction work that cannot be done during the day. Approximately 50 per cent of the efforts of the section are required for new construction.

The sanitation section is authorized 7 airmen and employs 6 airmen and 20 Koreans. This section maintains and operates water purification equipment, constructs and operates the sewage disposal systems, exercises insect and rodent control, and disposes of trash and garbage. Koreans are the equipment operators and laborers. Approximately 40 per cent of the work of the section is new construction.

The fire protection and aircraft crash rescue section is authorized one officer and 38 airmen and employs one officer, 33 airmen, and 25 to 40 Koreans. These sections have been undermanned throughout the Korean campaign. It is responsible for fire protection and aircraft crash rescue, for maintenance of assigned equipment, for distribution and maintenance of first-aid fire fighting materials throughout the base, and for fire inspections. Koreans have been trained as structural fire-fighters and mechanics and also assist in maintaining first-aid fire fighting equipment. New construction has very little effect on the section's work load.

SINCE the installations squadron has been tested extensively in the field in Korea under a wide variety of conditions, some basic conclusions as to the effectiveness of its system of organization now seem evident:

(1) The Air Force must be essentially self-supporting in engineer and installations effort. This is especially true because the periods of most urgent requirement for heavy construction are the same for both the Army and the Air Force.

(2) The present aviation engineer battalions are essentially prepared to construct airfield traffic surfaces, drainage systems, and road nets. The high priority of this work does not permit dissipation of engineer effort to housing and utility construction.

(3) The installations squadron in the combat zone is both a construction and maintenance organization, with the primary responsibility for facilities, other than airfield traffic surfaces, that are required for efficient Air Force operation on combat fields. As presently manned and equipped, it is not fully capable of performing its dual mission. Maintenance functions have been curtailed in favor of construction of critical facilities. Airmen

personnel have been utilized outside their normal career fields to provide engineering, drafting, engineer supply, and clerical effort required for the large new-construction program.

(4) Installation squadron supervisors and technical personnel arriving in Korea are not adequately trained in the special functions of the squadron. High equipment depreciation, delayed or unsatisfactory construction projects, and a marginal level of maintenance all demonstrate this fact. Pronounced improvement in all installations operations has been observed after relatively short periods of on-the-job training. Levels of individual skills and supervisory capabilities also become much higher.

These deficiencies suggest that three major changes should be made in the organization and training of air installations squadrons:

(1) A technical section should be provided to handle the planning and supervision of construction. The chief of this section should be an officer qualified in architectural, electrical, or mechanical engineering. The rest of the T/O might include:

Two	55270	Building Crafts Supervisors
Two	55250	Senior Woodworkers
One	53250	Metal Processing Specialist
One	56170	Electrical and Refrigeration Supervisor
Two	56150	Senior Electricians
One	56470	Plumbing Supervisor
One	56570	Heating Supervisor
Two	56450	Senior Plumbers & Steam-fitters
One	55170	Roads and Grounds Supervisor
One	55152	Masonry and Concrete Worker
One	22250	Senior Surveyor
One	22170	Cartographic Supervisor
Two	22150	Senior Cartographic Specialists
Two	64151	Senior Organizational Supply Specialists
One	70250	Senior Clerk
One	70230	Apprentice Clerk

The technical section would provide plans, specifications, and construction drawings for rehabilitation or construction of buildings, structures, ground improvements, and utilities; would compile material lists for specific projects and long-range requirements; would supervise major construction done by local labor or contractors; and would inspect minor construction work handled by the repair and utilities section of the installation squadron. This section of the installations squadron would operate in much the same manner as the engineering section of an air force headquarters does in relation to the maintenance and repair section.

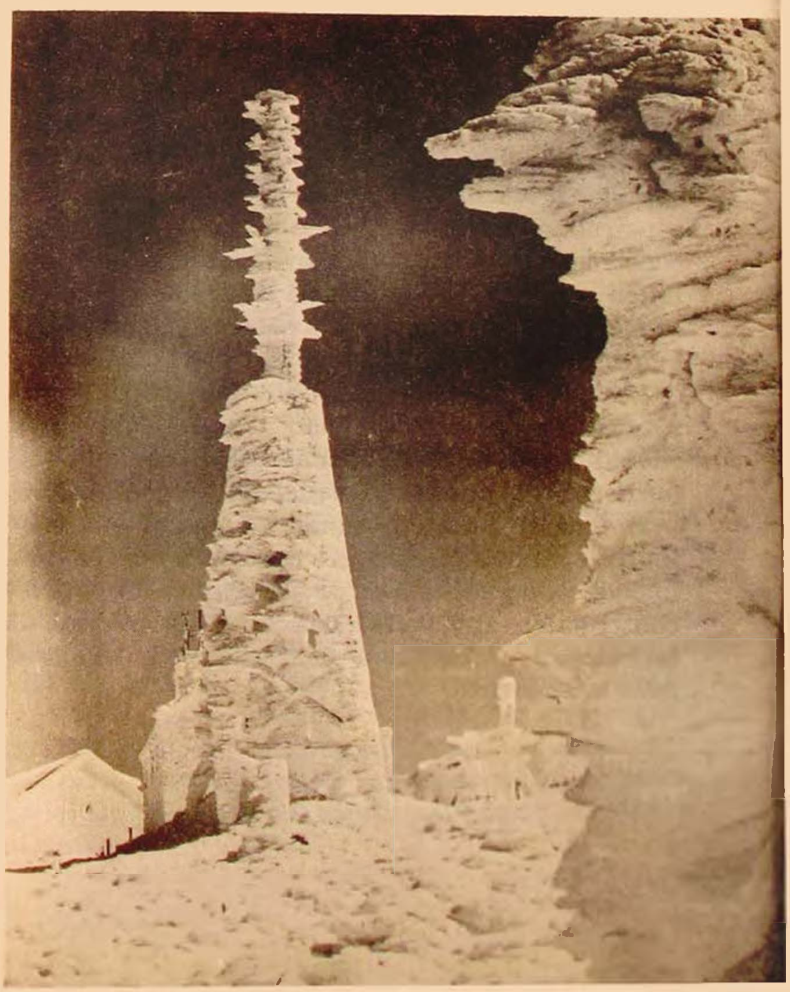
(2) Squadron-element installation units for support of staging bases or as custodians of major bases should be organized and trained. The unit should have a proportionate construction section in addition to the authorization shown in section II A of applicable T/O&E's.

(3) The installation squadron should be provided with adequate and realistic training prior to shipment to a combat zone. This training must include *supervisory responsibility* for, and *physical performance* of, the construction and maintenance of operational airfields, formal individual technical training, and field exercises which employ both T/O&E and field equipment.

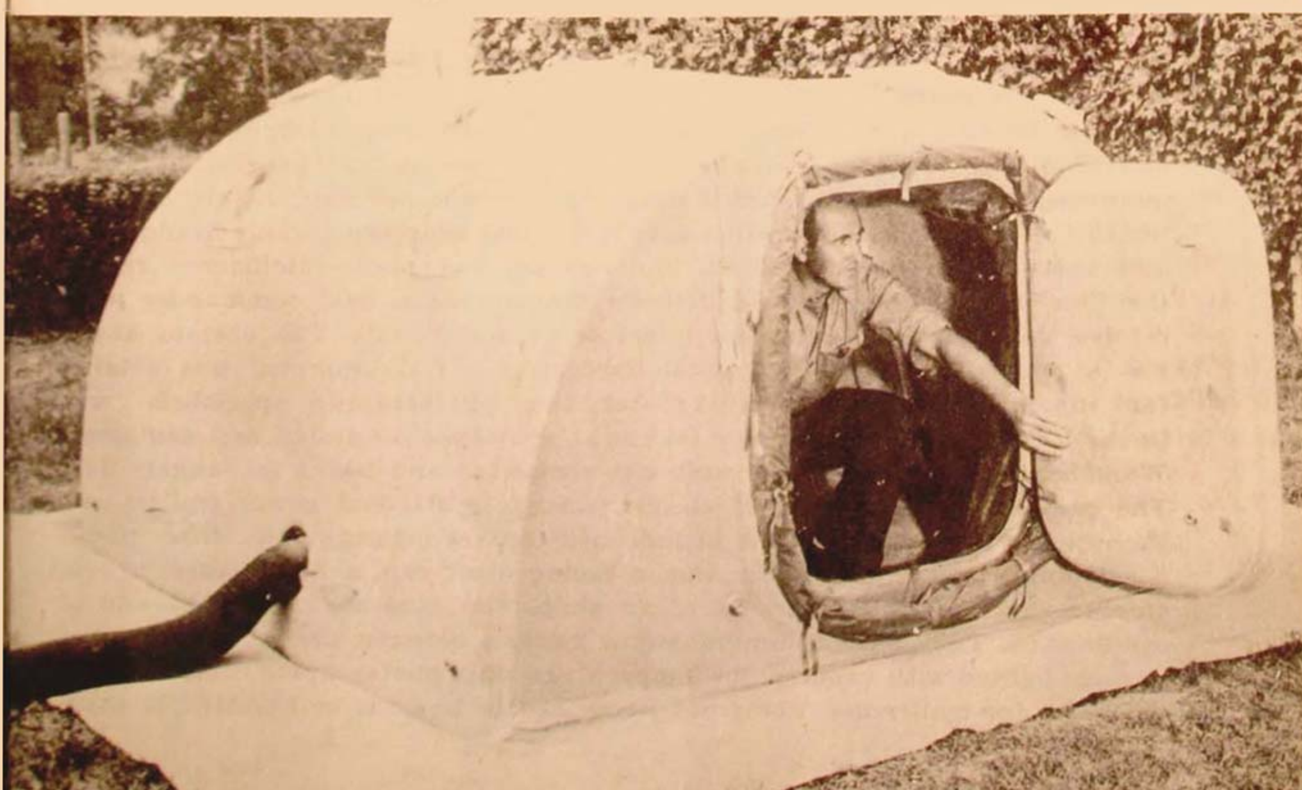
Hq. Fifth Air Force

Photo Notes

New Hampshire's Icy Mountain. *These two photographs show why Mount Washington, N. H., was chosen as the site of the joint Air Force-Navy-industry Project Summit, which seeks more effective anti-icing provisions for turbojet engines. Lying in the northeast storm track, Mount Washington lifts approaching air almost a mile high over an approach run of several miles, creating the condensation - plus - supercooling of its moisture necessary for icing and building up the high winds for which the mountain is famous. During the icing season, from mid fall until mid-April, icing conditions prevail about one dcy in four. When a freezing storm lifts, buildings are under massive frosting, and the radio tower is a giant finger of ice pointing silently toward the sky.*



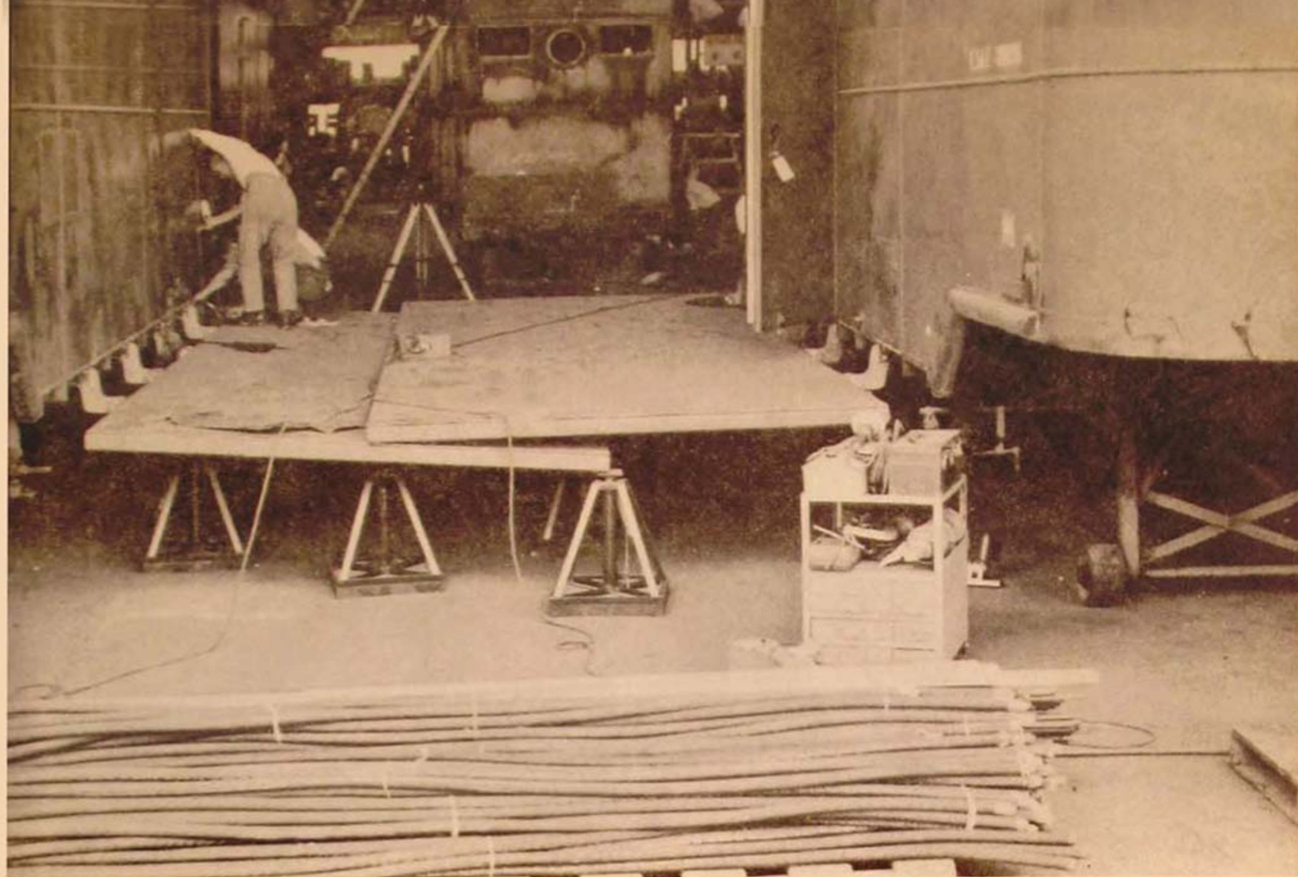
Igloo, Air Force Style. *The increasing Air Force interest in arctic and subarctic regions is reflected in the two pieces of equipment shown here. Above is one of the new ideas in heating and ventilation of subarctic housing being tested at Rapid City AFB, South Dakota. The Janitrol forced-air heating unit (center) can be mounted on either wheels or runners and will heat four huts simultaneously with fresh, warm air. For housing at small arctic stations or for emergency use, the pneumatic quonset-type hut shown below is transportable as a light, compact bundle. It can be inflated with a simple hand pump in three minutes to its full dimensions of seven-by-nine-by-four feet. The fabric walls are coated with a low-temperature neoprene compound to withstand the intense cold and to protect the four inhabitants from draft, snow, and water. The 32 pounds of air pressure within its walls will support 500 pounds of snow or ice. A ten-foot air duct (at left) provides even ventilation in a gale of 100 miles per hour, which the hut is designed to withstand. The rolled canvas around the door on either end extends to form a snug, four-foot tunnel similar to that at the entrance of an igloo.*



Sand Table, New Style. *The Mutual Defense Assistance Program (MDAP) not only furnishes our Western European allies with war materiel but operates a series of schools showing NATO personnel how to use the equipment. Here a USAF major demonstrates "let down" procedures on a scale model to four French F-84E pilots at the Allied Technical Training School in Germany, operated by the Twelfth Air Force.*

Mobile Darkroom

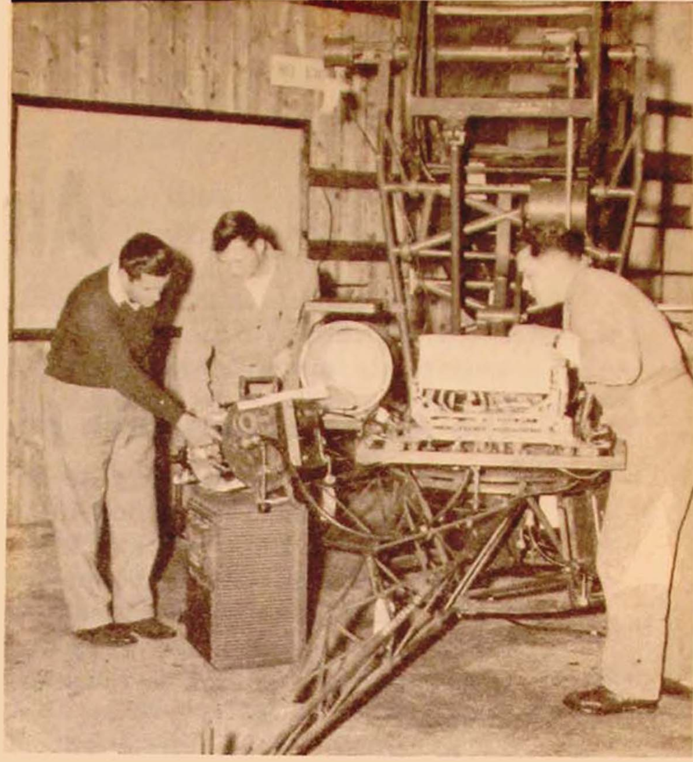
The photographic laboratory is now on the move. The necessity for mobile darkroom facilities was evident in the Second World War, but the fluidity of the Korean war greatly underscored the need. The standard photographic laboratory contains bulky yet sensitive equipment, much of which was put out of order by each move. Moving was slow and laborious. When the photo unit arrived at an advanced base, it required permanent-type housing and large quantities of filtered water. Yet if the laboratory was not near the airfields from which the reconnaissance sorties were flown and near the various headquarters and units which needed prints, photo-maps, and photo-intelligence reports, the time lost on both ends in delivery meant that a field commander would receive the materials he needed hours or even days late. The obvious answer was a mobile, self-contained photo laboratory. FEAF approval was obtained for the project in May 1951, and two photographic specialists went to the FEAMCOM shops to give technical assistance on design and equipment. Work began in June, and the unit was completed and tested in January 1952. The complete unit consists of eleven vans, four flat-bed power trailers, and three water tankers. The vans include two contact printing vans, three photo-developing vans, a photo-color van, a Sonne print van, a film library, a print storage van, and an instrument repair shop. The vans are light-tight and air conditioned. They have communications systems between the laboratory rooms and are lighted with vapor-proof lamps. Since most photographic equipment was too bulky for trailer use, numerous items had to be built in FEAMCOM shops.



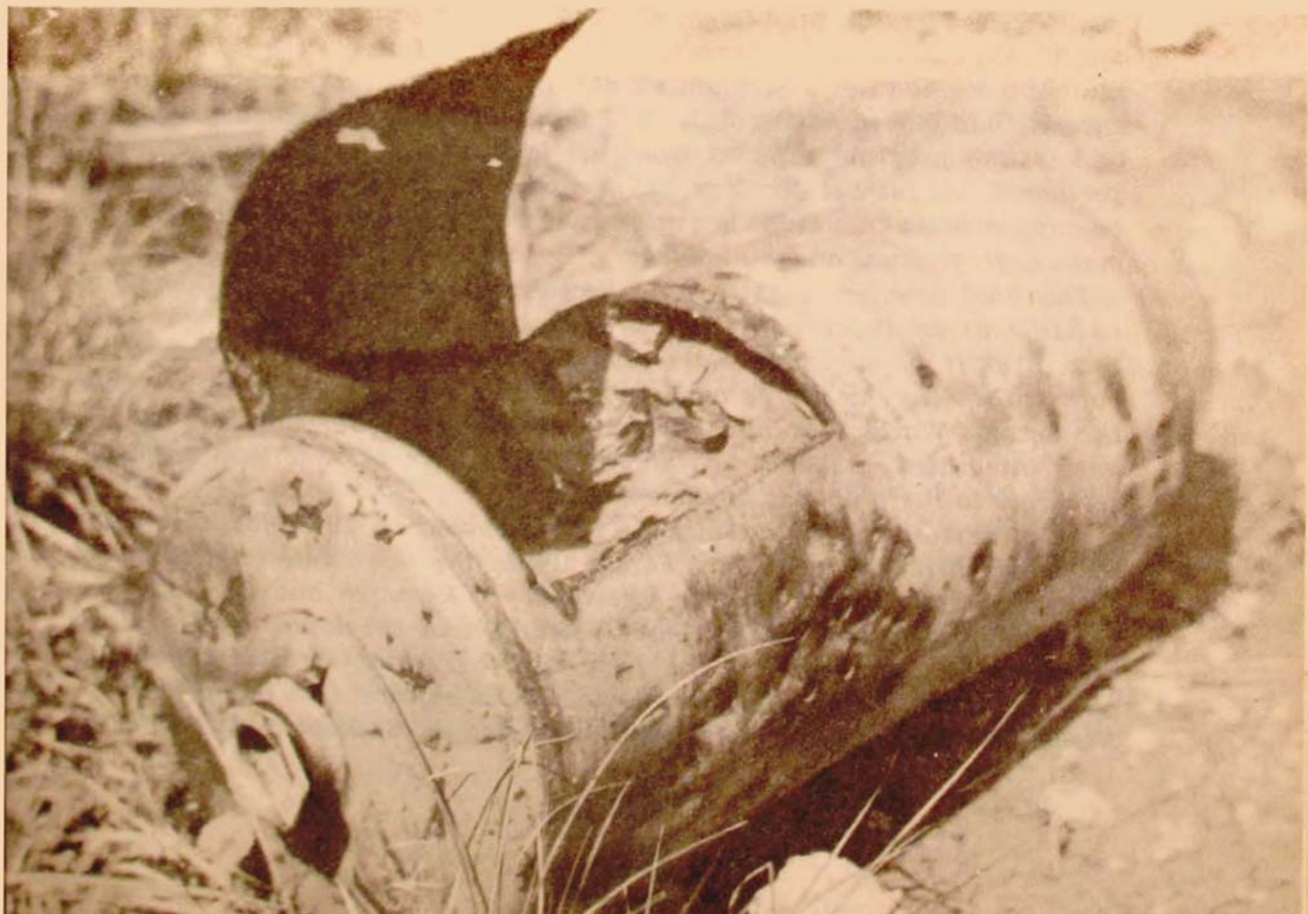
'our vans of the mobile photographic laboratory are fitted out in FEAMCOM's in-ustrial shops in Japan. The platform which folds down from the side provides each an with 300 square feet of additional work space. The platforms caused one of the roblems solved by the industrial shops. Steel was too heavy, and normal aluminum ould not bear the stress, so the heat-treat shop had to produce a special aluminum. Below is the interior of one of the contact printing vans. The copious supply of fresh, ltered water essential to the photographic process is supplied by converted F-1A air-raft refueling tankers which have been equipped with self-cleaning charcoal filters.

Camouflage. *In a desperate attempt to preserve the remnants of North Korean railroads, the Communists have recently made crude attempts at camouflage. At the left above, a bombed-out trestle is being repaired. Straw has been scattered on the near end of the trestle to give the appearance of a hole, and repair materials have been strewn in the ditch to resemble wreckage. The arrows in the low oblique (right) mark patches of straw placed on the track to look like a string of bomb craters. This line was formerly double-tracked.*

Electronics Courses. *An instructor shows two airmen students how to use height-finding radar at the FEAF Consolidated Technical School in Japan. Some 160 students from all over the Pacific take courses in radar—covering navigational aids, bombing devices, gunsights, and air defense warning—or various communications subjects. Students are mostly apprentice electronic mechanics or, in some courses, basic airmen who can pass the aptitude tests. Courses include lectures, theory, and laboratory classes.*



Fisherman's Luck. *This despoiled depth bomb demonstrates the need for constant vigilance and rigid security measures in all overseas ammunition dumps, even those well in the rear areas. Undeterred by the fact that the bomb was stored in the midst of a large USAF ammunition dump on Okinawa, natives cut open the bomb with a hammer and cold chisel and stole the explosive charge—presumably to use it in dynamiting fish. Not long after this picture was taken, other Okinawans were not so lucky. They were engaged in sawing open a 4000-pound bomb when it exploded and killed the lot of them. Had it not been a low-order detonation which the revetment could contain, such an explosion might have set off the entire dump, causing the loss of hundreds of thousands of dollars in explosives and endangering property and personnel.*



. . . Air Force Review

The Air Force Research and Development Command

The struggle for military technological superiority has been greatly intensified in the years since 1945. The Air Force has been particularly concerned with three new and tremendously complicated fields of research and development—atomic power, jet and rocket propulsion, and the guided missile. Each of these posed many problems to be solved before they reach the efficient weapon stage. They were, in addition, changes so fundamental that they have caused a revolution in the design and construction of aircraft.

The size of the research and development task confronting the Air Force and the seemingly endless ramifications which were bound to result from progress in these new fields made imperative a concentration of the sprawling Air Force research, development, and testing facilities into one command—first, to focus and coordinate the increasingly diverse activities and, second, to make certain that the needs of the present would not swallow up the research and development that should be devoted to the quality of future Air Force weapons and materiel.

ORIGINS

The Second World War taught the United States Air Force many lessons. As important as any was the sober fact that although we won the war by quantity and quality production of existing types of weapons, our enemies might soon have seriously threatened us with new types which we could not match, if we had not won when we did. In jet propulsion and guided missiles, we had lagged dangerously far behind. Not only had our development and testing program suffered from the lack of necessary equipment and personnel, but further development in certain fields was seriously hampered by gaps in basic knowledge in various phases of physics, chemistry, mathematics, geophysics, and metallurgy.

The final emergence of the Air Research and Development Command (ARDC) as an independent major command on 2 April 1951 was more than a shift in organizational responsibility. It reflected the conviction both within the Air Force and among prominent civilian scientists that the Second World War had demonstrated the need for broader, deeper, more integrated, and more continuing application of American scientific resources to the problems of the Air Force.

When research and development was surveyed in 1948, facilities were scattered throughout the Air Force. While the Air Materiel Command (AMC) had control, through its Directorate of Research and Development, of the main functions of Air Force research and development, a number of major facilities, such as the Long Range Proving Ground Command and the Arnold Engineering Development Center, operated independently. Numerous other staff agencies were interested in, and some were directly *charged with, research and development in their fields—the Special Assistant for Atomic Energy, the Special Assistant for Guided Missiles, and the Comptroller, among other*

In the light of these preliminary surveys the Chief of Staff requested the Air Force's Scientific Advisory Board to appoint a special committee to survey the Air Force research and development program and recommend its proper scope, emphasis, and organization. In September 1949 the committee submitted the Ridenour Report (named for the committee chairman, Dr. Louis N. Ridenour), which found the Air Force program antiquated in its methods, incomplete in its coverage, and failing badly to get the best use of university and industry scientists. This report and the Air University Report, made separately at about the same time, recommended the establishment of an independent research and development command.

Acting on this advice, General Vandenberg authorized on 23 January 1950 the activation of the Air Research and Development Command, with headquarters in Washington. Major General David M. Schlatter was assigned as its first commanding general. From 23 January 1940 until 2 April 1951, the command was engaged in the delicate process of defining its position in many fields, and in taking over the various independent development facilities and those of the Air Materiel Command without disrupting the scientific work in progress.

In November 1950 the headquarters was moved to Wright-Patterson Air Force Base, Ohio, to be assigned temporarily to the Air Materiel Command for organization and manning. Among the many problems of precise relationship between AMC and ARDC was the concept of "cradle to the grave" responsibility for research and development. Although a number of particulars remain to be ironed out, ARDC responsibility for an item of equipment now will not end with its production. Improvement and major modification will be under its jurisdiction as long as the item remains in use.

By 2 April 1951 the Air Research and Development Command had assumed the status of a major independent command, with headquarters at Baltimore, Maryland. Lt. General Earle E. Partridge was appointed commanding general of the new organization on 24 June 1951.

Present Organization

To the usual command components ARDC'S headquarters organization adds two staff sections with specialized functions and direct responsibility to the commanding general.

1. The Assistant for Operational Readiness has the job of maintaining USAF materiel and methods at the highest level of efficiency. To formulate a program that is a practical blend of field requirements and promising technical developments, he has deputies for Air Defense, MATS, Strategic Air, Tactical Air, Training, and special activities. These deputies work closely with their respective Air Force agencies to improve the current and future capabilities of the major air commands.

Keeping abreast of plans and programs of the Department of Defense down to and including major commands, the A/OR also supervises the preparation of periodic studies of the impact of air technology on military planning. His other responsibilities include guiding research and development for the improvement of operational systems; monitoring systems organization and research and development contracts pertaining to systems; and developing systematic use of military, scientific, and technical intelligence and new discoveries concerning combat systems.

2. The Chief of the Office of Scientific Research is charged with basic research in scientific fields of interest to the Air Force, together with furthering an understanding of the value of basic research to the Air Force.

Some Definitions

Basic Research may fall into the categories of

Fundamental Research. Theoretical analysis, exploration, or experimentation directed to the extension of knowledge of the general principles governing natural or social phenomena.

Background Research. The systematic observation, collection, organization, and presentation of facts, using known principles to reach objectives that are clearly defined before the research is undertaken. Its purpose is to provide a foundation for subsequent research or to provide standard reference data.

Applied Research is the extension of basic research to the determination of generally accepted principles, with a view to specific application, generally involving the devising of a specified novel product, process, technique, or device.

Development is the adaptation of research findings to experimental, demonstration, or clinical purposes, including the experimental production and testing of models, devices, equipment, materials, procedures, and processes.

Developmental Research is related to work on an existing model, device, equipment, material, or product process. Developmental research differs from applied research in that the work is done on products, processes, techniques, or devices that have previously been discovered or invented.

—From the Steelman Report (27 August 1947), an early study of Air Force problems in research and development.

He surveys, contracts for, and monitors basic research in chemistry (including combustion, fuels, lubricants, elastomers, transparent materials, photographic chemistry, propellants, and adhesion), physics (a program still in its early stages), fluid mechanics (a long-range program of investigations in basic aerodynamics, with emphasis on supersonic and hypersonic problems, and in boundary-layer control), mathematics (a search for new mathematical and statistical methods relating to Air Force needs), metallurgy and solid state physics (a systematic study of the entire field of metallurgy and solid state physics to aid development in metallurgy and electrical and mechanical engineering), the bio-sciences and geo-sciences (a modest program is planned for basic research in biology, psychology, and earth sciences, including atmospheric sciences). Some of this research work is done in the ARDC research centers; most of it is contracted to universities, research foundations, and other nonprofit organizations. Research proposals are welcomed from such institutions, and both graduate and nonprogrammatic research are sponsored. Another A/OR function that will increase in importance is supervision and encouragement of the exchange of information between Air Force scientists and those of the other services and of civilian institutions. A Western regional office has recently been established in Pasadena, California, to monitor the program in that area and to maintain liaison with West Coast scientific interests.

The Research, Development, and Testing Program

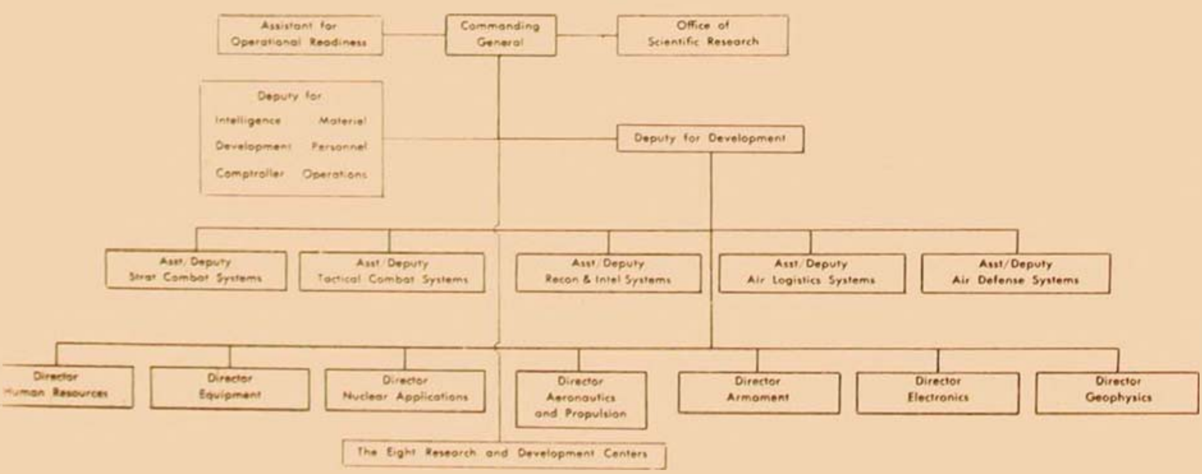
As would be expected in a command with ARDC's mission, the Deputy for Development at Headquarters, ARDC, has jurisdiction over the heart of the command responsibility.

A research project usually originates in one of three ways:

(1) One of the operational commands, or even an individual within a command, may submit a requirement for a particular piece of "hardware," research data, or system to fit the specifications of a certain segment of a mission. This request is channeled through USAF Headquarters to the Deputy for Development, ARDC.

(2) A requirement may originate in ARDC itself, as an offshoot of some other project, or simply by virtue of ARDC's ability to see the field as a whole.

(3) The requirement may originate in Headquarters USAF and then be sent to ARDC. At ARDC special assistant deputies for air defense, tactical combat, strategic combat, reconnaissance and intelligence, and air logistics consider requests in relation to the complete weapons system and to future requirements. Then the project goes to the interested directorate, where it is budgeted, assigned a priority, and sent to the appropriate center. At the center it is technically evaluated and broken down into its com-



ponents. Components that cannot be handled efficiently or economically in the centers are let on contract to universities, research foundations, or industrial firms for specialized development.

The ARDC technical directorate having primary interest in a project then monitors its progress and reports on the feasibility of the stated requirements from the standpoints of science, money involved, and time required for completion. If, as a result of the report, changes are made in the original requirements, the directorate channels these. At the same time it works with the other directorates on aspects of the project which may call for new information, techniques, or equipment in their fields. Certain fields of research and development which cut across the board of directorates, such as guided missiles, are parceled out among the assistant deputies concerned. Thus ground-to-air guided missiles would be under Air Defense Command, air-to-air missiles under Strategic Air Command, Tactical Air Command, and Air Defense Command, etc.

The actual research, development, and testing operations are carried on in the eight research centers under the command. After the appropriate Assistant Deputy for Development has received a requirement from USAF and has laid out the broad plan for its satisfaction, the directorate sets up the major projects, budgets them, and then forwards them to the interested centers. For a new aircraft the project would go to the Wright Air Development Center for research and development and to the Air Force Flight Test Center for testing. WADC sets up the technical phases of the project and deals with the aircraft company selected to build the aircraft. The company does the designing from the detailed data formulated by WADC, lets the innumerable sub-contracts, and begins construction.

Increasingly important to the thinking on research and development in both USAF and ARDC headquarters is the "systems" approach to new developments. There is a trend toward planning an airplane, for example, with all of its various integral components in the basic design. Not only may the airframe be designed around the engine, but account may also be taken of such components as the armament complex and provisions for crew comfort and escape. The pyramiding complexity of modern aircraft has added to the urgency of an integrated design. And the consolidation and coordination of research and development now afforded by ARDC puts the Air Force for the first time in position to implement this concept. Much of the basis for weapon-systems approach is already present in ARDC headquarters. The Assistant Deputies for Development can monitor the development of an aircraft from the over-all viewpoint of a weapons system and insure that the seven technical directorates work closely together.

Directorate of Aeronautics and Propulsion

Aerodynamics		**Structural Innovations**
Airframe		**Landing Gear**
	Engines	

The two main divisions of the Directorate of Aeronautics and Propulsion are indicated by its title. The airplane components section has charge of all research and development for airplanes. The propulsion division concerns itself with the whole range of power plants, from reciprocating engines, to turbo-prop, to jet, to ram-jet, to rockets, to the knotty problem of how best to apply the power generated by an airborne atomic plant. The goal of propulsion research for any type of engine is to increase the power output while reducing the weight and fuel consumption of the engine. No further major improvements can be expected in the reciprocating engine, which is approaching the limits of refinement for its type. The turbo-jet remains of great promise, as does the ram-jet. At altitudes above 65,000 feet the rocket, which provides its own oxygen, may largely replace the other types. The new research and development facilities under construction at AEDC will help to answer a great Air Force need in the development of larger and more powerful engines.

The entire background of airplane development is extremely fluid. During the five years required on an average to produce an aircraft, both scientific and tactical considerations may alter many times. World events such as the Korean War may drastically alter the most basic requirements. Any program of aircraft development must have constant monitoring, cross-checking, and coordination.

Directorate of Armament

Control Systems		**Rockets**
Bombs		**Guns**
	Defensive Armament	

The Directorate of Armament offers a good example of a systems approach to one phase of the Air Force development program. Not only are aircraft weapons in the province of armament, but also the maze of devices which operate these weapons—fire-control systems, gun turrets, bombsights, radar, auto-pilots, etc. Its projects cut across the board of the centers. All except AEDC are involved. A number of universities are working on contracts involving both applied research and development. The University of Chicago, for example, is gathering information on the effectiveness of World War II guns. From that data will come estimates of the best rate of fire, muzzle velocity, size of projectile, etc.

High-speed, high-altitude bombing has greatly complicated the whole bombing problem. New, more precise auto-pilots and fire-control apparatus are needed. Our most modern bombsight is some thirty times more complicated than the one used in the Second World War. Complication is particularly acute in electronic aids which must be employed to control and aim modern aircraft armaments. As electronic systems become more complex, the number of mechanical failures must also increase unless there is sharp improvement in the reliability of every individual part. To be most efficient, how much of the system should be automatic and how much left to the operator? Here is where other elements of ARDC enter the picture. The Human Factors Directorate provides guidance on what can be expected from the individual who must operate the mechanisms. The geophysics experts find what deviations can be expected in bombing equipment because of altitude, latitude, position over land or sea, and the amount of water in the air.

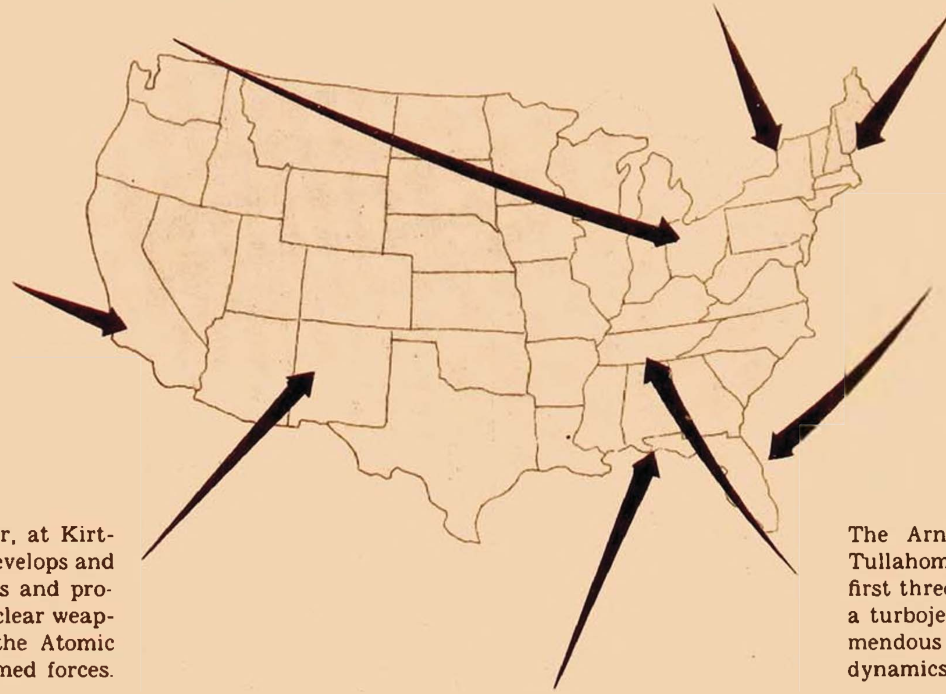
The Research and Development Centers

Wright Air Development Center, Wright-Patterson AFB, Dayton, Ohio, develops and tests aircraft, armaments, and AF materiel, and determines the general engineering standards for the Air Force.

Rome Air Development Center, Griffiss Air Force Base, Rome, New York, deals with development and testing of ground electronic equipment and of the electronic systems.

The Air Force Cambridge Research Center, Cambridge, Massachusetts, works in background and applied research in geophysics, electronics, and atomics and supports air defense research.

Air Force Flight Test Center, Edwards AFB, California, handles the bulk of Air Force flight testing of aircraft, power plants, components, and allied equipment and conducts research and development related to the tests. It also plans, controls, and operates several special test facilities.



Air Force Missile Test Center, Patrick AFB, Cocoa, Florida, develops and tests guided missiles, both at Cocoa and at its subbase, Holloman AFB, Alamogordo, New Mexico. Holloman also performs development and testing in electronics, atmospherics, and allied instruments and equipment.

The Air Force Special Weapons Center, at Kirtland AFB, Albuquerque, New Mexico, develops and tests atomic and other special weapons and provides support in the development of nuclear weapons to other governmental agencies, the Atomic Energy Commission, and the other armed forces.

The Arnold Engineering Development Center, Tullahoma, Tennessee, is now constructing its first three major aircraft test facilities. These are a turbojet and ramjet engine test facility, a tremendous propulsion wind tunnel, and a gas dynamics facility, or "hypersonic wind tunnel."

Air Force Armament Center, Eglin AFB, Florida, works on the development and testing of Air Force armament systems, including guns, turrets, control systems, and rockets. Components of the chemical armament system are also tested at Eglin.

Directorate of Electronics

Air and Ground Radar	**Special Requirements Electronics**
Communications	**Electronic Countermeasures**

Under the Directorate of Electronics, basic research, at the Cambridge Research Center, furnishes new data on such matters as the composition of the upper atmosphere and the altitude and character of the ionospheric layers which reflect radio waves of certain wave lengths. The air defense network is also studied at the Cambridge Center, as a part of Project Lincoln, a joint Air Force-Army-Navy project conducted by the Massachusetts Institute of Technology but dependent on AFCRC for support and technical assistance. The Rome Air Development Center is charged with development of ground radar and radio, and the Wright Air Development Center with airborne radar and radio.

In the air defense system efforts are being made to speed up the flow of information and reduce human error by using large automatic digital computers. Tactical Air Command needs radar for target detection, guidance, and homing. Then there are special devices such as the radar-bombing scoring system which gives the Strategic Air Command a probability score on its simulated raids on cities. Current emphasis in communications is on ultra high frequency as a part of the program converting all armed services to ultra high frequency—with the exception of components operating over long distances. In navigational aids a new development is the Omni Range Bearing Distance (ORBD), a UHF system like the radio range but with no fixed beam. The ORBD can get a fix on a radio station from any bearing and give direction and distance as well.

Long-range systems such as Loran, Whyn, and Cyclan are being developed to give extremely accurate readings—within 1000 feet at 1000 miles. Knowledge derived from these systems is being applied to bombing, and further development is programmed for self-contained systems, such as Doppler, which are not as susceptible to enemy jamming.

One of the major continuous efforts in electronics is the miniaturization of equipment. An important recent development is the transistor, a germanium droplet of great reliability which can be substituted for the vacuum tube in many of its functions.

Directorate of Equipment

Photographic Equipment	**Ground Equipment**
Materials	**Airborne Equipment**
Meteorological Equipment	**Uniforms and Personal Equipment**

The Directorate of Equipment has six divisions. The Ground Equipment Division provides support materiel for airbases (lighting, hangars, etc.) weapons, vehicles, missiles, and training equipment. Airborne Equipment is concerned with the mechanical, electrical, instrument and navigation, and airborne-training equipment which is not integral in the aircraft. Uniforms and Personal Equipment deals with clothing, rescue equipment, and miscellaneous equipment.

The Photographic Division is divided into components working on aerial photography, ground photographic and processing equipment, mapping, charting and geodesy, and general research. The Materials Division treats projects in packaging; chemicals, fuels, lubes, and paints; metallurgical research; and miscellaneous materials.

The Meteorological Division develops all meteorological equipment except those types allocated to the Air Weather Service.

The Research and Development Board of the Department of Defense has allocated primary responsibility in certain joint interests to other services. Thus the Corps of Engineers retains the responsibility for runway development and the Army for research on Arctic permafrost.

Because of its diverse activities, this directorate has been difficult to organize and some of the divisions set forth here are still in the projected stage. For the very reason that its components are so diverse, however, centralized responsibility and monitoring should do much to achieve better quality, uniformity, and economy.

Directorate of Geophysics

Atmospheric Forecasting	**Special Earth Studies**
Atmospheric Physics	**Climatology**

Geophysics is the study of the earth and its environment—the atmosphere, of primary concern to the Air Force. The chief interests of the Directorate of Geophysics are atmospheric forecasting, atmospheric physics, and the geophysical aspects of atomic, biological, and chemical warfare. The goal in atmospheric forecasting is to make accurate forecasting possible not only in the United States but for any place in the world, even in areas from which under war conditions there would be no weather data available. Atmospheric physics is investigated not only for use in weather forecasting, but for a better understanding of atmospheric effects on missiles, communications, airport location and design, etc. The in-service research and development work in this field is done at AFCRC and at AFMTC's Holloman AFB under AFCRC's direction.

A significant part of the work in geophysics comes from current operational requirements. B-36's and B-47's recently reported direct contacts with the "jet stream"—intermittent strong winds caused by a confluence of tropical and polar air in the middle latitudes at heights between 20,000 and 50,000 feet. These reports indicated the winds were much stronger than previously supposed. Projects were set up to chart the winds at that altitude. The second phase of the program intends to stay ahead of current operational requirements so that its results will be available when they are needed. Therefore the "Moby Dick" project was inaugurated to chart winds at 50,000 to 100,000 feet. For one year a constant-level, helium-filled balloon will be released each day from each of three stations. These balloons, 50 to 75 feet in diameter, will float across the country at the same level for 72 hours before they descend. Their drift will be tracked and will furnish valuable information on the direction, strength, and constancy of winds at higher levels.

Meanwhile the rocket flights undertaken for AFCRC from Holloman AFB continue to probe the atmosphere up to 70 miles, with instruments recording data on the formation of the atmosphere, the degree of ionization, temperature, etc. The Upper Air Research Observatory at Sacramento Peak, New Mexico, will aid in atmospheric forecasting by gaining data on the activity on the sun.

As for the lower atmospheric levels, work continues on such projects as atmospheric circulation, which is part of ARDC's research for the Air Weather Service. This information will also be useful in the proper exploitation of chemical, biological, and radiological weapons. Combined with the information on higher altitudes, it will also insure proper design of aircraft and missiles and their guidance systems.

Not all the work is confined to study of the atmosphere. There are projects underway on polar ice and on the newly discovered Arctic ice islands. Soundings are being taken to determine the thickness of the ice and the suitability of using the ice islands for aircraft landing fields. The surface and interior of the earth are searched for microseisms—the tiny shock waves generated in the sea by the passage of heavy storms. Triangulation of the shock waves offers an easy and economical method of locating and tracking typhoons and hurricanes. A new field of research is in the climatology of remote areas, valuable for strategic planning purposes.

Directorate of Human Factors

Human Resources	**Aero-Medical Sciences**	**Human Engineering**

The goal of all three divisions of the Directorate of Human Factors is to anticipate what a new aircraft, or job, or situation will require of the human beings it involves and to do all possible to insure that the individual and the weapons systems fit each other for maximum efficiency.

Only a small part of the total Air Force concern with the human factor belongs to the ARDC complex; five other commands operate components of the Air Force program. But within the ARDC all the centers except the Arnold Engineering Development Center and the Air Force Armament Center work on projects for the Directorate of Human Factors. In addition a considerable number of background and applied research contracts are let to universities, medical schools, and other contractors.

The Human Resources Division of the Directorate is concerned with training, selection, classification, assignment of personnel, and with psychological warfare. At all key Air Force training stations Human Resources Research laboratories analyze the training for the best means of instruction, the best types of instructors, and the best kinds of training aids. The selection and assignment sections work on such projects as the improvement of the career field programs and of efficiency reports to keep the Air Force abreast with the latest developments in psychology and sociology. The psychological warfare program has only recently begun the large-scale training of specialists in foreign languages and psychological warfare and the formation of air resupply and communications wings.*

*For an account of the AF psychological warfare program, see **Air University Quarterly Review**, V (Winter, 1951-52), 94-96.

The Human Engineering Division, representing the newest and least explored of the fields under Human Factors, is charged with devising and arranging equipment, methods, and procedures so that an operator can use them with greatest accuracy and efficiency. For example: How many instruments and controls can a man be expected to read and manipulate? Would it help him if the controls were shaped in readily identifiable ways? Are grouped dials most easily read as a unit if they are placed side by side, parallel but some distance from each other, or placed one over the other? Does a pilot scan the complex of dials as a whole or does he pause briefly on each one? To answer this latter question, films were taken of many pilots while they were flying. Contrary to the opinion of most pilots, they actually read each dial in turn. It was also found that their eyes lingered on certain dials, indicating that these were more difficult to read than some others. These dials were redesigned and regrouped. Different kinds of cockpit lighting were tried during the tests to find the one best suited to night flying.

Human Engineering also has projects in communications. How should the instructions of the ground control approach (GCA) system be worded so as to avoid any possibility of confusion or error? What sequence of information coming into an aircraft warning center will give the most speed and accuracy? How much information is really needed by each man in the chain? Is he getting more than he needs or not enough?

The aero-medical sciences are concerned with the bio-medical, physiological, and psychological reactions of the individual to the wide range of situations and factors involved in the Air Force mission. Within the Air Force the chief research and development agencies are the School of Aviation Medicine (SAM) of the Air University Command and the Aero Medical Laboratory (AML) at the Wright Air Development Center. SAM does background and applied research in the basic life sciences and clinical sciences, as they affect the Air Force. This includes studies on such subjects as hypoxia, high-altitude vision, rapid decompression, and the psycho-physiological implications of long flight. Using this information, AML develops the aero-medical protective equipment to offset man's physical limitations—equipment such as "g" suits, restraining devices, protective clothing, and escape equipment.

Specialized problems sometimes require separate research agencies. For instance the Arctic Aero Medical Laboratory, in the Alaskan Air Command, studies the effects of extreme cold on man, the selection of personnel for small, isolated arctic stations, and the psychological reaction to cold.

In the group of studies known as the clinical sciences, background and applied research in the medical and psychological specialties are of primary importance to the Air Force. Among these are the specialties involving diseases of eye, ear, nose, heart, and nervous system.

In all three of the divisions of the Directorate of Human Factors, in-service research is supplemented by a wide range of projects contracted for by universities and other civilian agencies. All these are monitored by the Directorate of Human Factors or by the research agencies under its technical control.

Directorate of Nuclear Applications

Atomic Weapon Tests	Use of Fissionable Materials
Defense Against Atomic Warfare	

The Directorate of Nuclear Applications determines the effects of atomic weapons and seeks to make Air Force personnel aware, as specifically as security will permit, of the possibilities and limitations of atomic weapons. More specifically the Directorate is responsible in three main technical areas for gathering together at one point in the Air Force all pertinent atomic information and for instigating and supervising the research and development programs necessary to fill gaps in this information. These three main areas are (1) Atomic weapons tests, including the effects of weapons tested. Such matters are included as indirect bomb damage assessment, study of the effects of atomic weapons on flying and parked aircraft, and study of their effects on buildings and structures. Information is sought both in the laboratory and in actual atomic tests. (2) Defense against atomic attack. (3) The best ways to use fissionable materials. This area involves such questions as what the energy release of bombs should be, what size and kind of targets they should be used against, and at what level the bomb should be set to explode.

The projects of the Directorate of Nuclear Applications are carried on in all the centers which work with weapons effects. WADC considers the problem from the point of view of the attacking aircraft—where it should be in the sky at the time it drops the bomb. AFCRC's Atmospheric Laboratory works on such problems as the blast effect on the atmosphere and the formation of radiological clouds. The whole Air Force program is closely coordinated with the Committee on Atomic Energy of the Research and Development Board.

One of the big jobs of the Directorate of Nuclear Applications is to disseminate the information which it acquires, not only to inform personnel who need the data in their own work but also to remedy the widespread feeling that everything connected with the atomic program is surrounded with ghostly mystery.

Throughout this discussion of ARDC's research and development program, it is apparent that in the vast majority of projects no one directorate or center functions alone. For the scattered examples of specific interactions which have been pointed out here, there are thousands of others which are implicit in the nature of the projects and the scope of the program. It is the increased unity, facility, and effectiveness which centralized command will bring to the Air Force research and development program that is the reason for the existence of ARDC.

USAF Air-Ground Operations School

In 1945 General Kurt von Rundstedt, one of Germany's outstanding commanders, stated that the greatest single factor in the German defeat in World War II was the effectiveness with which the Allies used air power.

He did not say that the quality or quantity of allied air power was greater. He attributed German defeat to the manner in which the Allies used what they had. The Allies had visualized their objectives, organized to meet those objectives, and then developed the equipment and techniques for each task. In the course of World War II, this concept for the employment of air power in concert with surface forces was developed in Africa and improved through the campaigns in Europe.

The campaigns in Korea have proved once more that despite minor deviations due to the peculiar characteristics of the Korean action the basic doctrine for the integration of air power with surface forces evolved during World War II is sound. This doctrine has been the subject of constant study and development since it was first accepted during the last war. The Korean War is serving the important purpose of giving it, in its current state of development, the most realistic adaptation that can be devised for military ideas—the test of combat. Korean operations indicate that this basic doctrine has sufficient inherent flexibility to enable it to be applied to special situations.

In the past, and particularly at the beginning of the Korean conflict, there was a woeful lack of properly trained personnel to operate the system employed in the integration of air power with the ground forces. The Army has a need for a reservoir of adequately trained personnel to operate the air-ground operations system, through which the Army's requirements for air support are presented to the Air Force. The Air Force likewise has a need for trained personnel in the tactical air operations system who are also familiar with Army requirements for air support as well as Air Force doctrine, tactics, and procedures.

What, then, is being done to ensure that the senior officers of the Air Force and the Army understand the doctrine for the integration of air power with surface forces in a military campaign? It is to fulfill this need that the Tactical Air Command is operating the USAF Air-Ground Operations School at the Highland Pines Inn in Southern Pines, North Carolina. The need for this school was vividly brought out in the early stages of the Korean War. Although Field Manual 31-35, "Air Ground Operations," was revised in 1946 and based on lessons learned in World War II, relatively few Army and Air Force personnel were familiar with its contents. Realizing that a vital need existed for such a school, Major General W. R. Wolfinbarger, then acting Commanding General of Tactical Air Commnd, instructed his Ninth Air Force to establish such a school to indoctrinate Air Force and Army commanders and staff officers in the tactics, techniques, and guiding principles of integrating air power with surface force efforts. To this school come officers of all services to learn the doctrine, techniques, and procedures of air-ground operations.

USAF AGOS was activated in September 1950 at Pope Air Force Base. The first class consisted of seventeen students. In the latter part of 1950 Headquarters USAF realized the important part this school was playing and gave it recognition as a USAF school and authorized a substantial increase in size. On 1 February 1951 the Air-Ground Operations School was placed directly under Headquarters, Tactical Air Command. Considering the number of personnel needing familiarization and training in air-ground operations, in both the Army and the Air Force, it was felt that a minimum of 120 students per week should be trained. To obtain proper accommodations, the school was moved to its present location at the Highland Pines Inn, Southern Pines, North Carolina, in June 1951. This is an interim location, as authorization to build a permanent school facility has been granted.

The Air-Ground Operations School is currently presenting three courses: the Indoctrination Course, the Specialist Course, and the Forward Air Controller Course. At the end of the first year, studies on future student potential indicate that there is a continuing requirement for approximately 5000 graduates each year.

The objective of the Indoctrination Course is to provide senior officers with a broad basic knowledge of the doctrine, techniques, and procedures by which air forces and surface forces in the combat zone accomplish joint planning and coordinate their efforts with respect to fulfilling their common mission—the defeat of the enemy armed forces. The course also explains the methods of requesting and controlling air support and the application of that operational force to the surface battle. It also covers the reconnaissance and the troop-carrier missions of tactical aviation. The duration of this course is five days.

The objective of the Specialist Course is to provide the student with a comprehensive knowledge of the subject material outlined for the Indoctrination Course, as well as to train the student to perform any special function in the tactical air operations or air-ground operations system for which he has been designated. This course is beamed primarily at the Ground Liaison Officer, G2-Air, G3-Air, S3-Air, Air Liaison Officer, Combat Intelligence Officer, Reconnaissance Specialist, and Combat Operations Officer. The duration of this course is ten days.

The objective of the Forward Air Controller Course is to provide a reservoir of Air Force pilots trained in the fundamentals of visually directing strikes against surface targets. This course is only for Air Force rated officers, whereas the other two courses are for all services. The duration of the Forward Air Controller Course is ten days, five days of which are spent in the field for practical training in the duties of the forward air controller. Emphasis is placed on the capabilities and limitations of the equipment available for visual control of air strikes, plus a basic understanding of the problems besetting the front-line commander, so that the controller can advise him on the proper employment of aircraft in a close support role. Some graduates volunteer for airborne training and are sent through the airborne training course at Fort Benning, Georgia. With this training they may enter combat with airborne units and assist them in gaining an objective by guiding aircraft to surface targets.

Instruction in the school is based on the Joint Training Directive for Air-Ground Operations published in September 1950. This directive, which represents the results of two years of intensive study and preparation, provides the needed uniformity of air-ground procedures employed in obtaining coordination so essential to close air support operations. The Joint Training Directive is based on lessons learned during World War II and subsequent developments made necessary by new weapons and equipment. The experience gained in recent field exercises and in Korea is being considered for a projected revision of the Joint Training Directive.

The procedure in the Joint Training Directive for Air-Ground Operations has been mutually agreed upon by the Office of the Chief of Army Field Forces and the Tactical Air Command. It is important that its contents are mutually accepted by staff officers of both services. The Chief of Army Field Forces has directed that the Joint Training Directive be used as a guide in all Army schools. Headquarters USAF has pronounced that it be regarded as "supplemental" to FM 31-35.

USAF AGOS is an official Air Force School; however the instructional material is jointly prepared and jointly presented. The Commandant of the School is an Air Force officer and the Deputy Commandant an Army officer. It has been stated that the school is rapidly eliminating service barriers or interservice differences that some newspaper writers have been prone to claim are a threat to our national security and effective utilization of the taxpayer's dollar. Since the students live, eat, and attend class in the same building, an incalculable benefit is derived from close association with officers of other services and the free exchange of ideas. It also provides an opportunity for the officer of one service to become acquainted with the activities of other services. They learn to know one another personally and gain much fuller realization of the need each service has for the other. This situation will enhance the teamwork between the Air Force and the Army in an enterprise of armed conflict.

The faculty consists of Air Force and Army officers who are combat seasoned. Most of the instructors have played a role in the development of the current doctrine of employment of air power in a military campaign. This is exemplified by the fact that both the Army and Air Force instructors had combat experience during World War II and many of them also in Korea. Each instructor is a specialist in his field. The Army instructors are representatives of the Office of the Chief of Army Field Forces.

The Royal Air Force and Marine Corps systems for integration of air power with ground forces are studied to allow comparison over a wide field and to give insight into the problems of integrating allied forces. An RAF officer and a Marine Corps officer are assigned to the instructive staff.

In its few months of operations the Air-Ground Operations School has turned out over three thousand graduates, including many general officers and representatives of the NATO countries.—*Hq. USAF Air-Ground Operations School*

Books and Ideas...

The Near East

PROFESSOR SYDNEY NETTLETON FISHER

SINCE the beginning of history powerful states have desired to control or at least to influence the destiny of the Near East—that region roughly bounded by the Caspian, Black, Aegean, and Mediterranean Seas, the Sahara Desert, the Arabian Sea, and the Persian Gulf. Frequently in world history the Near Eastern area has been a battleground for world power.

Throughout the nineteenth century the struggle for power in this narrow "concourse of the continents" was given the title "The Eastern Question," and at various moments it largely affected the diplomacy of the European Powers. To a considerable degree the present situation is a continuation of this problem; new factors, however, have been added in the twentieth century to alter the pattern of this struggle. The composite picture must be re-examined to obtain a reliable picture of the contemporary scene. A recent collection of essays* offers such a reassessment.

Among the more interesting of these essays is "The Pattern of Great Power Impact on the Near East," contributed by Harvey Hall. That each of the great powers desires peace and stability in the Near East and the friendship of its governments and peoples, the author accepts as axiomatic. But in seeking this goal each of the four powers—Great Britain, France, the U.S.S.R., and the United States—projects its dominant characteristics into the area: Britain, its structure of government; France, its culture; the Soviets, their attack upon the social structure; and the United States, its moral and material well-being. Mr. Hall, of course, recognizes that this is a simplification of the very diverse interests each of these powers maintains in the area. Nevertheless one must admit there is much truth in his thesis, for the diplomacy of each of the powers does follow the line the thesis proposes for it.

A better approach may be found in the essay, "The Near East between East and West," by the Honorable Charles Malik, Minister of Lebanon to the United States and Representative of Lebanon at the United Nations. After demonstrating that the Near East is neither East nor West but an area with its own identity and its own cultural pattern, Mr. Malik forcefully indicates that none of the great powers will be successful in their approaches unless its aim is accompanied by an honest acceptance of the Near Eastern people as they are, by the desire to understand them, and by friendship for them and their culture rather than merely a search for some advantage from friendly association.

In spite of the obvious truth of Mr. Malik's observations, the great pow-

***The Near East and the Great Powers, edited by Richard N. Frye (Cambridge: Harvard University Press, 1951, $3.50), pp. 214.**

ers continue to pursue their political, economic, social, and strategic aspirations. In the last generation the oil resources of the Near East have greatly sharpened the interests of the powers and raised the stakes in the game of imperialism. As the extent of the oil reserves grows more fabulous year by year, the inclination to exploit the land and its people naturally becomes more pressing. Mr. E. L. DeGolyer, in his article, "Some Aspects of Oil in the Middle East," explains some of the problems involved in the development of these oil resources. After a lucid description of the background of this development, particularly with reference to Iraq and Saudi Arabia, he sketches the present day relationships between the American oil companies with their American skilled technicians and the Near Eastern governments with their unskilled workmen. Mr. DeGolyer ably points out the difficulties arising from wage differences, housing projects, cultural barriers, royalty payments, and many other frictional situations and speculates as to their bearing on future relations. He finds hope for their amicable solution in the fact that "a half dozen or so of our greatest companies are actually sweating over difficult problems in the deserts of Arabia."

In regard to Palestine none of the three essays in the book is very significant or very satisfying. In "The Palestine Problem," Dr. Ralph Bunche briefly chronicles the official steps and actions taken by the United Nations but is so reticent with his comments that it reads like a series of restrained communiques. The other two articles are Israeli propaganda pieces.

Dr. Majid Khadduri provokes considerable thought in his study, "The Scheme of Fertile Crescent Unity: A Study in Inter-Arab Relations." At first glance, one might question the propriety of including a discussion of the age-old Arab unity question within the larger scope of this work. But Dr. Khadduri shows the effects of great power interest upon the current rivalries and disunity. His essay barely touches the Palestine question.

The greatest lacuna of the book is in regards to current activity of the U.S.S.R. in the Near East. The one short article on this subject is quite inadequate. Published before the crises arose in Iran over the Anglo-Iranian Oil Company and in Egypt over the Suez Canal and Sudan issues, the book illustrates how rapidly events are unfolding in the Near East and how quickly a book concerned with this area could become out of date. However, as the jacket of the book correctly observes, the Near East is "a critical area, rich in oil and full of political dynamite." Consequently background knowledge, deep and broad, is necessary for any understanding of the area and for amicable solution of its problems.

Because of widespread British and American ignorance about the Near East and a lack of interest or appreciation of the importance and the complexities of the area, no far-reaching or steadfast policy can be maintained by either government. Professor Gibb of Oxford University in his introduction to this book states this very clearly: "At the root of the errors of our western democratic governments lies the ignorance of the people about the Near East, and, because of this ignorance, their susceptibility to one-sided propaganda. It was because of this that the British governments of the interwar years, against the advice of the Foreign Office, adopted that shillyshallying, temporizing, and incoherent policy which ultimately not only lost for Britain the substantial object of British policy in the Near East—I mean the creation of an integrated and friendly bloc in the whole area—but also deprived her of reputation and honor. The same factors have underlain the policy and action of the United States."

Ohio State University

An Instructor-Training Handbook

LT. COLONEL HAROLD J. CATT

IN a handbook-sized volume,* Lt. Colonel Pickard (Ed. D.), Educational Adviser with the Engineer School at Ft. Belvoir, Virginia, has recorded much of the instructor training course at Belvoir. His text is intended as a guide for a formal course in instructor training, an instructor reference text, and a clear picture of the "mechanics of the processes of instruction" for military leaders.

As Colonel Pickard points out in the preface, knowledge of theory is helpful, "but it alone cannot make a teacher. Practice in teaching is necessary." An instructor's effectiveness is directly proportional to his ability to apply sound principles of education. The author has reduced all methods of instruction to two—the lecture and the conference. Either may include demonstrations and practical exercises. Five steps must be employed in the best instruction: preparation, presentation, application, examination, and critique. This book concerns itself with why and how these steps are accomplished.

With this text a training officer can organize and conduct a two-week, 65-hour instructor-training course. Each chapter (except the last) contains the basic information necessary for a one- or two-hour lecture or for conferences. Each is preceded by an outline of the period and followed by data on time and training aids required, the period objective, and references to be used by instructor and student. Recommended training films and film strips are listed. Photographs of charts, graphs, and other display-type aids are contained in the appropriate chapters. The final chapter, although written in the same style and format as the others, is directed at officials operating the school. It contains suggestions on the orientation of students, the conduct of student presentations, and the critique of these presentations. A daily schedule for a two-week course is suggested in an appendix.

A reader might question the author's statement that the chapters are arranged in "logical order." For example, Chapters 3, 5, and 12 deal with speech; Chapters 13 through 16 and 20 concern evaluation; and the widely separated Chapters 8 and 23 cover lesson planning. It may be preferable, as this arrangement infers, to schedule classroom hours on these topics over different stages of the course rather than concentrate them in one block. But this reviewer reacted as someone is reported to have said of the dictionary, "It changes the subject too often." A more nearly homogenous grouping of chapters would certainly be preferable from many points

*Edward E. Pickard, The Military Instructor (Harrisburg: Military Service Publishing Company, 1951, $2.75, paper bound), pp. 369.

of view, even though it might sacrifice the psychological unfolding and amplifying of material sought in present organization.

The psychologist might complain that the author has oversimplified educational psychology; the professor of speech might deplore the implication that speech and delivery are synonymous; the evaluation expert might bemoan the omission of certain statistical procedures. Not all materials and approaches reccmmended here are in agreement with the most recent writings and attitudes of "experts" in specific fields. Many books have been written about matters only briefly mentioned in a paragraph or two of this text. Yet although the author may not have contributed anything *new* to the field of education, he has certainly given adequate coverage to the most critical elements of the instructor's job. Considering the magnitude of the task, he has done a commendable job in reducing the volume of material on the subject into a single practical and useful book. Air Force instructors and training officers should find this a handy desk reference.

Air Command and Staff School

Psychological Effects of Bombing

Dr. Milton D. Graham

THE Air Force very early recognized the need to assess war damage to urban populations as well as to property, so that when the U.S. Strategic Bombing Survey teams evaluated the effects of air warfare in Japan and Germany they estimated psychological as well as material damage. Their findings bore out the contention that results of the application of air power are no longer strictly confined to "hardware" targets and that the effect of bombing on urban populations had to be considered too in planning of future operations.

The Air Force then set about systematically examining this new "human factor." The Strategic Bombing Survey reports were an important beginning, but their interest was extended to many kinds of data from Japan and Germany. Any study of the resistance to bombing on the part of urban populations had to emphasize psychological data and had to include Britain before any reliable generalizations could be made.

Through the RAND Corporation the Air Force invited Professor Irving L. Janis of the Department of Psychology of Yale University to consider the problem. A book, first a RAND Corporation report to the Air Force and now a general release to the public,* is the result. Professor Janis divides his problem into three phases and proceeds to examine it in a scholarly manner, devoid of the overeasy moralizing and emotional language too often employed in discussions of these controversial questions of air warfare. He examines his data thoroughly before he draws any conclusions.

In Part I he considers the psychological reactions among survivors of the A-Bombs in Hiroshima and Nagasaki. He is concerned with how the

***Irving L. Janis, Air War and Emotional Stress (New York: McGraw-Hill, 1951, $5), pp. 257.**

survivors in Hiroshima and Nagasaki felt and acted immediately after the explosion and how they reacted during the days that followed. From the many interviews of survivors, it appears quite clear that the main key to their feelings and actions was the surprise they felt and the psychological unpreparedness with which they met the bombing. In sifting out the distinctive psychological effects of the A-bombings (as distinguished from conventional bombings), every personal reaction in Hiroshima and Nagasaki points back to this unpreparedness. All semblance of social or group concern broke down for a while. "Initially each individual was totally preoccupied with the immediate danger that confronted him personally." Nearly 75 per cent of those interviewed mentioned personal injuries suffered when asked for first impressions.

In addition to the unusually high degree of personal involvement, some people exhibited nonadaptive behavior: they stared at the bomb-flash instead of shielding themselves from it or they maintained that they heard no familiar bomb roar and had not acted to protect themselves. In short they were not prepared to react properly to an A-bomb explosion.

After the concern for personal survival, the major immediate emotional impact seemed to be dictated not so much by fear of bomb flash or roar but by sight of the many dead, maimed, and mutilated. Again the survivors were not prepared for the effects of A-bombing. "The mortality rate per square mile and the total casualty rate per square mile were from 15 to 20 times greater at Hiroshima and Nagasaki than the average result of the 20th Air Force's intensive campaign against 93 Japanese cities . . . This antipersonnel feature of the atomic weapon seems to have definite psychological implications."

Immediate acute emotional disturbances were not markedly more severe than the acute anxiety and depression noted among British and German populations after severe raids of conventional bombing. Nor was there a noticeable increase of mass panic or purposeless action. Instead of individual or group panic resulting from fear, a British clinical psychologist states: "Such signs of panic as have been manifested after the heaviest attacks never assumed a serious form. The pathological reactions noted have been less due to fear than to lack of adequate social organizations." It seems to the point that the next day after the explosion in Hiroshima (pop. 245,000), 190 policemen and over 2000 Civilian Defense Corps workers reported for duty although 60 per cent of the population was estimated dead or seriously injured.

Less immediate reactions (that is, those occurring days after the explosion) also show that the A-bomb raids caused unique psychological reactions only in a few aspects. Unique perhaps was widespread sustained fear. As a Hiroshima physician testifies, "Whenever a plane was seen after that, people would rush into their shelters. They went in and out so much that they did not have time to eat. They were so nervous that they could not work." The *Enola Gay* had bequeathed them an anxious respect for a stray plane. This acute anxiety was also sustained by viewing the delayed effects of deaths by radiation. Still this anxiety (common enough in wartime) did not cause exceptional apathy or lack of cooperation among A-bomb survivors, say, more than among survivors of severe conventional bombing such as the London East Enders. Indeed, "the amount of defeatism

Part II of Professor Janis' study deals with psychological reactions to conventional bomb attacks, repeating most of the analysis of reactions to at Hiroshima and Nagasaki was less than in other Japanese cities . . . The attitudes of the A-bombed population were found to resemble those of people in the lightly bombed and unbombed cities rather than in the heavily bombed cities." As far as urban resistance to A-bomb attack is concerned, frequency of severe air attacks and lack of psychological preparedness are the negative factors that can be definitely isolated, human adaptive capacities and well-knit social organizations the positive factors. A-bomb attacks in more detail and in more technical language. The repetition is deliberate. To permit reliable generalizations, identical findings had to be made in Germany, Japan, and Britain. Also "the dominant psychological effects resulting from A-bomb disasters generally did not differ in any unique way from those produced by other types of bombing disasters."

These more inclusive findings dispel many "myths" of urban resistance to air attack. "Mental breakdown, panic and mass demoralization rarely materialized." Chronic mental disorders markedly increased only among those predisposed to psychoneuroses like phobias to loud noises, darkness, fire, and danger. Psychosomatic reactions to bombings were not numerous. Many cases of minor psychopathological shock did not reach medical attention, since recovery was relatively quick and complete. Individual and group adoptive mechanisms absorbed these minor shocks without ill effect.

While severe reactions were limited, mild reactions were widespread and often important. Children's reactions closely followed those of their parents, with the exception of the older children's acute anxiety feelings aroused by extreme destruction and danger. Consequently children were generally evacuated from much bombed cities, often splitting families as a result. Adult's neurotic tendencies and poor morale increased in direct proportion to the frequency and magnitude of air attacks and to the number of "near-misses" that they experienced. The result was much increased hostility toward their own government (which was not protecting them) and other scapegoats, increased hostility of a lesser order toward the enemy, and a general lack of cooperation caused by hostility or apathy. Those survivors experiencing "remote-misses" quickly adapted themselves to constant bombing. Acute fear reactions were mitigated considerably by augmented group identification and group cohesiveness. ("During the blitz everybody was matey' is a familiar British explanation.) Other people found their fear lessened by adopting fatalistic attitudes and religious and ritualistic beliefs.

For all the adaptiveness and defense mechanisms against fear, there was no lessening of feelings of hostility caused by deprivation. Inadequate food and sanitary facilities, breakdown of transportation and public utilities, added to lack of retaliation against the enemy and lack of warning of air attacks, caused bitter resentment against home authorities and led quickly to deterioration of morale. Equally important, "severe emotional reactions are often aggravated, and in some cases precipitated by lack of adequate social organization, e.g. delay in rescue work, disruption of social services, inadequate welfare arrangements, etc."

Part III draws the obvious moral: it can happen as disastrously here unless we are adequately prepared. We must not only make the most of the experience of the last war but we must investigate the human factor problems posed by the H-bomb, radiation poisoning, and biological warfare. Several preventative measures are possible now: "realistic education of the population to possible psychological reactions to all kinds of bombing and disasters, increased Civil Defense participation, more effective therapy for psychiatric cases and persons so predisposed, greater awareness of group identification as a major factor underlying efficient performance in the face of danger." Many more suggestions are listed without any pretense being made that the list is complete. To interpret complex human experience and to arouse awareness of possible similar experience in the future is mission enough for any book. This book ably accomplishes that mission.

Human Resources Research Institute

Phillippine-American Relations

Professor E. S. Pomeroy

SEVERAL times during the last half-century Philippine-American relations have seemed to be approaching the end of the connection that began, in effect, when Commodore Dewey and the Asiatic Squadron entered Manila Bay on 1 May 1898. The Wilson administration nearly gave up effective control over Philippine government; the Harding administration gave up the means of defending the Philippines; the F. D. Roosevelt administration specifically promised Philippine independence; and the Truman administration redeemed that promise on 4 July 1946. Only the blind or the Russophile could speak of "colonial oppression of the Philippine Islands." Yet the Philippines and the United States are more closely and effectively associated for military defense under the agreement of 14 March 1947 for American bases in the islands and the mutual defense treaty of 30 August 1951 than they were during most of the colonial period, when the United States bound itself to limit defenses to little more than they had been under Spanish rule and when Filipino leaders (as American leaders earlier) expressed confidence in Japan's intentions. With hostile and aggressive forces all along the Asiatic mainland and within the islands themselves, it seems unlikely that the United States will soon be able to write off its responsibilities in the Philippines. No other nation in eastern Asia seems more clearly committed to democracy, or more eligible for American economic and military reinforcement.

Political considerations alone probably would justify American interest in continued Philippine independence. Whether we need the Philippines economically and militarily is another question. Their trade has been of relatively slight concern to the United States as a whole, however vital to the Philippine economy and however profitable or objectionable to some specific American interests. Their long coastlines make them easy prey to invaders, as Homer Lea pointed out many years ago. During the naval limitation discussions of 1936, even after General MacArthur had gone to Manila, Army experts considered the Philippines too vulnerable to defend.

It was not until May 1941, that the Philippine Department Air Force was organized and not until November that war plans were revised to call for operations in direct defense of the Philippines as an air and naval base. The prospect then of soon being able to defend the Philippines was a major factor in our attempts to stall off the Japanese. By the end of the war, however, even though it was commonplace to speak of the Philippines as the southern anchor of our line of defense, the experts again had qualified their opinions. The war had demonstrated the possibilities of using anchorages such as Ulithi, small islands such as Saipan and Tinian. It had demonstrated also the limitations of Manila Bay. "Manila was a good base in the Nineties but is not adapted to conditions today," said Admiral Kinkaid in 1945. The agreement of 1947 called for establishments not only in the vicinity of Manila, as Fort Stotsenberg (near Clark Field) and Camp John Hay (Baguio), but in outlying areas as well; however even in 1946 the Navy, because of pressure for economy and because of the unsettled political situation in the Philippines, was reported to have recommended against developing the principal Philippine base area of Leyte-Samar. When the Communists crossed into South Korea in June 1950 the United States had kept up only four of the twenty-three bases and base sites offered at the end of the war—all of them prewar establishments near Manila, and excluding the newer and potentially more important bases at Leyte-Samar and Mariveles (Bataan Peninsula) as well as several major sites for new airbases. It is not clear whether now (when funds, but also claimants for funds, are more than they were) the Philippine political situation is more promising than in 1946. The scandals respecting the sale of Army surplus materials exposed early in 1949 reflected far-reaching political irresponsibility. The Bell report of 1950 was still more disturbing. Perhaps the most encouraging aspect of recent Philippine politics was the orderliness and honesty of the 1951 elections. Yet the Nationalist candidate, a former collaborator with the Japanese, came close to the presidency in 1949, and apparently his strength has increased since then. Likewise the Hukbalahap forces have put aside all appearance of being other than Communist (especially since the 1949 election); in 1951 they were still strong. Weaknesses in Philippine democracy probably justify American assistance and protection, but it is not yet clear how much they are compatible with the security of the islands as a permanent American base.

Grunder and Livezey, in telling the history of relations between *The Philippines and the United States*,* emphasize that "At mid-century, American policy toward the Philippines bore closer resemblance to the concepts prevailing around 1900 than at any other period of our relationship with the Islands" (p. 285). "With World War II, we had completed the circle and again viewed the Philippines somewhat as in the days following Dewey's victory, as a valuable base from which we could operate" (p. 284). The book offers little, however, on military or foreign policy affecting the Philippines. It centers around the policies of American governors-general and Congressional legislation for the Philippines. The authors note that "American policy toward the Philippines has been anomalous . . . in the sense that while we prepared them for political independence we . . . failed to take any steps toward preparing them

***The Philippines and the United States, by Garel A. Grunder and William E. Livezey (University of Oklahoma Press, $4.00), pp. 315.**

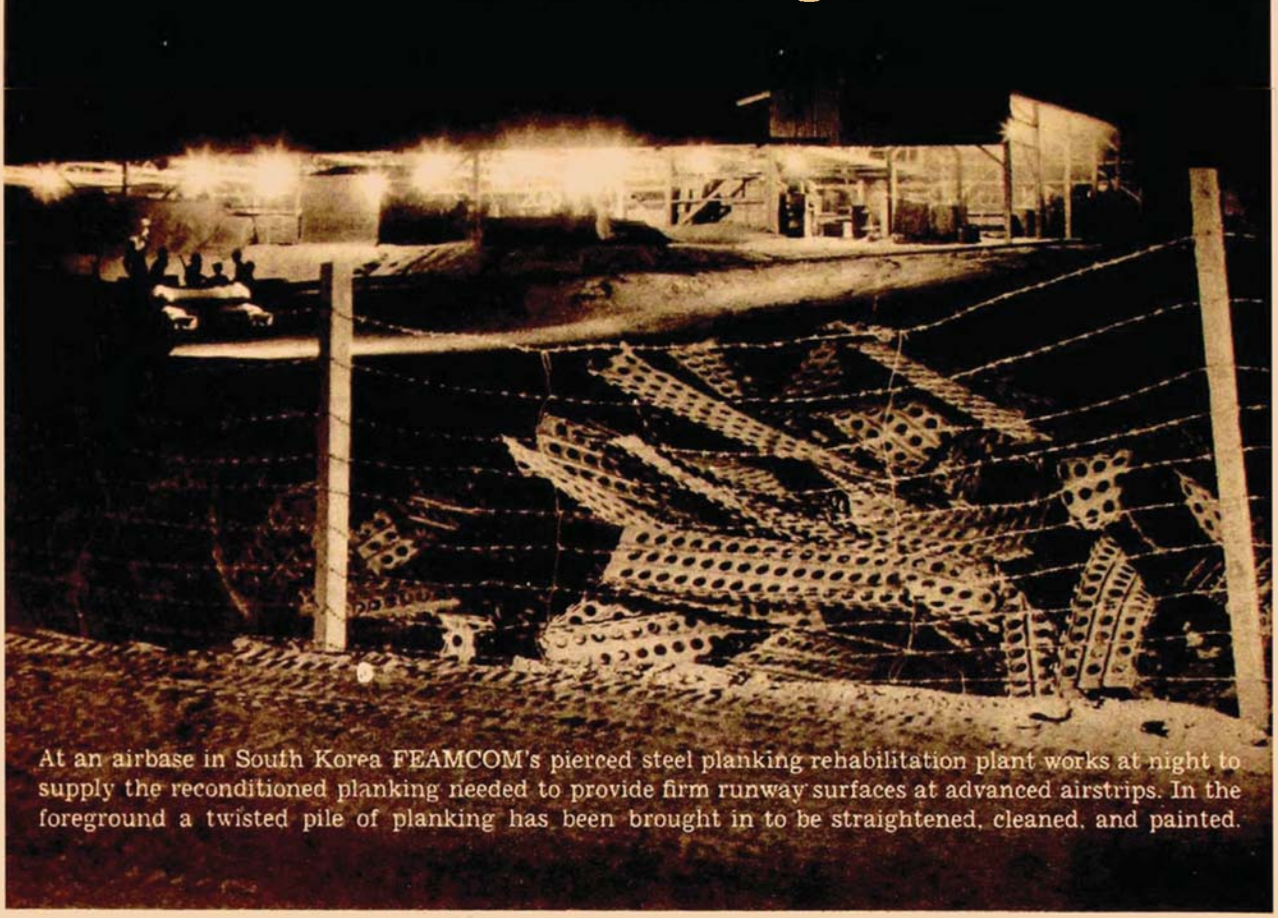
militarily for self-defense" (p. 210), but they themselves do not develop the military theme. There is a brief reference to "certain developments late in the thirties," and to "the advice of General Douglas MacArthur, son of th elder MacArthur and for a time field marshal of the Philippine Commonwealth Army" (p. 237). Uncertainty is suggested in occasional minor inaccuracies respecting military matters—the wrong date for the battle of Santiago (p. 25), the misspellings "Lingayan" and "Bantanges" (p. 240).

To this reviewer such subordination of a major theme in Philippine-American relations constitutes a defect in the book, and not merely from the point of view of readers of the *Air University Quarterly Review*. The authors say that they do not intend to discuss "our policy in operation" but rather "the origin and evolution of United States policy toward the Islands" (p. vii). This choice is reasonable enough, although others, as Julius W. Pratt, *America's Colonial Experiment* (1950), which is not cited, and Grayson L. Kirk, *Philippine Independence* (1936), have told enough on the basis of Congressional debates and reports so that probably a major contribution in this field will come only from those who go to the archives of the Department of State and the War and Navy Departments, which the present authors have not consulted. Archival materials would support not only a substantial story of "policy in operation," which is outside the plan of this volume, but also much that bears intimately on the announced themes. Even aside from unpublished materials bearing on government and on foreign policy and economic and military affairs, published hearings on military appropriation bills and the reports of the Pearl Harbor investigation would have been useful. There are no references to Homer Lea, to the *Army and Navy Journal* and other service periodicals, or to as standard a monograph as Clinard, *Japan's Influence on American Naval Power, 1897-1917* (1947).

A further defect of the book is in style, which tends to be colorless and labored. Since one of the authors has written a book on Alfred Thayer Mahan, readers may expect both some of Mahan's interest in international politics and national defense and some of Mahan's facility in expression. Yet despite some stiffness and some narrowness this book is a useful survey of American policy toward the Philippines. The authors have excavated industriously in the official record. They have weighed the evidence carefully, and their judgments are intelligent and balanced, a welcome relief from the doctrinaire pronouncements that are so prevalent respecting our colonial relations. They have much to say, especially respecting our commercial policy, which is still unfinished business, to anyone who has to deal with Philippine affairs today. And our relations with the rest of the free world are so important now that that includes most of us.

University of Oregon

Steel Planking



At an airbase in South Korea FEAMCOM's pierced steel planking rehabilitation plant works at night to supply the reconditioned planking needed to provide firm runway surfaces at advanced airstrips. In the foreground a twisted pile of planking has been brought in to be straightened, cleaned, and painted.

When the Korean war began, South Korean airstrips had no runways that could stand up under the constant pounding of combat aircraft. Fighters, tactical-control aircraft, and the heavy troop and cargo transports were forced to operate from old Japanese bases long since converted to rice-paddies and farmlands.

The heavy Korean rains turned the runways into rivers of mud. When the rainy season ended and the runways dried out, knife-like ridges of hard Korean soil edged the countless ruts. Long-buried rocks had churned to the surface.

Runway troubles were not confined to Korea. Airplanes flying men and supplies in from Japan were loaded to capacity and required more and more runway for take-off. Most runways in Japan had been reconstructed after the war and had been designed for conventional aircraft carrying minimum Air Force loads.

Some of the runways in Japan had to be lengthened, and all of those in Korea had to be reconditioned. For remedy, engineers turned to the steel runway construction materials valuable during the island-hopping days of the Pacific war. The long, perforated steel strips of pierced steel planking (PSP) could be laid down rapidly to form a runway of fairly high stability.

PSP has its disadvantages. First among them is its limited durability under the heavy weights of the cargo and bomber aircraft and the shearing caused by the high-pressure tires of the jet fighters. The planks soon warp. Sharp bayonets of steel pop up where the metal tears between perforations. Jet blast erosion corrodes its surface. It must steadily be replaced.

The Far East Air Materiel Command (FEAMCOM) surveyed the stock of PSP in Yokohama. Very little unused planking was found, but approximately 60,000 used sheets, if properly conditioned, could be reissued. FEAMCOM called on all outlying airbases in the Far East to report on all PSP on hand. A considerable amount of reparable landing mat was located and brought in for rehabilitation.

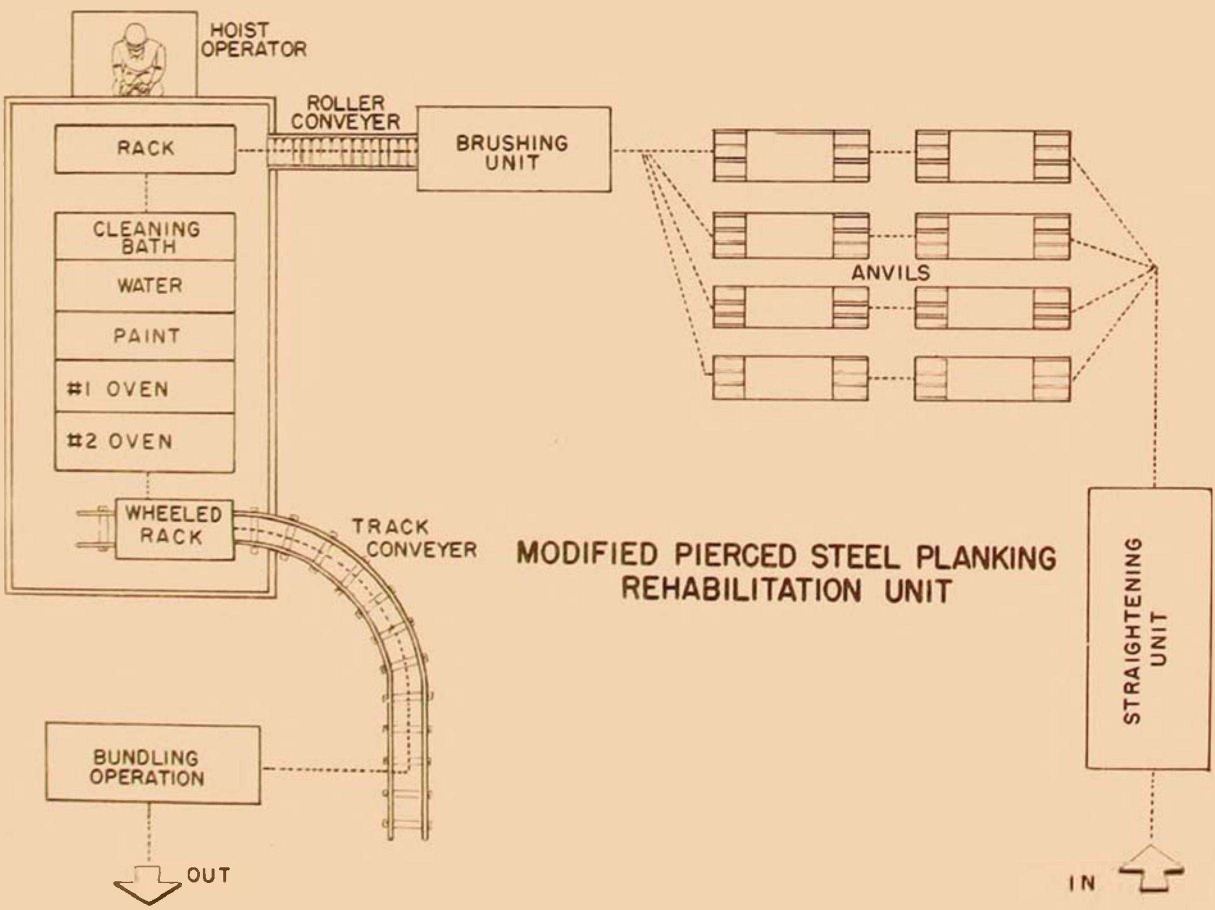
Two rehabilitation plants were set up, in Southern Korea and at FEAMCOM headquarters in Japan. These units were modifications of the standard Engineer rehabilitation plant, which had consisted of one straightening unit, one brushing unit, and one painting unit, fed by a hand-operated hoist. FEAMCOM factories turned out a new hoist made from a bomb utilities truck hoist and equipped with a gasoline engine. A roller conveyer was set up between the brushing unit and the hoist and a track conveyer, similar to a miniature railway, between the painting unit and the bundling section. The original 63-man operating crew had then shrunk to 45.

Bent and corroded planking is run through the straightening unit, where the mechanical press straightens out the more obvious malformations. Then smaller distortions are pounded out on anvils and the locking-lugs—small "L" shaped tabs which run the full length of the plank—are beaten into line. The sledges also chip off hard-caked rust before the planks reach the brushing machine.

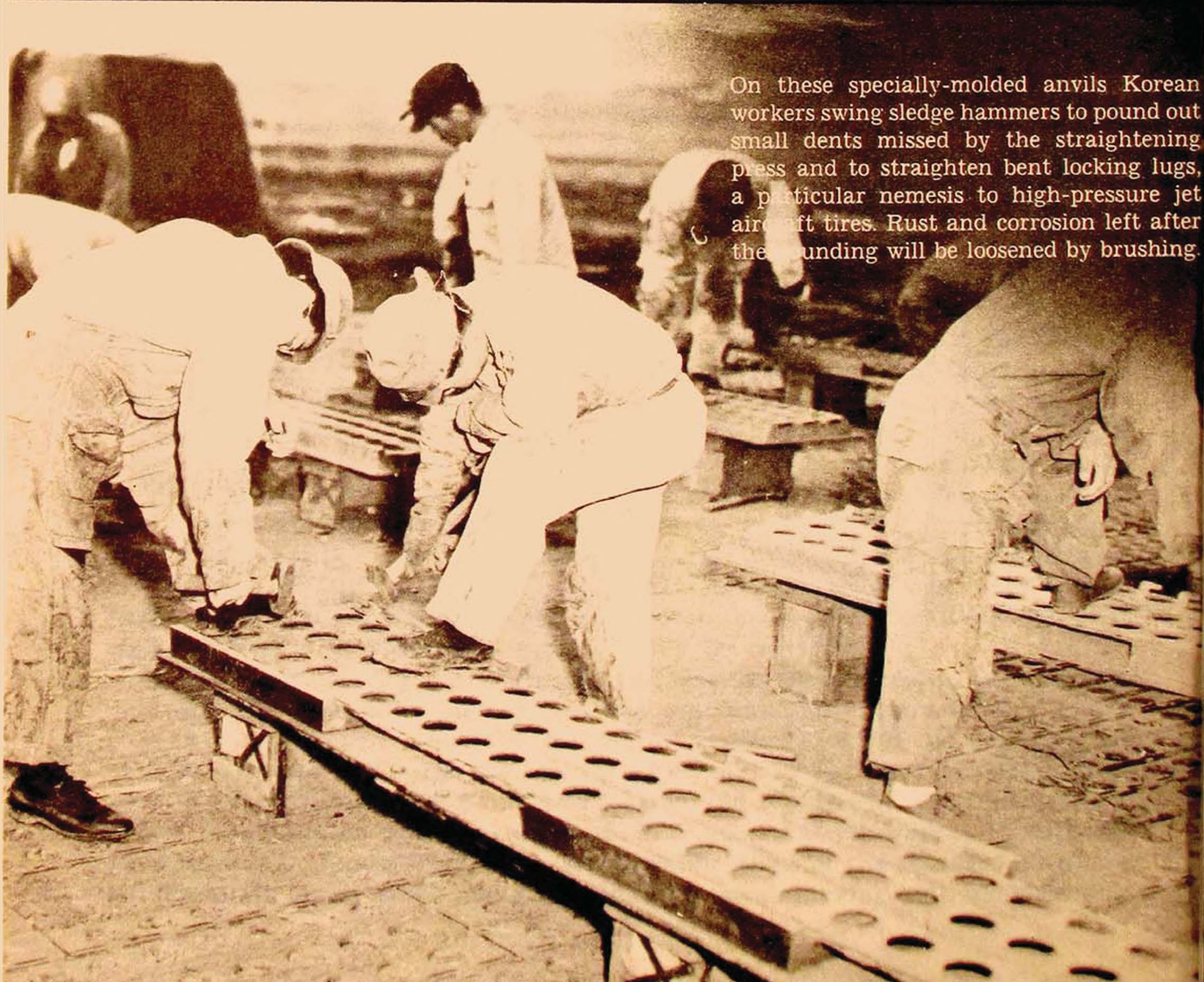
From the brushing unit the PSP travels by roller conveyer to the hoist, to be racked into bundles. The hoist carries the bundles first to the cleaning unit, where a hot bath of tri-sodium phosphate cleans off the remaining rust and dust; then to the water tank where the tri-sodium phosphate is rinsed off; then to the paint tank where the bundle is dipped, pulled out, and allowed to drain; then to the oven to dry. The two-section oven bakes the paint at 360 degrees in approximately four minutes. The track conveyer then rolls the planking to the bundling section, where two of the 15-mat sheafs are banded together. Two packages of reconditioned mat pins (containing 90 pins each) are wedged in the bundle, and the planks are ready for shipment.

Between March and October 1951 FEAMCOM plants in Japan and Korea rehabilitated more than 4,729,000 square feet of PSP. The total cost was $139,840, a net saving of $1,716,600, in this period alone, on the cost of new planking.

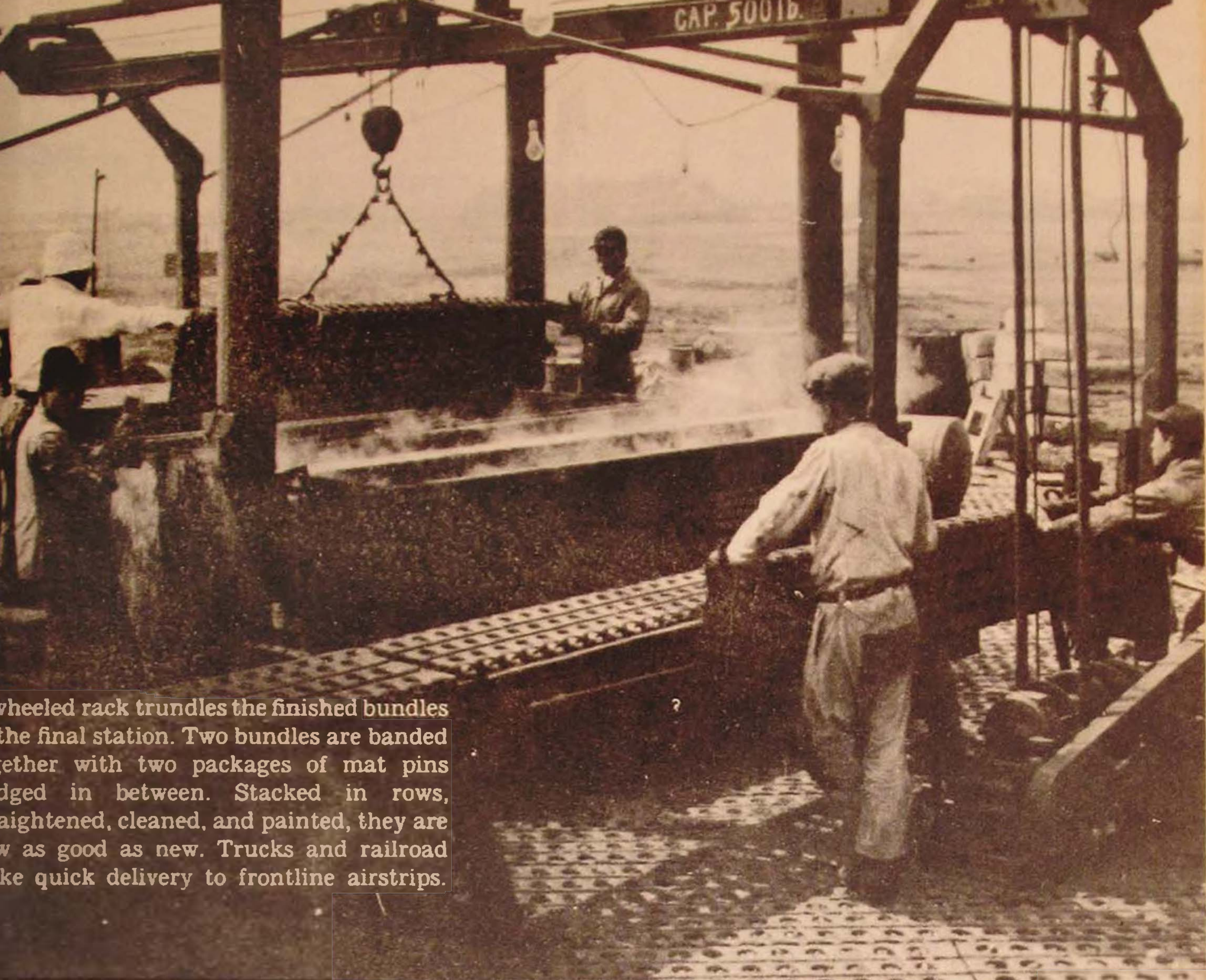
This diagram shows how the process flows at the PSP rehabilitation plant. The damaged planking enters at the straightening unit station (lower right) and emerges like new at the bundling station (lower left). A crew of 45 men operates the entire plant.



The straightening press rolls the major twists and wrinkles out of the steel planks. Requiring only two operators, the heavy press forces steel plank into alignment by one quick trip through its powerful rollers. One press keeps eight manually operated anvils busy at the next station in the line.

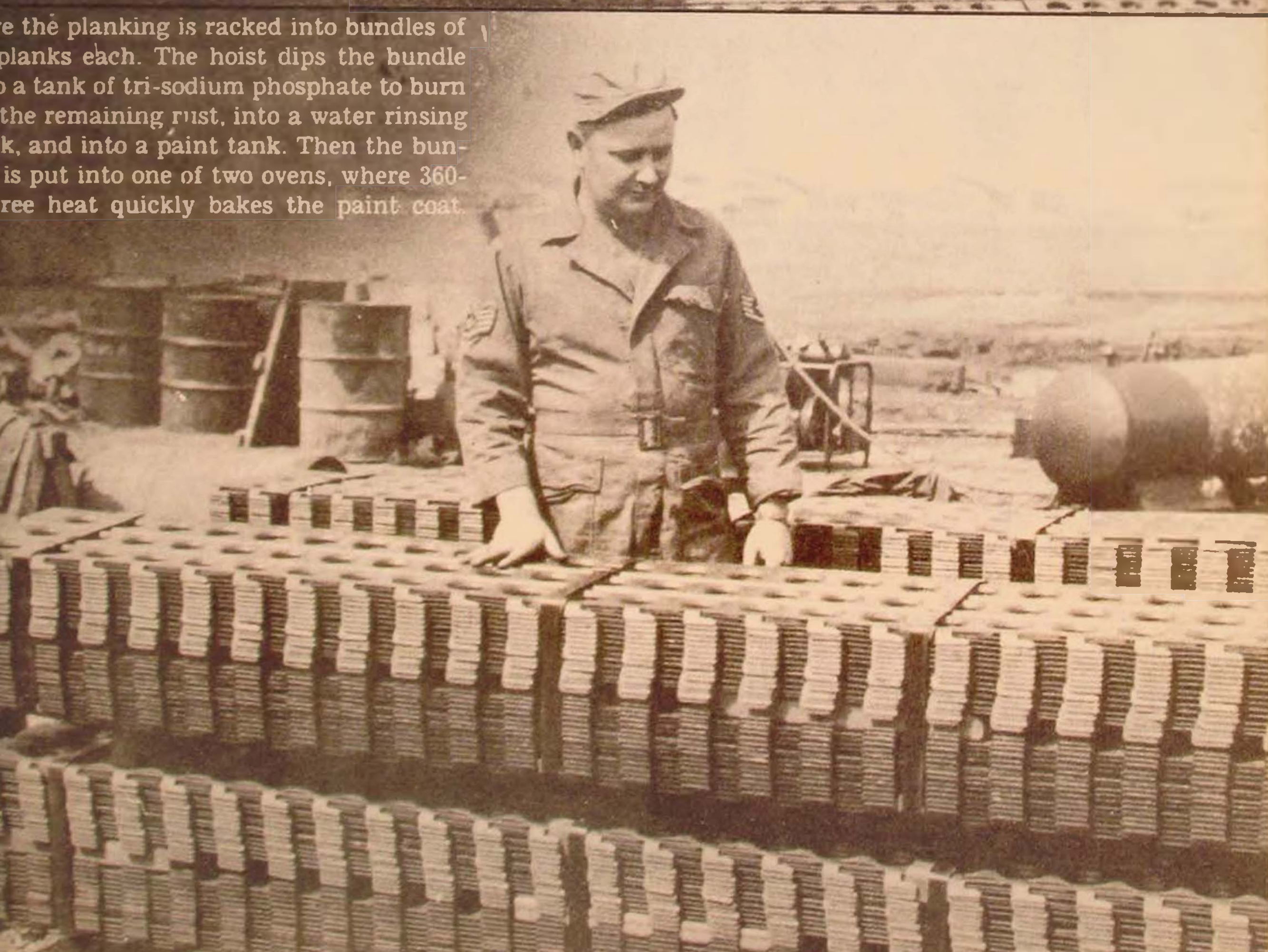


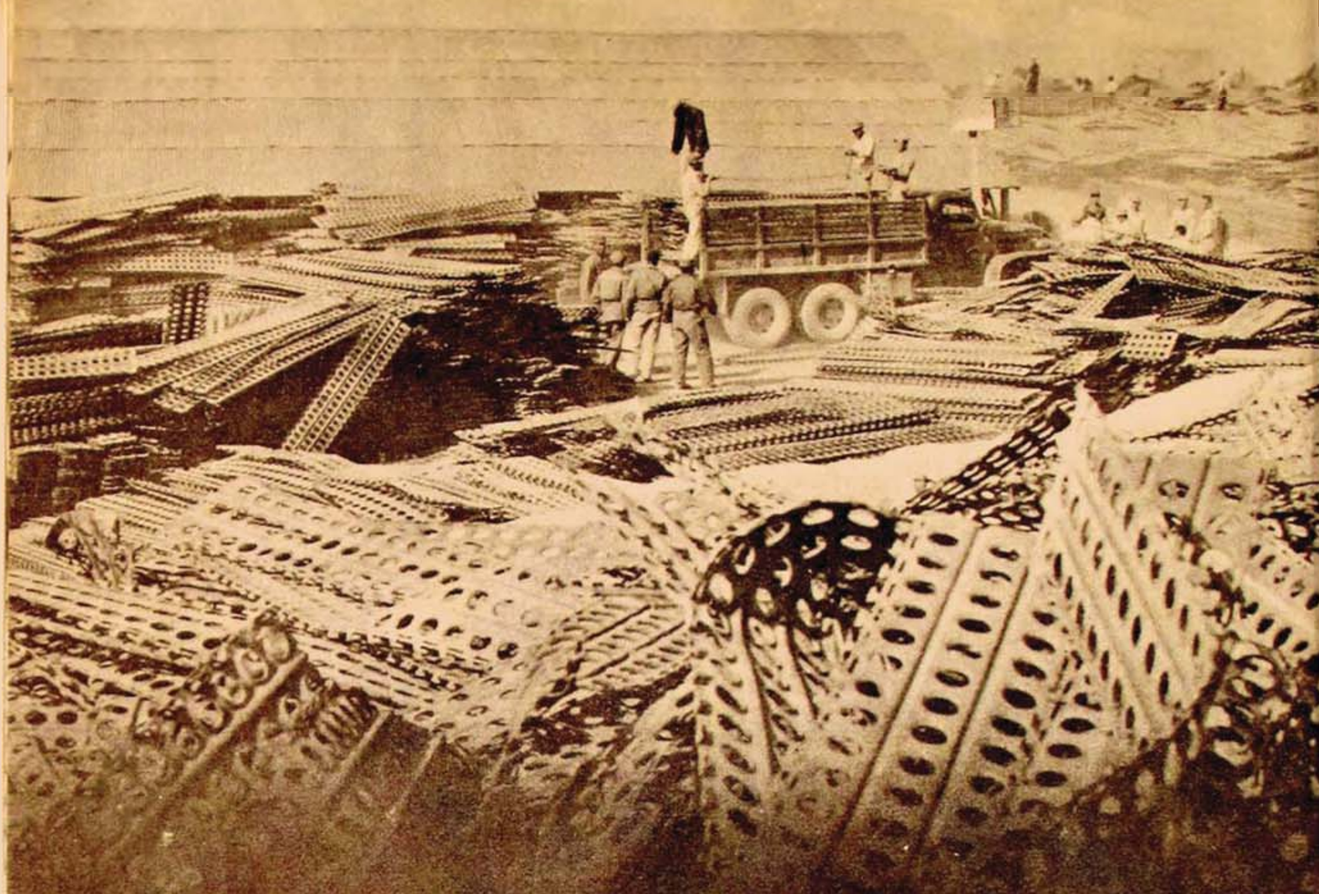
On these specially-molded anvils Korean workers swing sledge hammers to pound out small dents missed by the straightening press and to straighten bent locking lugs, a particular nemesis to high-pressure jet aircraft tires. Rust and corrosion left after the pounding will be loosened by brushing.



vheeled rack trundles the finished bundles the final station. Two bundles are banded ether with two packages of mat pins dged in between. Stacked in rows, aightened, cleaned, and painted, they are v as good as new. Trucks and railroad ke quick delivery to frontline airstrips.

e the planking is racked into bundles of planks each. The hoist dips the bundle a tank of tri-sodium phosphate to burn the remaining rust, into a water rinsing k, and into a paint tank. Then the bun- is put into one of two ovens, where 360- ree heat quickly bakes the paint coat.





Thus the mountains of twisted and rusted pierced steel planking are returned to use on advanced airstrips. Korean laborers carry the plank into position, mesh the locking-lugs with the lugs on the adjoining plank, and nail each plank down with six mat pins. Steel planking affords the quickest method of providing a reasonably stabilized runway surface. Renewing and reusing planks saves as much as nine tenths of the cost of new planking.

The Periodical Press

Theodore H. White, "Africa is Next," Harper's Magazine, February 1952, pp. 32-41.

THEODORE H. WHITE, European correspondent for *Reporter Magazine*, believes revolutionary movements in Asia have so attracted the attention of the Atlantic World that few have noticed what is rocking the African continent. Africa, he predicts, is next. The withdrawal of France is inevitable. Two great conflicts are shaping up: the first a clash between communism and democracy, the second and "perhaps the more important" the liquidation of foreign control. The method of French withdrawal from Africa may alter the course of European history for generations.

It is ironical that the problem of getting out of Africa confronts a nation already drained by years of costly fighting in Indo-China and faced with "the three archetypes of challenge the colonial world offers in this century to the men who conquered them in the last—Asian communism, Moslem nationalism, and the first stirring of the Negro peoples."

In French North Africa, the problem of political withdrawal is "urgent and immediate." It stems from the clash of French-fostered postwar industrial-economic progress, and the rise of native nationalism. Morocco Tunisia, and Algeria quiver with unrest. A tremendous increase in population, rapid urbanization, and the spread of education in Morocco is "a problem for which no solution has been advanced." Tunisia also appears troublesome for the simple reason that it is adjacent to Libya, which becomes free and independent in 1952. Algeria presents actually no serious immediate threat to the empire, for French success in Algerian colonial development has been above average. Yet stirrings of class unrest exist. The over-all demands of the North African states are many and varied, with independence the dominant theme. Underlying this theme, however, "are ripples in the single great wave of challenge which is the Moslem renaissance."

In Black Africa the word "equality" is the theme of politics. Here the French are not faced with the problem of immediate political withdrawal. Nevertheless, the question is quite complex, for perhaps "nowhere in the world is the spread between the extremes of culture so unbelievably great." The people that make up this vast area are split into dozens of hostile tribes with many diverse cultures. Three distinct problems—of education, of water, and of roads—require solution before development of the region can take place. The thirty million Negroes need far more than the existing eighty-eight secondary schools to satisfy their hunger for learning. Water dominates the Negro's entire way of life. With sufficient water starvation can be avoided; without it the grassland is turned to desert. Vast mineral deposits of incalculable value lie beneath the surface of equatorial Africa, yet they are worthless to the Negro if roadways and lines of communication do not exist.

The African Negroes seek partnership in the French Union. But the French cannot give this without solving their outstanding problems, and the badly strained French economy cannot afford schools, roads, and irrigation. U.S. capital, the author claims, provides the only key to Africa's future.

The U.S. is more deeply involved than the average American realizes. We are interested in Africa for its raw materials and the airbase locations it can offer. The Marshall Plan already has invested over a quarter of a billion dollars, touching off one of the world's most spectacular booms. Yet political agitation has increased in proportion to the progress made, due in the main to the small material benefits received by the natives. It appears to many Africans that the U.S. is supporting the French empire. In addition the educated natives dislike our handling of racial problems. Surveying the whole, the author feels we have been drawn into "a blind partnership not so much with France as with French colonial officialdom, to the exclusion of the Africans themselves. This partnership needs to be reorganized."

In reorganizing the partnership, we must continue to work with the French, who have spent years in the environment of Africa and who know the culture of that area. The inevitable political withdrawal of France can be made orderly "if the United States pays for the necessary capital investment and development to make contentment possible." If we do not help, the author prophesies that the French will be driven out of Africa. What the Africans need is a group of definite programs, with clean-cut terminal dates "at the end of which they may have autonomy, independence, or partnership on whatever terms seem fair." Coupled with this must go "equally specific programs for education and training of African personnel who will take over when the French leave."

Chester Bowles, "Ten Point Program for Asia," Foreign Policy Bulletin, February 15, 1952, pp. 1-2, 7-8.

CHESTER BOWLES, former head of OPA and present ambassador to India, believes reassessment of American foreign policy is necessary if we are to salvage Asia from Communist imperialism. The rapid build-up of NATO, he maintains, is slowly closing the European door to Soviet expansion, forcing the Kremlin to increase its activities in the Far East.

In the critical ideological struggle for Asian minds, America is handicapped by meager knowledge of Asiatic affairs and ignorance of the Asian way of thinking. This embarrassing condition, Bowles contends, stems basically from our close cultural and historical ties with European peoples and a complete lack of community of interest with the East. It has resulted, likewise, in Asian inability to fathom Western concepts and modes of thinking. In addition our failure to view revolutionary movements in Asia with complete objectivity, devoid of emotional bias, has forced us to support anti-revolutionary regimes in an area where such regimes have been thoroughly discredited. Unless Asian democracy can pass the ultimate test and raise the standard of living for millions of poverty-stricken people it has little chance of surviving. With Asia lost to Communism the balance of world strength would swing to the Kremlin.

America still has time to initiate a policy which would stem the advance of Communism in Asia and assist democracy in its uphill struggle. Such a policy, Bowles asserts, must consider ten important points:

(1) Do not allow the Presidential election in November to make us lose

sight of the need for inaugurating a positive Asian policy which men in both major parties can support.

(2) Do not become panicky, and at all cost, do not underestimate the very real advantages that are available to us in Asia.

(3) Have patience when it comes to dealing with Asian nations. Solutions to their problems are not easily found.

(4) Give the world a chance to see the real America as exemplified by Jefferson, Lincoln, and Wilson and not the shallow materialistic picture that Asians often get.

(5) Remember that the U.S. was the first colonial possession to gain freedom and disavow inperialism in any form.

(6) Don't try to cover up our record on racial prejudice. Show our advancement in racial relations.

(7) Remember that the freedom of speech and freedom of vote will be a hollow mockery unless democracy can grow more food for the teeming millions of Asia.

(8) Do not let the problem of population and food supply be discouraging.

(9) Meet the Communist threat in Asia with all our resources, but remember that communism in Asia cannot be stopped by money alone. It takes intelligence, tact, patience, and respect for the rights and convictions of others.

(10) Never proceed on a purely anticommunist basis. We must build a positive program which will successfully combat communism with better ideas.

"Latin America," Current History, March 1952.

HISTORICALLY many Latin Americans have felt ideas basic to the political system of the United States have been more often broken than observed in our foreign policy. But in spite of the ebb and flow of harmonious relations, the two areas have learned to live together more successfully than the nations of any other part of the earth.

The March issue of *Current History* is devoted to a study of political, social, and economic difficulties common to many of our southern neighbors. Contributors of the articles are authorities in Latin American history and current affairs.

Dr. Walter V. Scholes, Associate Professor of History, University of Missouri, and a member of the editorial board of the *Hispanic American Historical Review*, discusses Mexico's efforts to combat a high illiteracy rate and the concentration of land ownership in the hands of a few—two factors which it is stated have affected the political, social, and economic development of all Hispanic countries. Dr. Arthur P. Whitaker, Professor of Latin American History, University of Pennsylvania, and author of many books on Latin America and the United States, uses the Peron regime in his analysis of the "strongman" phase of Latin American politics. By examining the reasons for Costa Rica's success in securing a relatively high rate of stability, Harry B. Murkland, writer on Latin American affairs and senior political analyst in the office of the Coordinator of Inter-American Affairs during the Second World War, gives his reasons for unstable economic and political conditions in other Latin American nations. Dependence upon a one-crop economy is a dangerous and unsound policy for any nation and is a problem facing various Latin American countries, says

Dr. John Linberg, a member of the Institute of Advanced Studies, Princeton, N.J., and long-time public servant on the international level. He examines Bolivia to show a reliance on the fluctuating export of tin for economic and social progress. Dr. Myron S. Heidingsfield, Head of Department of Marketing, School of Business and Public Administration, Temple University, explains that Cuba's unbalanced economic development and dependence on the U.S. has resulted from the economic dominance of the sugar crop. In their reliance upon an agrarian economy Latin American countries have passed by the industrial potential which lies in their rich mineral resources and manpower. Yet although industrialization may be the answer, industrial promotion introduces complex and formidable problems, as is shown by Mark K. Hammond, one of the editors of *Current History*. The final article, by Richard W. Van Alstyne, Professor of History, University of Southern California, discusses relations with the United States. He believes that inter-American solidarity was promoted by the Roosevelt government because of the serious bid by Nazi Germany for the leadership of South America.

Charles Malik, "The Meaning of the Near East," Journal of International Affairs, Winter 1952, pp. 32-36.

One of the most dangerous habits in Western civilization and culture today is that of dividing the world, including the Near East, into oil, strategy, and politics, while completely losing sight of cultural values, historical ties, and the fundamental concepts by which a civilization lives and dies. An example of this trend, according to Mr. Malik, Lebanese Minister to the U.S., Chief Lebanese delegate to the U.N., and Chairman of the United Nations Commission on Human Rights, is the gradual replacing of the term "Near East" with the designation "Middle East." Harmless though this shift of terminology may seem, it implies that the Near East is significant today only for its economic resources, strategic position, and political relations. "The Near East is neither a political, nor geopolitical, nor geographic, nor strategic concept; it is cultural-genetic." It is the cradle of Western civilization, the region where the essences of that civilization originated.

Mr. Malik takes issue with two arguments advanced by the strategic-political theorists who claim (1) that the ties between West and the Near East are only romantic and at best historical, and have been severed long ago, and (2) that the term "Near East" is relevant today only because of such things as "oil, strategy, Israel, and the Arab League." The name "Near East" is thus outmoded, they claim, and should be supplanted by a more meaningful term. These arguments are not true, Mr. Malik asserts. Western cultural influence has had tremendous impact in the Near East. It is increasing and the West must assume part of the responsibility for the existing turbulent state of mind and soul. There is a basic community of culture linking the two regions. It is true that strategically the Near East is of crucial importance to the West and vice versa, but more fundamental is the fact that this interdependence between the two presupposes a common origin of ideas which will continue to exist irrespective of history, shifts of power, or scientific advancement. The Near East (Egypt, the Levant, Syria, and Turkey) is a "precise, living, revelant and stable concept—far more profound and enduring . . . than the 'Middle East'!" It is a distinct area and must remain so. Historically the breeding ground of significant ideological challenges, this region is the microcosm of the world in a unique and special way; the meeting place of the ages where the eternal issues of death, destiny, decision, and being underlie the passing excitements of the moment. Problems such as nationalism, communism, industrialism, and agrarianism, which elsewhere are resolved—rightly or wrongly—or are judiciously covered up, remain in the Near East in eternal suspension. In this state they serve as a constant reminder of the problematic character of human existence.

The meaning of the Near East, the author concludes, is not political, not economic, not strategic. It is eschatological—"a futural orientation into the fartherest limits of being and even beyond."

Barry Brannen, "The Soviet Conquest of Rumania," Foreign Affairs, April 1952, pp. 466-487.

THE author, a member of the Allied Control Commission for Rumania from November 1944 to February 1946, feels that the current history of Rumania "provides mournful illustration and example" of attempting to do business with or place good faith in Soviet Russia.

Unlike her neighbors Rumania has never oriented her foreign policy towards the U.S.S.R. Rumania has never indicated the slightest disposition to collaborate with the Soviets on a military, political, or economic plane. Soviet conquest meant a direct imposition of Soviet control on a people whose race, language, and previous policies gave no indication that such controls were desirable or acceptable. This conquest was accomplished under the Armistice Convention of September 1944, a negotiated settlement made for the expressed purpose of safeguarding the "independence and sovereignty" of the country.

Beginning with the Soviet conquest in August 1944, the author traces political events from King Michael's successful *coup d' état* to the suppression of the Nationalist Peasant Party in 1947 and the proclamation of the "popular Republic," a Soviet satellite state. When she cast off her German chains, Rumania hoped that she would earn the freedom and independence which the Armistice Agreement promised. Instead, concludes Brannen, she found herself bound in the tightest serfdom the country has ever known.

Peter F. Drucker, "Frontier for this Century," Harper's Magazine, March 1952, pp. 69-74.

AN important misconception in our China policy, according to Mr. Drucker, has been the assumption that the land problem is the basis of China's dilemma, that the magic solution to starvation and overpopulation lies in land reform. What is misconceived about China, the author feels, is misconceived about the entire agrarian world, which from the heart of Europe to the China Sea is economically and culturally bankrupt and is faced by problems which cannot be solved by agrarian reform. We have wrongly assumed, Drucker emphasizes, that most countries with a dominant agrarian economy have large estates which can be broken up and handed over to the peasants. Except in a few European nations, however, estate farming is a rarity. In addition, there are too many peasants for the amount of land available for distribution. The real need is not elimination of landlordism, but getting "the submarginal peasant . . . off the land" by industrializing agrarian countries.

The United States is the natural leader, Drucker believes, for promoting this industrial revolution, since it possesses the two prerequisites—capital and technicians. Yet we should not pump huge sums into backward areas, for large-scale investments are frowned upon both by Americans, who fear loss of investments, and by the people of the agrarian countries, who regard such investments as imperialism. Furthermore American capital would probably be used to support a senile, agrarian society rather than be channeled into industrialization.

Japan, Russia, Turkey, Brazil, Argentina, and Australia have all made long strides toward industrialization during the century. In each country industry was financed "without using foreign capital to any significant extent." It is possible, Drucker believes, to raise the main capital investments within the economy of each country involved.

The real leadership that the U. S. should offer is "know-how." We must help develop technicians, workers, and sound business principles. In addition we must encourage native capital and savings to go into industry and business.

American private business, working on a management contract and a fee basis, can do the job. As soon as native people are trained, Americans should leave. Once the American establishes the fact that his "main aim is to make himself dispensable" he will find he is much in demand. This, then, is a new frontier for the American economy. Above all, it would strike a positive blow in the titanic conflict between the forces of freedom and tyranny.

Constantin Fotitch, "Tito and the Western Democracies," Journal of Central European Affairs, January 1952, pp. 353-371.

An unfavorable view of the Tito regime is presented by Mr. Fotitch, a former Yugoslav minister and ambassador to the U. S. from 1935 to 1944. He believes Tito's break with Russia was "devoid of any ideological aspects and was due primarily to personal reasons."

Realizing his conflict with Stalin was irreconcilable and the majority of his people were opposed to any form of Communism, Tito used the break as a means to exploit a deteriorating internal situation. He posed himself the defender of Yugoslavian independence against Soviet ambitions. To avoid a split among his fellow Yugoslav Communists, he attempted to present his break with the Comminform as an ideological one in which he was defending the purity of Communism.

This break was unexpected but welcome to the Western democracies, who began immediately to develop the crack in the monolithic Soviet system. It was difficult for Western minds to reconcile their ideals with expediency toward a regime which suppressed all freedoms. Moreover Tito had been one of the most outspoken critics of the Western powers. Nevertheless the West began pouring money into Yugoslavia in loans and trade agreements. The November 1951 agreement provided for military rearmament of Tito's 30-odd divisions.

The tragic consequences of this unconditional aid, the author believes, will be to "enable the Yugoslav dictator to crush the resistance of those remaining independent farmers who constitute the most solid barrier to the expansion of Communism and are the pillar of democratic forces not only in Yugoslavia but also in other enslaved countries."

Tito, the author emphasizes, has given nothing to the Western democracies in the political and diplomatic field in return for their generous aid. Moreover he will fight in Europe only if the aggression there involves Yugoslavian independence—of which he will be the sole judge.

The Tito break with Moscow and subsequent large scale Western aid has not justified our hopes that Tito's example would be contagious in other satellite countries. Quick Kremlin countermeasures in the form of ruthless mass purges liquidated Communist leaders in most satellite countries and enabled wholly reliable stooges to assume power. From the whole incident came stronger, more tightly-knit Communist parties all over Europe.

We can only hope, the author concludes, that Tito's military contribution in case of armed conflict between East and West will be more effective than political collaboration has been and that it will justify Acheson's policy of "calculated risk" which the Western democracies are following.

BRIEFER COMMENT

B. G. Reed, "Building the World's Biggest Bombers," Automotive Industries, April 1952, pp. 38 ff.—The problems involved in constructing the B-36 are different only in degree or intensity from those involved in construction of other aircraft. In addition to Government-furnished equipment, 1610 subcontractors furnish some 68,000 part numbers (2 or 3 parts to a number), which require 8500 different assemblies for each aircraft.

Hans Thirring, "Why There Will Be No World War III," U. N. World, January 1952, pp. 13-15.—Atom bombs coupled with the Kremlin's belief in the ultimate triumph of Marxism have made war not only obsolete but improbable. The most important goal of the Soviet Union is not world revolution but gigantic economic, financial, social, and cultural progress on the home front. This can be realized only if the world enjoys at least a fifty-year period of peace. If we do not attempt a crusade to liberate the peoples under their yoke, the Soviet Union will refrain from direct military aggression.

Romney Robinson, "Defense Without Inflation—or Inflation Without Defense," Mechanical Engineering, April 1952, pp. 312-314.—Science has made weapons so intricate that the cost of producing them in the necessary volume and variety taxes even the strength of so productive a nation as the U. S. A discussion of the serious economic problems which our national defense program presents.

Percy Knauth, "The Voice of Free Berlin," The Reporter, April 1, 1952, pp. 17-21.—A report on RIAS—Radio in the American Sector of Berlin—its activities, aims, influence, operating problems and the duties of the 700 men and women who operate the station which reaches 12 million listening Germans in the Soviet-controlled zone of Germany.

"Russia's Trade Flop," U. S. News and World Report, April 4, 1952, pp. 31-32.—Russia's International Economic Conference is a reaction to stern measures by the West to strangle East-West trade. So successful have these measures been that only a trickle is now seeping through the Iron

Curtain. The conference itself is a flop—for the West still is not interested in doing large-scale business with Stalin.

"Capacity and Location of Soviet Aircraft Plants," Aviation Age, March 1952, pp. 6-17.—An interesting compilation by the editors of *Aviation Age* on the capacities, limitations, and resources of Russia's aircraft industry and how it could be injured by strategic bombardment. An inclosed map locates the various types of aircraft factories.

Benjamin Rivlin, "Nationalism in French North Africa," Foreign Policy Bulletin, February 15, 1952, pp. 1 ff.—The liberal-democratic traditions of the Western world with its concepts of freedom, equality, and self-determination of peoples, plus the sharp contrast in living standards between the French and the native population, inspired the nationalist uprising in North Africa.

M. N. Roy, "Danger of Dictatorship in India," New Republic, March 3, 1952, pp. 15-16.—The strong showing of the Communist Party was the most significant feature of India's general election. Five years of constitutional government failed to improve conditions for disillusioned and discontented millions of Indians and has shaken their faith in older ideologies. Communism offers a point of crystallization by promising a clean sweep of the established order. These circumstances herald the end of Nehru's one-party rule. The impending chaos will facilitate the rise of an avowedly dictatorial regime.

Max Beer, "The U. N. Thrives on Disunity," U. N. World, January 1952, pp. 31-35.—The disunity among the great powers in the U. N. resulted in stalemate on vital issues. To eliminate this stalemate, the autocratic Security Council was deposed in favor of the democratic General Assembly—something which should have been taken care of at San Francisco in 1945.

Joseph Warner Angell, "Guided Missiles Could have Won," The Atlantic Monthly, January 1952, pp. 57-63.—If Germany had possessed enough V-2 rockets and had employed them earlier, the tide of World War II could have been turned. Had Hitler not cancelled Peenemunde's first priority in 1939, the V-2 would have been ready for combat in 1942 while German industry still was capable of producing 100,000 per month. America would have felt the impact of the transatlantic A-10 rocket by 1946.

Dr. J. F. Flagg and M. J. Gross, "Nuclear Fuel for Power Production," General Electric Review, March 1952, pp. 8-13.—A study of the design and operation of nuclear reactors and nuclear fuel for producing various types of power.

Atreya, "Why the Communists Gained in India," The New Leader, March 24, 1952, pp. 15-18.—Soviet Russia capitalized on Nehru's failure to solve India's food problem and exploited racial separatism.

John H. Storer, "Bird Aerodynamics," Scientific American, April 1952, pp. 24-29.—Birds and airplanes fly in accordance with the same aerodynamic principles. Discussion of how each employs the airfoil and propeller, accompanied by slow-motion-camera shots, illustrations, and diagrams. Contains a chart of bird airspeeds.

Chiao-Min Hsieh, "Formosa—a Rich Island of the Far East," The Journal of Geography, February 1952, pp. 45-55.—Excellent description of this strategic island, including a discussion of Formosan transportation, population, minerals, water power, climate, agriculture, forests and topography, and a brief historical summary of the island. Explains Formosa's strategic importance, economically and militarily, to mainland China.

Quentin Reynolds, "Is England Necessary?" U.N. World, March 1952, pp. 13-16.—Without the military, naval, economic, and moral strength of England, SHAPE would be a shadow headquarters without meaning or substance. The whole concept of collective European security as symbolized by NATO would be meaningless.

William J. Donovan, "The Schuman Plan: A Blow to Monopoly," The Atlantic Monthly, February 1952, pp. 58-61.—Presents the Schuman Plan as the only practicable means of releasing the tremendous industrial energies of the German people to the benefit of Germany and the entire Western World, while preventing German industry from again serving aggressive ambitions.

Lewis V. Thomas, "Recent Developments in Turkish Islam," The Middle East Journal, Winter 1952, pp. 22-40.—Recent developments in Turkey do not constitute a pronounced new trend, are not a great danger, and are not Communist-inspired. They bode well for the future health of Turkish society and American-Turkish ties.

Bernard Lewis, "Islamic Revival in Turkey," International Affairs, January 1952, pp. 38-48.—After a century of Westernization Turkey has undergone unusual changes—but the deep Islamic roots of Turkish life and culture are still alive and are responding to a profound national need. It is hoped that Turkish common sense and powers of improvisation will effect a working compromise between Islam and modernism. Should the reaction to modernism follow a different path, the Near East may again see a clash of civilizations.

Mark Alexander, "Is Egypt Heading for Civil War?", The New Leader, April 7, 1952, pp. 6-7.—The uneasy truce prevailing since the "Black Saturday" riots of January 26 threatens to give way to serious international strife as the "corruption-ridden" Wafdist party faces King Farouk and the Army command in a struggle for the support of the Egyptian masses.

Ellsworth Raymond, "Korea: Stalin's Costly Miscalculation," U.N. World, March 1952, pp. 28-31.—An authority on Soviet affairs claims the U.S.S.R. is deeply in the red both in the economic and political columns of the Korean balance sheet.

Dr. J. Lewis Robinson, "Changing Arctic Maps-II," The Beaver, March 1952, pp. 24-26.—The second part of an article discussing new geographical discoveries in the little-known northlands which are constantly changing the maps of that area.

Calman R. Winegarden and Joseph S. Teizel, "National Manpower Needs and Supply, 1952-1953," Monthly Labor Review, March 1952, pp. 263-266.—Aggregate manpower supply should be sufficient to meet the expected additional manpower requirement of 3½ million for national defense and civilian production by the end of 1953. The nation can attain this goal if intensive efforts are made to expand the labor force and to make effective use of all available workers.

David Blelloch, "Technical Assistance: Programmes and Policies," International Affairs, January 1952, pp. 49-58.—Our future and that of the world is bound up with the success of the Point Four programs and policies, in that unequal economic development of different world regions will deepen the gap between East and West. Blelloch analyzes Point Four and factors upon which its success will depend.

Sidney C. Sufrin, "The Outlook in Spain," Foreign Policy Bulletin, March 1, 1952, pp. 5-7.—Spain and its Hitler-type government will play an important role in the structure of Western security. Discusses the uneven economic development, the ideological conflicts, living standards, and political trends of this totalitarian nation.

David Shub, "March 1917: When Russia was Free," The New Leader March 17, 1952, pp. 16-18.—Thirty-five years ago the Russian people overthrew Tsarism and set up a government under Premier Alexander Kerensky based on liberty, justice, and equality. Ironical though it may seem today, this Russia, according to historians, was "the freest country in the world."

Fred De Armond, "The One-World Illusion," The Freeman, April 7, 1952, pp. 433-434.—The U.S. has a bad hangover from imbibing too much of the great illusion of One World—an illusion which was advocated by Americans with an intensity never before equaled.

Raymond Aron, "French Public Opinion and the Atlantic Treaty," International Affairs, January 1952, pp. 1-8.—The Atlantic Treaty is not regarded with affection by the French because they know that if war comes there would be no victory for them even if the Western coalition were successful. They fear Communism, but Germany is still their greatest enemy. The Russians are considered dangerous but are remote compared to the traditional threat just across the Rhine.

"Syria is Not a Democracy," Fortnightly, March 1952, pp. 158-163. —Four times in the last three years military intervention in Syria has disrupted or abolished any emerging concepts of democracy. The lack of interest in these events, both at home and abroad, indicates that democracy has failed in that key Mediterranean country.

Arnold J. Heidenheimer, "The Saar—Bridge or Chasm?" New Republic, February 25, 1952, pp. 14-15.—The destiny of the Saar Basin, industrial giant in the heart of Europe and a French-German bone of contention for generations, could well determine the course of a new Europe and be a test case for bigger things to come. Under international control of the Council of Europe, the Saar could become the first federated member of the new Europe.

Rupert Emerson and Inis L. Claude, Jr., "The Soviet Union and the United Nations: An Essay in Interpretation," International Organization, February 1952, pp. 1-26.—Ultimate Soviet aim is to transform a capitalistic and procapitalistic world into its own image. Convinced that the present balance of power precludes achieving this by all-out war, the Soviets seek temporary peaceful co-existence until the balance of military, economic, and political power swings more clearly in their favor. Thus the U.N. is of positive value as a listening post, forum from which to spread dissension, and a meeting ground with their opponents. Peaceful co-existence and U.N. participation is an interim measure only. To view the matter any other way is groundless Utopianism.

Robert C. North, "The Rise of Mao Tse-Tung," Far Eastern Quarterly, February 1952, pp. 137-145.—A documented account attempting to settle the controversial question: when did Mao achieve effective political and military power within the framework of the Chinese Communist movement? North claims it was in 1935 although it was not until 1938 that Mao won full recognition as Communist China's leader.

Hermann Oberth, "Errors in Rocket Development," Rocket Science, March 1952, pp. 2-7.—A former German scientist discusses errors made by both German and American scientists in the theory and development of rockets.

Field Marshal Alexander Papagos, "Guerrilla Warfare," Foreign Affairs, January 1952, pp. 215-230.—A discussion of the two methods of warfare used by modern guerrilla forces—arms and propaganda—by a past commander-in-chief of the Greek armed forces. Shows how these two methods were used and combatted during the period of the Communist guerrilla war in Greece.

Wickham Wells, "The U.S. Shapes a Middle East Policy," The Reporter, March 4, 1952, pp. 5-7.—U.S. policy in the Middle East has two objectives: (1) to assure the defense of the area and (2) to foster economic, political, and social progress in order to build effective allies who can contribute to the common arsenal. These two provide a short-range military plan and a long-range concept.

Wayne S. Vucinich, "Soviet Rumania—1944-1951," Current History, February 1952, pp. 85-91.—An account of the socialization of Rumania and its evolution into Communism. Although the same pattern was to be followed in other satellite countries, Rumania today is more thoroughly dominated by the Soviet Union than any other people's democracy.

Allen Griffin, "Must Indo-China Be Lost," New Republic, March 31, 1952, pp. 16-17.—Two requirements must be met to save Indo-China: the formation of a government which will serve the people directly and dramatically; and the granting to that government full independence which is guaranteed by the United Nations. There can be no military solution without a political solution.

Theodore H. White, "Build-up in Western Europe: the End of the Beginning," The Reporter, April 15, 1952, pp. 25-28.—Lisbon was the first meeting of the Council of North Atlantic Powers which was signalized by real achievement. Although its decisions were a retreat from former target dates and commitments, these decisions strengthened rather than weakened the alliance because they were based on economic and political reality rather than theoretical speculation.

The Quarterly Review Contributors

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Vol. V

No. 3