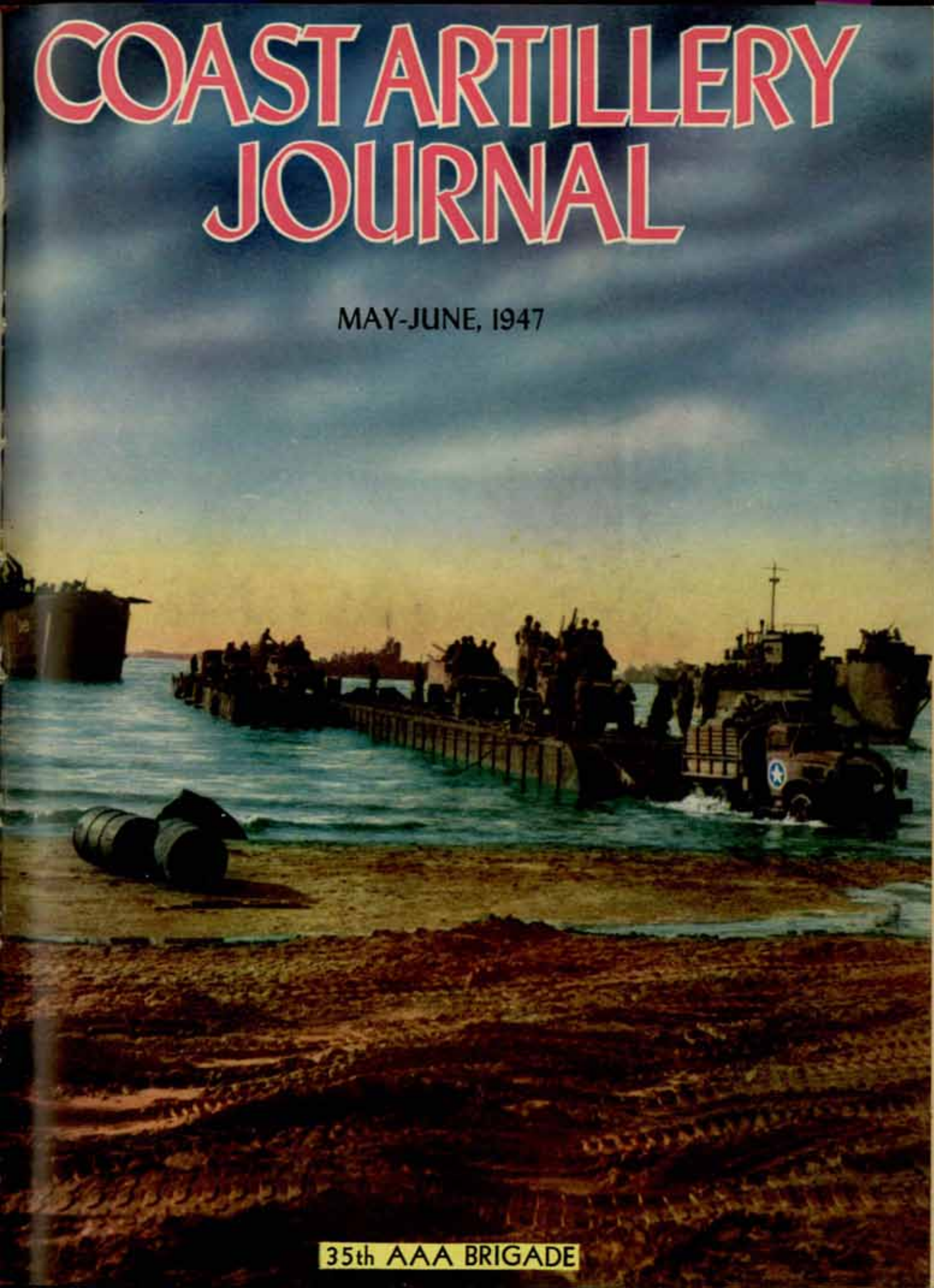
COAST ARTILLERY JOURNAL

MAY-JUNE, 1947



35th AAA BRIGADE

HEADQUARTERS

ARMY GROUND FORCES

OFFICE OF THE COMMANDING GENERAL

FORT MONROE, VIRGINIA

27 May 1947

To the Officers and Men of the Coast Artillery Corps:

The Coast Artillery Corps, as a separate and distinct arm of the military service, observes its fortieth anniversary today. I join the other members of our armed forces in tendering the Corps my sincerest congratulations for the four decades of achievement which mark its history.

Forty years ago, the establishment of a separate Coast Artillery Corps was appropriate to the times. Today, however, the War Department looks forward to the unification of all three of our artilleries—the Field, Seacoast, and Antiaircraft—so that the most effective coördination between them may be insured in time of emergency. In its forthcoming role, then, the Coast Artillery Corps can look ahead to new achievements as part of the unified team of our national defense.

As Commanding General of the Army Ground Forces, I express my appreciation for the accomplishments of the Coast Artillery Corps during the past forty years, and wish it every success in its new endeavors.

Jacob L. Devers

JACOB L. DEVERS,
General, USA,
Commanding.

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ACTIVITIES AAA

20 November 1942 will always be remembered as a red letter day for it was on that date the 35th Brigade was activated at Camp Stewart, Ga., under the command of Brigadier General Rupert E. Starr. A few days after this, the original enlisted personnel arrived from Fort Sill, Okla. Then began strenuous weeks of conditioning, maneuvers and schooling in the fundamentals so necessary to the operation of a Brigade Headquarters.

The Brigade said goodbye to Camp Stewart on 20 April 1943, and sailed from Staten Island aboard the S. S. *Santa Elena* on 30 April, with a convoy of twenty-one troop transports, one aircraft carrier, one battleship, two tankers, one freighter and nine destroyers: whither bound nobody knew. The trip was highlighted only by the usual number of alarms, mostly due to threats of submarine attack. Only once was this a reality and subs were in the vicinity. Depth charges were dropped, and were accompanied by excitement, anticipation, the low rumble of underwater explosions and a sincere desire for solid earth under one's feet. Fortunately the convoy was not damaged.

North Africa

Excitement reigned on the S. S. *Santa Elena* as it coasted into the harbor of Oran, Algeria, during the afternoon of 11 May 1943. It seemed everyone was on deck, viewing the beautiful harbor with the city of Oran sprawling on the hillside. Buildings were tile, and the white walls topped with red clay roofs combined with grapevines and other green foliage growing in the red soil presented a truly striking picture.

Debarkation—down the gangplank to the waiting trucks, then to the bivouac area and the "new life"—insects, hot days and cold nights, chlorinated water, atebrine, "C" rations, and helmet baths. On 15 May, the Brigade moved to Mostaganem, Algeria, and received its first mission:—the defense of the ports of Tenes, Arzew and Mostaganem, along with six neighboring airports, all under the command of Lieutenant General Mark Clark's Fifth Army. This was no small assignment in view of the importance of these ports as main centers of supply for North Africa and the impending operations in Sicily and Italy. During the Brigade's tenure of this command not one enemy bomber succeeded in striking one of these vital objectives.

Although there were no huge air attacks, the ones that came did prove valuable and they taught lessons only experience can teach. All of the Brigade's "Old Timers" delighted in recalling their baptism of fire at Mostaganem when German planes raided the city. At this point two young officers would never fail to mention promenading along Rue de Bel-Hasel with French Mademoiselles, which they said helped to relieve the monotony not to mention improving our diplomatic relations.

On 15 August 1943, the 35th was relieved of its North African mission and attached to the VI Corps to prepare for the landing at Salerno, Italy. This was the beginning of a long and harmonious association with the fighting VI Corps. To accomplish its first mission of protecting a beachhead on foreign soil, the Brigade was given the 8th AAA Group with the 534th and 630th AAA AW Battalions attached to land with the assault forces on D-Day. Several other groups and battalions were scheduled to start landing D plus 2 as follow-up troops.

Italy

The story of Salerno Beachhead is now a familiar one. At 0330 hours, 9 September 1943 (D-Day) our first troops went ashore and the quiet beaches of Paestum and Salerno broke into a hell of tracers, flares, shot and shell. The enemy, exerting every effort to throw our forces back into the sea, launched attack after attack by air, relentlessly bombing and strafing the narrow stretch of shoreline. But despite the fierce fire from ground and air, the Antiair

OF THE 35th BRIGADE

BY LIEUTENANT-COLONEL FRANCIS C. GREVEMBERG, CA. RES.

craft Artillery succeeded in emplacing ever-increasing numbers of its guns ashore and meeting each new air attack with ever-increasing fire power. In addition to accomplishing their primary mission, antiaircraft artillery units provided supplementary machine-gun fire for both infantrymen and beach battalion workers. It became routine for AW sections to blast away at snipers and rat pistolmen. Two AW sections teamed to cause a German 88mm battery, which was delivering withering fire on the main beach area, to cease fire and abandon its position. The advance elements of the Brigade Headquarters were among the first antiaircraft artillery troops ashore. In establishing its CP on the mainland of Italy D-Day, the 35th not only became the first American unit of its type to land on D-Day during an initial invasion on enemy soil, but was also the first antiaircraft artillery brigade headquarters to set foot on continental Europe during World War II. Battipaglia, Montella, Piazza, Avellino, the Volturno River, Prata, Venafro and the Winter Line in front of Cassino marked the Brigade's progress up the mountainous Italian mainland through the cold rains and mud of fall and winter. It was on 23 November 1943, that Brigadier General Starr relinquished command of the Brigade to return to the U.S. with his firsthand knowledge of Antiaircraft Artillery in combat, and on December 10, 1943, Brigadier General Aaron Bradshaw, Jr., assumed command.

With the exception of one month during which the Brigade was attached to the French Expeditionary Corps, with the specific mission of coordinating and improving the French and American Antiaircraft Artillery defenses in the Venafro sector, it was charged with the Antiaircraft protection of VI Corps infantry, artillery, vital points and lines of communication.

The Brigade's next assignment on the Anzio Beachhead was no doubt its greatest. It landed there on 2 February 1944, to take over control from Colonel Edgar King who had established the initial defense with his 68th CA Regiment on D-Day 22 January.

General Bradshaw immediately began applying pressure to Fifth Army Headquarters for more antiaircraft units at Anzio to meet the ever-increasing air attacks. Fortunately, due to the General's foresight, when the all-out attack by the Germans began on 16 February, he had amassed the greatest concentration of antiaircraft units for an area the size of the Beachhead (7 miles deep and 14 miles wide) in the history of warfare. This defense included more than 400 40mm and 37mm guns and 1000 50 caliber machine guns plus 16 batteries of 90mm weapons. Proof that it was effective is the fact that 204 German aircraft were definitely destroyed by that array of firepower during the four months' period at Anzio.

Many new techniques were developed at Anzio. Planned and controlled AW barrages were used at night over forward troops (Infantry and Artillery), which were designed to force enemy aircraft up where they could be engaged effectively by the 90's without danger to our own troops. A new type AAAIS was introduced, using the military Grid System for plotting purposes at AAOR and all gun sites and a new method was developed to permit simultaneous transmission over telephone hot-loop and radio from AAAOR. The flying of barrage balloons during daylight was first attempted, although these balloons were within easy range of enemy artillery and plainly visible to enemy terrestrial observation. Centralized fire control of more than one battalion of 90mm guns during mass terrestrial fire was another "first."

Smoke generators were used in forward areas to form a thin smoke haze capable of obscuring enemy terrestrial observation. Enemy mines (naval) were located by furnishing our Navy with SCR-584 plots in graphic form on all enemy aircraft flying at low altitudes and suspected of being on mine laying missions. All of these new techniques

Self-propelled guns move inland from the Fifth Army beachhead at Anzio to establish the initial defense which shortly afterwards was built into a most formidable array of antiaircraft units.

and many others, plus numerous lessons learned, were promptly dispatched to Headquarters AA Command and our theater commander for dissemination to all antiaircraft artillery units. The important thing about it was that this information was sent in as promptly as possible and certainly must have been of value to other units as was their information to us.

During Anzio's initial phases, the Germans were able to "jam" our Radar equipment permitting several night raids without mishap to the enemy because of the inaccuracy of our fire control equipment. General Bradshaw had new Radar equipment diverted and shipped immediately to the beachhead. This equipment arrived with only one trained crew of operators and two trained officers. Then for a period of a little more than forty-eight hours, the enemy bombers laid off at night. During that time the new equipment was installed and old SCR-268 operators were trained without letup, in its use. When the enemy resumed his night raids with a flight of 12 JU-88s, using the same tactics, dropping bales of "window" and flying straight, level courses, he received a big surprise. Our gunners shot down five of these twelve aircraft. This proved how quickly men could adapt themselves to new equipment in combat. An interesting note at this point is the fact that captured veteran German and Italian airmen at interrogation centers stated that Anzio's flak defenses were the "most terrifying and versatile" they had ever met.

Field artillery firing for the 90's on Anzio reached a climax under the command of Lieutenant Colonel Francis M. McGoldrick, 35th Brigade Field Artillery Commander at Anzio, when they were used to help smash the 14-division German Carroceto offensive which began on 16 February 1944. In one engagement, the 90's put out 1,442 rounds in thirty-five minutes. Proof of their effectiveness during this all-out attack was recognized by the beachhead commander, Lieutenant General Lucian K. Truscott, in his commendation to the 35th stating "the 90mm AAA weapons firing in a field artillery role proved very effective and contributed a major part in stopping the enemy's recent all-out offensive." During that critical period all men were pulled off AW fire control equipment and together with two AA Machine Gun Batteries were formed into a provisional infantry battalion. This Battalion was employed for several weeks under Engineer supervision, in the laying of mine fields in front of our Infantry and in the construction of other defenses.

Organization of AAA for Combat at Anzio.

35th AAA Brigade.
35th AAOD
5th AAA Group
434 AAA AW Battalion (SP)
441 AAA AW Battalion (SP)
443 AAA AW Battalion (SP)
106 AAA AW Battalion (SP)
435 AAA AW Battalion
9th AAA Group
90 LAA Regiment RA. (British)
18 LAA Regiment RA. (British)
168 LAA Battery RA. (British)
224 LAA Battery RA. (British)
433 AAA AW Battalion
451 AAA AW Battalion
536 AAA AW Battalion
68 CA Regiment (AA) (Hq and Hq Battery)
1st Battalion, 68 CA Regiment (AA)
2nd Battalion, 68 CA Regiment (AA)
72AAA Gun Battalion
108 AAA Gun Battalion
216 AAA Gun Battalion
102 AA Bln Battery (Vla)
24 Cml. Decon. Company (Smoke)
179 Cml. SG Company
622 SEP AA MG Battery
623 SEP AA MG Battery

On 1 April 1944, Brigadier General Bradshaw relinquished command of the Brigade to take up his post as

Fifth Army AAA Commander. Brigadier General James H. Townsend was called in to assume command bringing with him a wealth of experience and understanding.

During April and May, while the Germans continued to try to eliminate the beachhead, final plans were made for the break-through and capture of Rome. Antiaircraft artillery shifted to its offensive role as field artillery when the drive finally came. The 90mm Battalion Fire Direction Center was tied in directly to its division's artillery. Guns were massed to deliver a withering fire against terrestrial targets. Never before had antiaircraft guns been used so extensively on the offensive. For the first time our infantry was advancing under a barrage curtain of 90mm shells.

The movement from the beachhead was coordinated with the drive from the South; both were swift and sure, all defense lines were broken and the Germans were put in full flight.

On 4 June 1944, the 35th set up the first Antiaircraft Artillery defense around Rome and across the Tiber River. The bombing of vital bridges was rendered impossible and many enemy aircraft were destroyed.

The enemy was fleeing and the pursuit was continued by VI Corps until Rome was left about 100 miles south. 11 June 1944, VI Corps and the 35th Brigade were relieved in the line to participate in the planning of landing operations which were to take place in Southern France. Three weeks were spent on the beach near Santa Marinella, a small coastal town about 50 miles north of Rome. This time was spent reconditioning, re-equipping, and training, as well as providing adequate recreational periods which were the first received by VI Corps units since the days prior to the Salerno operation. Passes to Rome were plentiful. St. Peter's Cathedral, the Coliseum, and the monument of Victor Emanuel soon became familiar landmarks to all. Then came the long drive to Naples and the staging area at Bagnoli where equipment was readied for the forthcoming operation. Waterproofing immediately started speculation as to the exact spot of the now-certain landing. If the German Intelligence Corps received information by way of a leak from the average GI strategists, they certainly had a huge force awaiting a landing in the extreme northwest corner of Italy.

After many long hours of sweat, toil and conferences, final plans for the operation were completed in early August. No effort was spared to make the landing in Southern France successful. Antiaircraft artillery had proved vital in Italy and was accorded its proper place in this new venture.

Still operating with VI Corps, but now under the command of the U.S. Seventh Army, the Brigade was charged with providing the initial antiaircraft artillery defense for the landings, defense of beachheads until relieved and of combat units moving inland with the advance. To accomplish this mission, we were given some of the most experienced units in the theatre. Practically all units of the Brigade's Anzio Command were on its roster.

Three groups: 5th, 68th, and 105th; three 90mm battalions: 68th, 72nd, and 216th; four 40mm battalions: 433rd, 451st, 534th and 895th; three 37mm (SP) battalions 106th, 441st and 443rd and three barrage balloon batteries: 102nd, 103rd, and 104th were the antiaircraft artillery troops that were scheduled to land with the assault forces. All units embarked at Naples and started on an uneventful trip to the shores of France.

France

At 0800 hours 15 August 1944, (D-day), the first wave of our veteran troops assaulted the shores of Southern France. Once again the 35th was in battle with VI Corps commanded by Lieutenant General Truscott. The mission of the Corps was to establish a beachhead and to advance rapidly inland to contact friendly airborne forces and secure airfield sites. The tactical plan called for employing three divisions abreast to destroy enemy beach defenses and to advance rapidly inland in order to extend the beachhead to the "Blue Line." Contact was to be made with the Airborne Task Force in the interior. The Third Infantry Division was assigned to the left flank, from Cape Cavalaire to the Cape of St. Tropez, including the town of St. Tropez. The 45th Infantry Division was to assault the center of the invasion area, from Cape of St. Tropez eastward to Point Alexandre including the town of St. Maxime. The 36th Infantry Division was to land and advance on the right flank, from Point Alexandre to the Agay Region. In the 36th Division area was the important Red Beach, near the town of St. Raphael, and nearby was the road junction and airport at Frejus. The "Blue Line" delimited a beachhead approximately 45 miles long, 20 miles deep, well established on high ground and including suitable terrain for air strips. The divisions were to advance beyond the "Blue Line" on Corps order.

The assault on the southern coast of France was a complete success. At the close of D-day, all combat elements of VI Corps had landed, and the exploitation of a weak and confused enemy was in rapid progress. By midnight, 15 August, 2,041 prisoners of war had been taken and corps casualties had been negligible. The enemy could offer

The muddy terrain in Italy presented a major problem. Here is pictured, left background, a blown-out bridge, with a muddy by-pass choked as a result of the bogging down of a 90mm antiaircraft gun on what is being used as a road.

only scattered resistance. The German Air Force had been weak and ineffective. Enemy reinforcements never arrived in the beach area, and no large scale counterattacks were launched. The three divisions advanced inland according to plan, already ahead of their time schedule.

The rapid development of the beachhead in the Seventh Army's invasion of Southern France and the scattered disposition of German troops indicated that coming operations would be a pursuit, a race to the north up the Rhone valley, an eventual junction with Allied forces in the Paris basin and the entrapment of German forces pulling out of France. But before a full exploitation to the north could be realized it was essential to secure the port cities of Marseille and Toulon. That was the mission assigned to the French Army under General De Lattre De Tassigny with full allied naval and air support.

At 2000 hours on 16 August, French units of the Seventh Army began landing over beaches already cleared by the VI Corps in the St. Tropez area and started their advance to the west against Toulon and Marseille.

The initial assault and its subsequent expansion of the beachhead opened the way for a rapid debouchment inland. By D plus 2 a definite breakthrough had been accomplished, and the German Nineteenth army was in serious danger of being cut in two.

It soon became clear that the Germans had been caught on D-day with the great bulk of their defensive strength far to the west of the assault beaches. Pre-D day bombardment had wrecked all but one bridge across the Rhone and the shortage of trucks and motor fuel hampered any large-scale movement of troops.

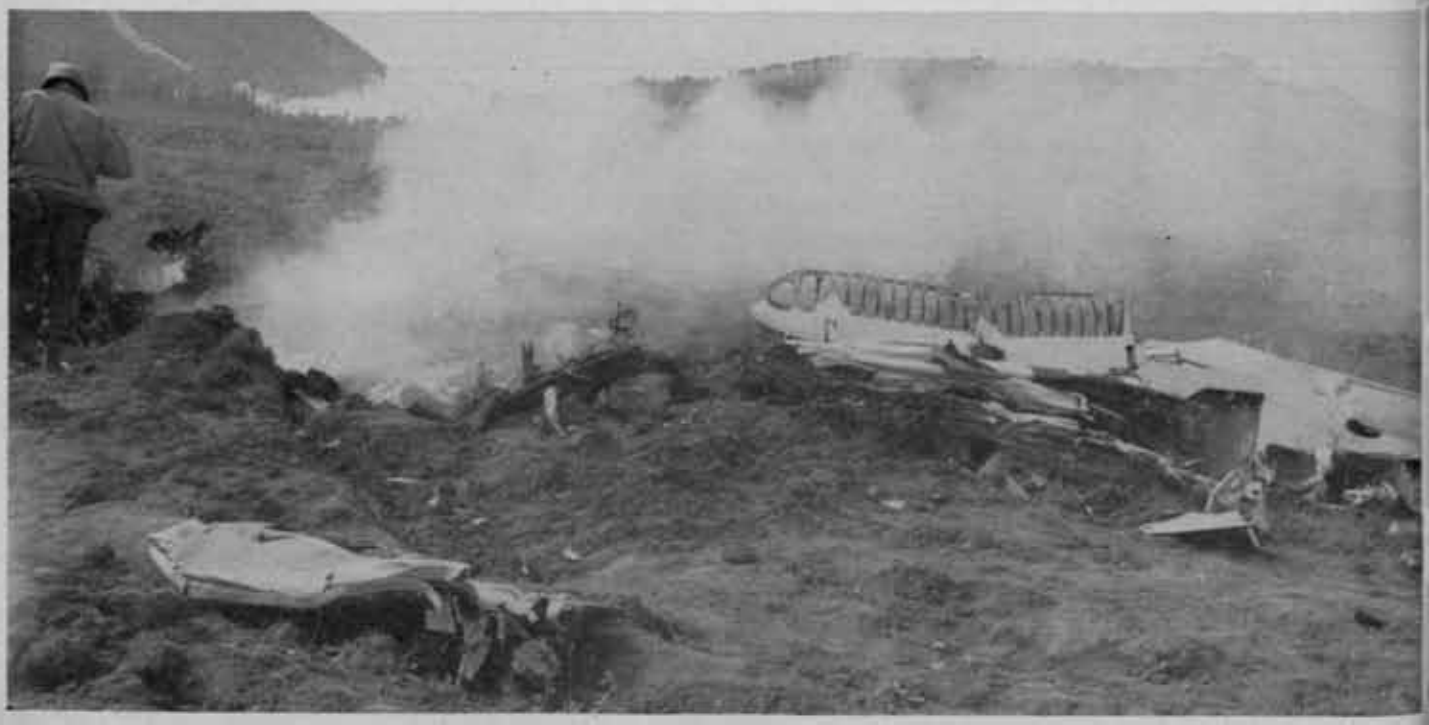
This breakthrough from the beaches again found new use for ack-ack. The 37mm half-tracks were employed with infantry spearheads to provide a mobile weapon to supplement light tanks and reconnaissance cars which were scarce at this stage of the landing. Much opposition arose as to the feasibility of their use in this role particularly because of the thin armor of the 37mm half track, but General Townsend made the decision to use them provided they were not committed against enemy tanks and pillboxes. Their success was outstanding and all troops of the Corps praised their work. Many enemy strongholds were blasted away by them and snipers in buildings were their specialty but several German reconnaissance cars also met their doom on the receiving end of these deadly weapons. One incident in particular stands out in my mind. A German command car came driving down the highway, turned a corner and stopped about 100 yards in front of an M-15 that was parked sideways on the road. The German car tried to turn around to go back but the M-15 crew poured automatic fire from its 37mm and .50 calibers into the vehicle which was immediately put out of action. Five German officers and one enlisted man lost their lives within about 5 seconds of fire. Casualties among the crews who manned these half-tracks were very few and not one half-track was lost during these encounters. General Townsend was right again, antiaircraft artillery could definitely be used on the offensive in terrestrial roles if used properly and if the proper precautions were taken.

France was a sharp contrast to Italy in more ways than one. People were clean, neat and friendly, and everywhere their welcome was genuine. Many could not believe the Americans had finally come, they would walk over, touch us and with tears in their eyes say—"I had to touch you because I just couldn't believe it was true. You are our liberators. God bless you—Lafayette did nothing for your country compared to what you are doing for ours."

Montelimar, Grenoble, Lyon, Besancon, Epinal and St. Die marked our advance to the Vosges mountains.

For the first time in history an army crossed the Vosges Mountains. For centuries military men had considered the Vosges impregnable; however, in the fall of 1944, VI Corps

American soldier inspecting the remains of a German ME-109 that was shot down over the Volturno River by Brigade guns.



broke through. Precedent fell like Germans as both veteran and "green" troops fought the hun, the terrain and the weather to shatter enemy defenses in a history-wrecking campaign that rocked the supermen back against the Rhine.

In centuries past, military men seeking new plans to exploit the battlefields of France, shook their heads and shouted "NO" when the Vosges sector, with its pathway to the east, was mentioned. And well they might because geography seemed to be caught in a mixture of beauty and agony when the Vosges mountains were put down on the plotting board. Beauty there is, undoubtedly, tall pines on taller mountains, rushing streams and jutting crags of sheer rock. That same picturesqueness which excites the layman is agony for the military man who has to find a new way to scale those cliffs, to push through those forests and at the same time root a stubborn enemy out of defenses which he has had months to prepare.

Thus a new page of history was written and it was written in the early winter campaign of 1944 with mud, rain, snow and sleet offering practically as many problems as the hazardous terrain and a stubborn enemy. This sector was the scene of bloody, vigorous fighting during the first world war but the Germans then could not be pushed off the crest of the Vosges nor could they shove the French back from their positions in the lower mountain regions; therefore a stalemate existed in this area for four long years from October, 1914, right through to the end in 1918.

Generally speaking the campaign to win the Vosges was inaugurated on or around 21 September 1944, immediately prior to the cracking of the Moselle River Line. The first period, which for the greatest part was rapid in development, extended to about the 15th of October when phase two got under way with the Mortague River Line and a push to a new river barrier, the Meurthe. In between those two river lines lay more than a month of dreary fighting which saw the German offering his most stubborn resistance, taking advantage of the almost continual rain, snow, sleet and natural defenses in the thickly forested mountain country.

The push across the Meurthe (the exploitation phase) got underway about 20 November, and found the Germans retreating with a speed reminiscent of the drive through Southern France.

Sounds simple to put it that way. But those who were there will never forget nights so black that a wisp of fog could be mistaken for an enemy, days of continual rain when the sun became a thing of the almost forgotten past, cold chilled bones, gun pits filled with water, snow 16 inches deep and Germans fighting with a fanaticism born of knowledge that only the fatherland lay behind them. It is a story too, of minute planning, of day and night consultation on one operation after another and of perfect liaison between all types of units which molded this smooth working VI Corps team for its drive to sweep the Vosges.

The 35th AAA Brigade with attached units (including the 91st Group that replaced the 105th Group which remained defending main ports in Southern France) under the command of General Townsend, participated in the drive through the Vosges mountains in support of VI Corps.

Although the Luftwaffe made only a token effort toward

An enemy plane is plotted in the operations trailer of the 35th Brigade at Dettwiller, France.

stopping this operation, the ack-ack men were by no means idle. Thirty-two enemy aircraft were engaged over the Corps sector, resulting in six destroyed and two probably destroyed with no resultant damage to Corps troops or installations. All flights were either high flying single reconnaissance planes or hedgehopping planes on strafing missions.

Because of the elaborate and smooth functioning Brigade AAAIS, no enemy aircraft entered the VI Corps area undetected, and in all cases ack-ack crews received early warning, enabling each gun crew to plot the enemy aircraft by means of the military grid system, even before it entered the area, completely eliminating the surprise element.

In addition to providing continuous antiaircraft protection for all corps elements, the M-15 and M-16 self-propelled guns were used as infantry support weapons and 90mm guns were used as an integral part of the field artillery fire power of the Corps.

Three self-propelled automatic weapons battalions: the 106th, in support of the 45th Division, the 441st in support of the 3rd Division and the 443rd supporting the 36th Division, again proved their value on ground as well as air targets in close support of infantry and armored attacks in the VI Corps advance through the Vosges. Both important river crossings, the Moselle and the Meurthe, were ably supported by antiaircraft ground fire. Infantry support followed this general procedure: When a certain objective was to be taken, the "buzz wagons" rolled up, cut loose with all they had which was plenty and paved the way for the doughboy. On river crossings the same treatment was applied, firing from the friendly bank to the hostile shore to keep the Germans down while the infantrymen slashed across to apply the finishing touch.

The M-15 and M-16 weapons were found to be among the most versatile weapons in the Corps and can show a long list of a variety of ground fire missions to back up that statement. Their fast rate of fire and tracer ammunition encouraged many a Nazi to forget about "der Fuehrer." Prisoners taken after lasting out one of their automatic barrages were completely demoralized and expressed great curiosity over this "New buzz weapon."

On one road block an M-15 and M-16 fired at least five

A 443d Battalion half track deploys outside an airdrome in Southern France to cover a main road.

engagements each day against infiltrating Germans only 100 yards away and closer at times. Fanatical Nazis even threw rocks, when their supply of hand grenades was depleted, trying to dislodge the ack-ack weapons.

In all, a total of ninety-two ground missions were fired by the three battalions during the Vosges Campaign. These involved a total ammunition expenditure of 3,500 rounds of 37mm and 130,000 rounds of .50 caliber. Their missions included neutralization of enemy machine gun nests and troop concentrations, road interdictions, tree bursts over dug-in positions, fire fights with enemy infantry, AW protection of road blocks and several victorious duels with enemy flak wagons.

Air war in the Vosges was only part of the 90mm battalions battle, because they took a goodly share of the field artillery firing of the Corps and the Germans particularly dreaded the 90mm shells because they had no warning whistle—until too late. "Rautsch-Boom" was the Germans' nickname for this shell that always came suddenly without warning because high velocity got the shell there almost simultaneously with sound. Our field artillery commanders favored the 90's for placing a large amount of fire on a target in a short period of time. One battery of 90's was equivalent to two battalions of 155mm's in maximum rate of fire.

During the 60 days ending 24 November 1944, the Brigade's forward heavy battalions, the 72d AAA Gun Battalion and 216th AAA Gun Battalion, fired 25,086 rounds on 1,300 ground targets. The daily average was 21 missions. Ammunition restrictions held the figures down during the first part of the period but toward the end, 40 to 50 missions daily were the rule. Roughly 1/9 of the rounds were fired as air-bursts.

Men of the 72d had one of their most unusual shoots during October 1944, near Nassoncourt while "D" Battery was firing on a German troop concentration. The rounds were hitting home and FA observers reported high casualties but suddenly the AAOR reported two ME-109's coming in fast toward the battery while it was in the midst of its FA mission. The men instantly swung their guns to the hostile planes and fired direct laying with three-second precut fuzes. One plane crashed in flames, then the gunners went back to work on the enemy ground troops. The whole interruption covered only two minutes time.

"A" Battery of the 216th had one of the most unusual shoot records in France. Registering on a house, the fourth round hit the building, causing about 20 Germans inside to take to the streets. As they ran the observer shifted fire to follow them; many fell, and one took the count when he was hit in the back by a 90mm shell.

It was also in France but shortly after the capture of Strasbourg that "D" Battery of the 216th got in some pinpoint shooting when, near Lingolsheim, it fired across the Rhine into a concrete observation tower, one round went directly through the tower window, causing FA observers to brand it "the most accurate shooting" they had ever witnessed. Maybe they could have done this with their FA weapons also if they had had our fire control matériel to assist them.

Next the battle for Alsace began; VI Corps captured Strasbourg and swung north toward the Lauter River and the Siegfried Line while the First French Army in the south became very much involved in the Colmar Pocket. VI Corps penetrated the German border and was pounding away at the Siegfried Line above Wissembourg, Scheibenhardt and Lauterberg in early December 1944.

At this point we were forced on the defensive by the turn of events in the North. The German breakthrough in the Ardennes prevented us from continuing our rapid advance, and we were forced to withdraw to a line more suitable for defense because half our divisions were pulled out of the line to check the great German drive to the North.

That withdrawal will always be remembered by those who participated in it but especially by those who fought so hard to win this vast area of ground which, through necessity, had to be given back to the Germans without a fight. Everyone was on the move and the Alsatians proved which side they were on. They were streaming back with us. Most of them walked, rode bicycles or wagons, each person carrying as many treasured family possessions as possible. This withdrawal was successful and defensive positions were taken up on high ground in Northern Alsace about 30 miles south of the Siegfried Line. The winter was long and hard and the war quieted down to some extent mainly because of the very heavy snowfall.

In March 1945, our last great offensive was opened and we soon moved back to the border town of Wissembourg and crossed the border into Germany. This entry into Germany will never be forgotten; the storming of the Siegfried Line with its dragon's teeth and cleverly camouflaged pillboxes, the destroyed cities of Ludwigshaven and Mannheim, the crossing of the famous Rhine River, the eager anticipation of "seeing how the other side lives," the University city of Heidelberg, the crossing of the not-so-blue Danube, and the final mass surrender of German troops.

At 1030 hours on 4 May 1945, troops of our VI Corps met old friends of the Fifth Army who had driven up from the south through Italy. The historical junction was made

a few miles south of the famous Brenner Pass. On 5 May 1945, the final chapter in our struggle against the Germans was written. At 1800 hours Lieutenant General Erich Brandenberger surrendered unconditionally the remaining elements of his German Nineteenth Army to Major General Edward H. Brooks, Commanding General, VI Corps. Three days later, 8 May 1945, the entire German Army had surrendered unconditionally to the Allies and Victory in Europe was finally ours. The cessation of hostilities found the 35th AAA Brigade with a total score that is probably unequaled by any other brigade. Throughout its overseas operations, units while assigned or attached to the Brigade were credited with 407 enemy aircraft definitely destroyed and 286 probably destroyed not to mention the valuable contribution made by Brigade units in ground roles.

If there was even any doubt of the adaptability of Coast Artillery Corps personnel and the versatility of our antiaircraft matériel certainly units of the Brigade erased it. This short history of their exploits could not possibly chronicle all the accomplishments of all the units which performed such outstanding service under the Brigade but it is hoped that credit has been given where due and that the highlights have been touched upon.

In the final analysis this history is the same as any other major artillery unit history; it is the story of the individual gun crew and groups of gun crews, in short it has been the story of the soldiers manning the weapons and to them the story is dedicated.

A Flag Day Tribute

FLAG SALUTE

BY KARL VASS

I pledge allegiance to Old Glory,—
  Flag of the U. S. A.,
Whose banner, born in battle gory,
  Leads the world today;

And should my country ever need me
  I await the call
To follow where Old Glory leads me,—
  Pledge my life, my all.

JET PROPULSION—

By Captain C. R. Tosti, Air Corps and J. B. Tuzen

"Future military requirements of supersonic speeds demand the production of jet propulsion power which is available only in engines with turbo jet, ram jet, and rocket characteristics." R. L. Wassell, Colonel A.C., Chief of Engine Research, Wright Field.

Foreword

Are you familiar with the history of jet propulsion? Do you understand the principle of operation of jet propulsion engines? Have you any conception of the present and probable future applications of jet propulsion to aircraft and guided missiles? If your reply to these questions is in the negative, or if you are anxious to consolidate, organize, and, perhaps, augment all of the miscellaneous information you have picked up on the subject to date, we recommend this article to you.

In preparing this article we have attempted to summarize the story of jet propulsion for the edification of the non-technical reader who is interested in obtaining a sufficiently broad idea of the subject to discuss it intelligently and to appreciate the significance of any developments about which he may read in the future.

Introduction

Jet propulsion is based on the principle of reaction as postulated in Sir Isaac Newton's Third Law of Motion which, in essence, states that to every action there is an equal and opposite reaction. However, you may ask, how does jet propulsion differ from any other type of propulsion? Isn't all propulsion based on reaction? For instance, are not walking, running, swimming and many other operations of everyday life based on Newton's Third Law? Yes, that is true. All propulsion is associated with reaction. Even the action of a conventional aircraft propeller which pulls an airplane through the air consists essentially in increasing the momentum of the air passing through the propeller, and can, therefore, be considered as the reaction of the increased momentum.

How then shall we differentiate between jet propulsion and other methods of propulsion which are also based on the reaction principle? The distinction lies in the fact that in the case of jet propulsion, gases are ejected from the propelled body itself through a suitably shaped discharge nozzle and the propulsive force, or reaction, occurs within the body. Several different types of jet propulsion devices have been used, are in use at present, or are being developed for use in the future. These will be described in greater detail later in this article. It will suffice to say at this point that jet propulsion devices are divided into the following general classes:

1. Devices which utilize air from the atmosphere:
   a. Mechanical Jet Units—air is compressed and ejected with an increase in velocity.
   b. Thermal Jet Units—air is compressed, heat is added to it by the combustion of a fuel, and the gases formed are ejected with an increase in velocity.
2. Devices which do not require air from the atmosphere—these devices are called rockets and carry a self-contained fuel system, including the oxidizing agent required for the combustion process to form the gases which are ejected through the discharge nozzle.

The Principle of Jet Propulsion

In order to understand more easily what jet propulsion is, we should associate it with some familiar everyday illustrations of the principle such as the "kick" or recoil of a gun, the operation of a lawn sprinkler, or the flight of a Fourth of July skyrocket. In all of the illustrations cited, the "reaction" mentioned in the statement of Newton's Third Law of Motion is at work. For instance, in the case of the gun, let us see what takes place. When the trigger is pulled and the powder is detonated, combustion occurs and gases are formed. These gases which expand explosively exert pressure in all directions within the barrel of the gun in trying to escape. When the projectile leaves the barrel, the gases at the nozzle end of the barrel, are allowed to escape while the remaining gases are still exerting pressures against the breech end of the gun. As a result of this unbalance in forces, motion occurs in the direction of the greater force, thus the "kick" or recoil of the gun occurs. In other words, since an expansion of the gases occurs, there must be a force within these gases to cause them to expand and to expel themselves through the gun nozzle; since there is such a force in action, it follows, in accordance with Newton's Third Law of Motion that an equal and opposite force, or reaction, must be in play. It is this reaction applied to the inside of the barrel in a direction opposite from that in which the gases are being expelled which causes the gun to recoil.

This same principle applies to the jet propulsion engine—it is the reaction within the gases bursting out of the discharge nozzle which drives the airplane forward. Actually, the operation of the jet engine may be visualized as a con-

PART ONE

st, Present and Future

tinuous recoil action which would be obtained if it were possible to fire a gun at an infinitely high frequency.

From this discussion of the principle of jet propulsion, it is obvious that the reaction which propels a jet engine occurs within the engine; and, contrary to popular belief, does not occur as the result of the exhaust gases "pushing against the outside air." In order to appreciate the principle of operation of jet propulsion, you must grasp this concept—that outside air is not necessary to achieve jet propelled motion.

A gun fired in a vacuum would "kick," or recoil, with the same force as it does when air is present. Similarly, a jet propelled aircraft, providing that it carries an internal source of air necessary for the combustion processes of the engine, will operate in a vacuum. In fact, a jet propelled aircraft will operate more effectively at high altitudes where the air is less dense and offers less aerodynamic resistance than the denser air at lower altitudes.

Historical Background—? B.C. to Early 1930's

Having established the basic principle involved in jet propulsion, let us see how novel the principle is. As early as 130 B.C., a philosopher from Alexandria, named Hero, demonstrated his aeolipile which is reputed to be the first apparatus converting steam pressure into mechanical power, and probably the earliest demonstration of the principle of jet propulsion. Hero mounted a hollow sphere between two supports over a closed vessel containing water which was converted to steam by a fire burned under the vessel. One of the supports was hollow and served to transmit the steam from the closed vessel to the hollow sphere. The sphere was caused to revolve by the reaction created by the escape of the jets of steam from two pipes with right angle ejecting nozzles which were affixed to the sphere on opposite sides.

Aside from Hero's toylike device, the first practical application of jet propulsion was made by use of the skyrocket as signalling and illumination devices and decorative fireworks. The Chinese are credited with the use of rockets employing the exhaust gases of burning powder as a means of propulsion several centuries before the advent of Christ. The earliest known occasion of the employment of rockets for the purposes of warfare was the defense of Pien Ching China, during a Mongolian siege in 1232 A.D. Soon after this, rockets made their appearance on the battlefields of Europe and during the 13th, 14th, and 15th centuries they were clothed in many ingenious guises, such as floating fishes, running rabbits and flying pigeons, to set fire to enemy fortifications. With the introduction of the cannon, the use of rockets disappeared for several centuries since artillery fire was more efficient and more accurate.

Although Hero and the thousands of rocket makers who created the devices described above made use of the principle of jet propulsion, they were unaware of its theory. They merely knew that their devices worked. It was Sir Isaac Newton who explained the phenomenon by the postulation of his famous Laws of Motion, previously mentioned in this article. Newton proceeded to apply these laws to the design of a jet propelled vehicle (Figure 1). The engine of this vehicle consisted of a spherical boiler mounted over a fire. The top of the boiler had a rearwardly directed nozzle through which the steam was allowed to escape to provide the propulsive thrust. You will notice that the speed of the vehicle was to be regulated by the driver's control of a steam cock in the discharge nozzle. No tangible evidence exists to indicate that Newton ever constructed this vehicle. In principle, however, we must concede that it was a workable idea.

As the 19th century began to draw to a close, the seeds of thought were beginning to be planted for the development of thermal jet units. The evolution of these thoughts and experiments resulted in the jet propulsion engine as we know it today. The names of some of the pioneers in this field are: Circiu of Rumania (1886), Octave Chanute of the United States (1886), Marconnet and Lorin of France (1909), Morize of France (1917), H. S. Harris of England (1917), and Dr. Gustave Eichelberg of Switzerland (early 1930's).

Modern Era of Jet Propulsion

In 1927, the Italian Air Ministry began work leading to the development of the only practical application of the principle of mechanical jet propulsion to an aircraft which has been recorded in the annals of aviation history. At that time, the Italians began investigating the possibility of a venturi tube fuselage with the propeller placed at the mouth of the tube. The theory behind the development was that the slipstream issuing from the rear orifice would supply an additional thrust along the tube, thus increasing the propeller thrust. Between the years 1928 and 1931 numerous wind tunnel tests were made; and, in 1932, a monoplane was built by the Caproni Aircraft Company for the Italian Air Ministry. In flight tests, this airplane exceeded the anticipations of its designers; and, although not of very high performance, it showed itself to have excellent maneuverability and stability.

The principle of the Mechanical jet unit just described involves merely the compression and expansion of air and

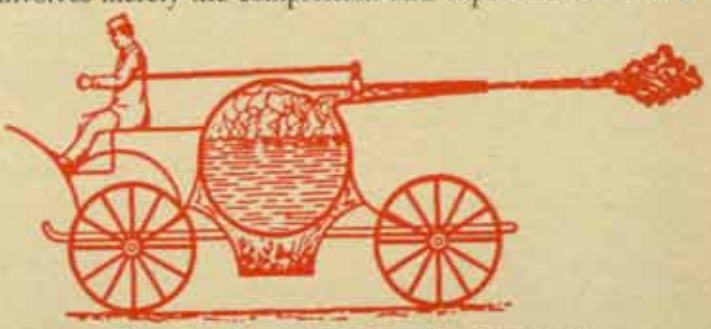


Figure 1—Newton's "Horseless Carriage."

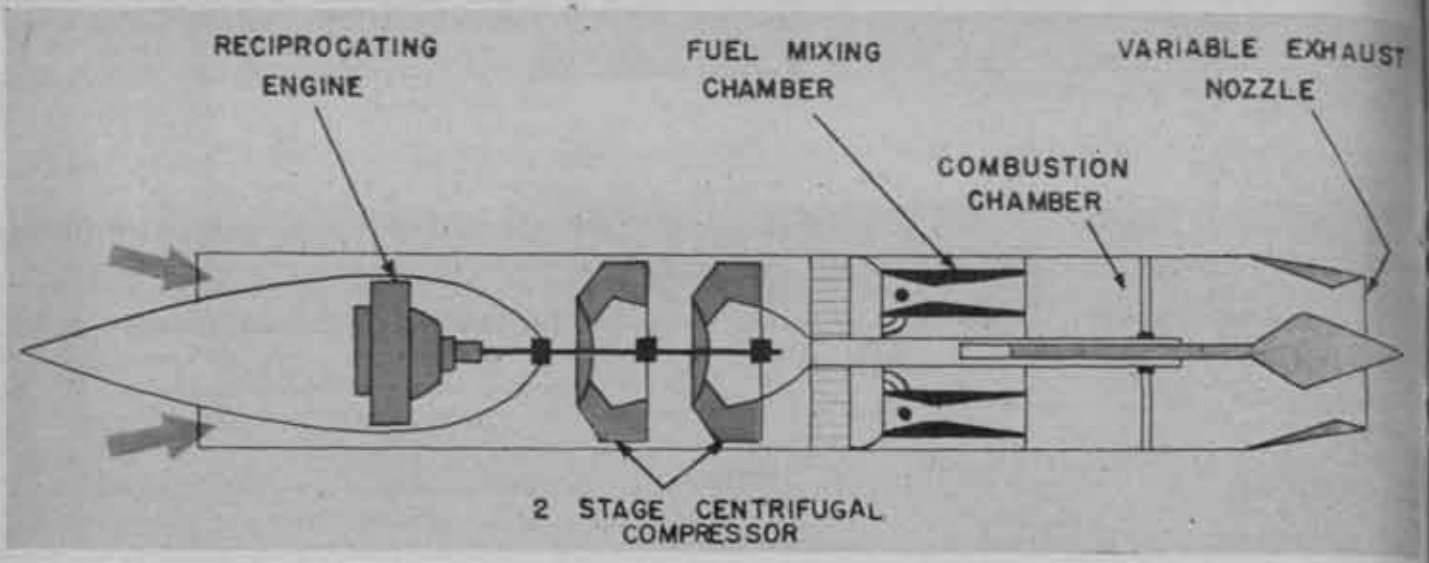


Figure 2—Schematic of Campini Principle.

its discharge at a greater velocity without the addition of any heat to the air. However, when we think of jet propulsion devices today we are thinking, in general, of thermal jet units, the main features of which are:

a. A means for compressing air—COMPRESSOR.
b. A means for adding heat to the air by the combustion of a fuel—COMBUSTION CHAMBER.
c. A means for the expansion of the resulting gas-air mixture—DISCHARGE NOZZLE.

The first thermal jet unit we shall discuss is the Campini System proposed in 1932 and illustrated by the schematic diagram (Figure 2). Air was admitted through the annular opening as indicated by the arrows. The annular space widened out to convert the kinetic energy of the air into pressure energy. The air then passed through a two-stage centrifugal compressor driven by a reciprocating engine and was compressed into the combustion chamber where fuel was introduced and ignition occurred. The expanding gases were then discharged through the nozzle to obtain the propulsive thrust.

Among the first jet airplanes to fly were two airplanes built in accordance with the principle described above. The first airplane, usually referred to as the CC1 (Campini-Caproni), was built in 1940. It was of all-metal construction and weighed 8800 pounds. A trial flight was made on the 27th of August 1940 at Milan and the plane remained in the air ten minutes. Until the details of German aviation developments were learned after the fall of Germany, this flight was recorded by historians as the first ever made by a jet propelled propellerless plane incorporating a thermal jet engine. Actually, the first flight was made in Germany exactly one year before, on the 27th of August 1939 by a Heinkel 178. In 1941, a revised version of the CCI, designated the CC2, was flown from Milan to Rome, a distance of 168 miles, with a stop at Pisa, probably for refueling. The speed attained was reported to be 130 MPH and the fuel consumption was excessively high. The use of the internal combustion engine to drive the compressor was inefficient and increased the weight of the plane considerably.

A logical improvement on the Campini system was the gas turbine type of thermal jet unit invented by Air Commodore Frank Whittle of Great Britain. Campini used the energy of the expanding gases only for propulsion; Whittle employed this energy not only for propulsion, but also to drive the compressor and thus to eliminate the necessity of using a reciprocating engine which was highly inefficient for this application.

In the Whittle design, air is compressed by a centrifugal compressor into combustion chambers where the fuel is injected and the gas-air mixture is ignited. The expanding gases which result from the combustion process then pass through the turbine wheel and drive it and the compressor, which is mounted on the same shaft, thus providing more air to maintain the continuous combustion process. Only a part of the energy of the exhaust gases is utilized to drive the turbine and the compressor; the rest of the energy is utilized for the propulsive thrust obtained from the expanding exhaust gases as they are ejected through the discharge nozzle.

In January 1940, Whittle obtained his first patents on a jet propulsion engine. On April 7, 1941, during taxiing tests the airplane became airborne, reaching an altitude of six feet for 100 to 200 yards range. The first official take-off of the Gloster Pioneer E-27, forerunner of the Gloster Meteor, occurred at Cranwell on the 15th of May 1941, almost two years after the flight made by the German HE 178. The flight lasted 17 minutes and was successfully completed. The Army Air Forces "started things cooking" in America after the successful flights in England. In July 1941, a special American technical mission viewed the British-developed jet engine at Rugby. As a result of this investigation, arrangements were made to conduct the development of turbo jet engines, based on the Whittle design, in the United States. At the time this decision was made, only fifteen flights and ten hours of jet engine operation had been accumulated in the United Kingdom.

The development of the turbo jet in the United States was entrusted to the General Electric Company because of the experience which this company had gained in the de-

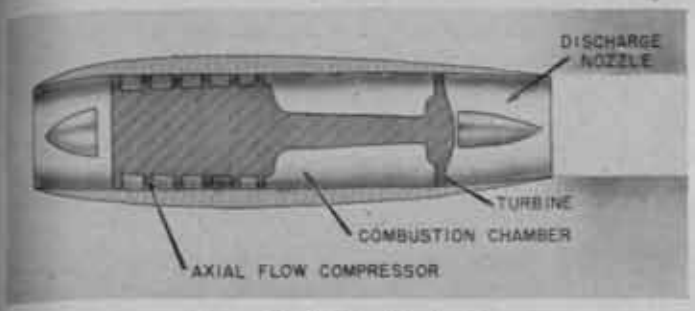


Figure 3—Turbo Jet Engine.

velopment and production of the turbosupercharger for high altitude, high-power, American reciprocating engines. Essentially, the turbo jet engine is a large turbosupercharger with a means for the combustion of the fuel-air mixture incorporated.

Perhaps the outstanding jet engine today is the British Rolls-Royce "Nene."

Besides the development of turbo jet engines of the Whittle design, the development of axial flow type turbo jet engines has been conducted in this country. The principle of operation of this type of engine is exactly the same as that of the Whittle engine. However, the design of the axial flow compressor, as can be seen by the schematic diagram (Figure 3), consists of a series of rows, or stages, of blades rather than one large centrifugal compressor. In this way, a compressor of smaller diameter can be designed to provide the required amount of air compression. Consequently, an engine of smaller diameter can be constructed. Such an engine offers the advantage of less drag, or, in other words, it provides greater horsepower per unit of projected frontal area.

The first American developments of this type of engine were carried on by the Westinghouse Company for the Bureau of Aeronautics of the Navy Department.

In addition to the development work in the field of the turbo jet engine, development has proceeded in the field of turbo prop engines. You will notice from the schematic diagram of the turbo prop engine (Figure 4), that internally, its construction is similar to that of the turbo jet engine, the major difference being that the turbine wheel is larger in the turbo prop engine, since a greater portion of the energy in the gases must be utilized to drive the propeller in addition to the compressor. The remainder of the energy in the gases is used for jet propulsion. Actually, the jet propulsion is relegated to a position of secondary importance and serves merely to augment the thrust obtained from the propeller.

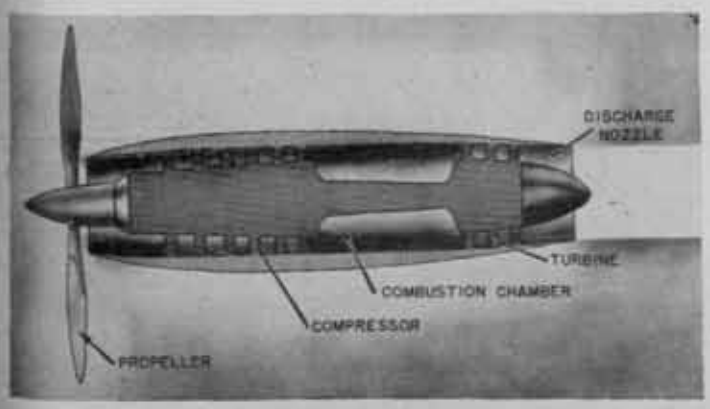


Figure 4—Turbo Prop Engine.

The first turbo prop engine built in the United States is the General Electric T-31.

In order to visualize more clearly the relative performance obtainable from the conventional reciprocating engine, the turbo jet engine and the turbo prop engine let us refer to Figure 5.

You will notice that the conventional reciprocating engine is more efficient than either the turbo prop or the turbo jet engine up to an altitude of approximately 35,000 feet, and 400 MPH. However, above 400 MPH, the efficiency of the reciprocating engine drops off sharply because of the highly inefficient operation of present-day propellers above that speed. The turbo prop engine, although more inefficient than the reciprocating engine up to 35,000 feet and 400 MPH, becomes more efficient at speeds above 400

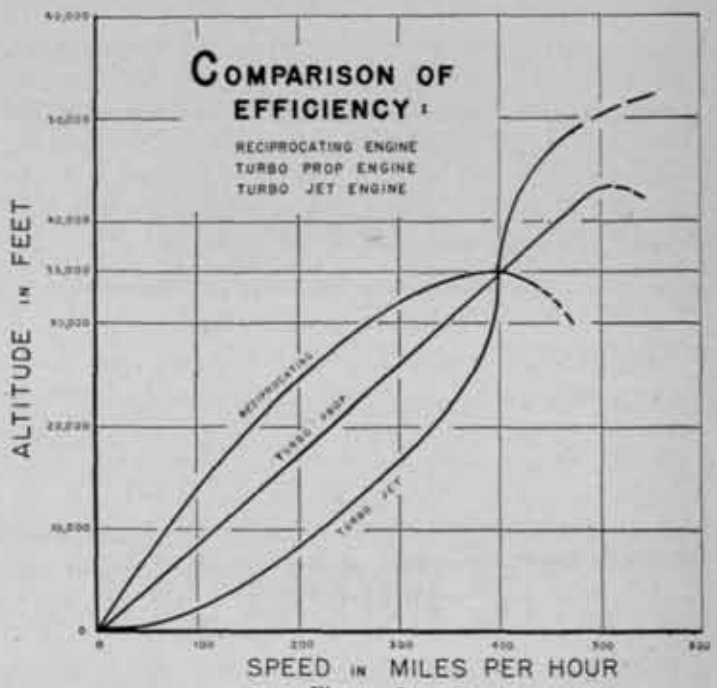


Figure 5.

MPH and will possibly attain efficient performance up to a maximum altitude of 45,000 feet at 500 MPH. The turbo prop engine is able to obtain this added performance because of the thrust augmentation obtained from the auxiliary jet propulsion. The turbo jet, or pure jet, engine is less efficient than either the reciprocating engine or the turbo prop at lower speeds and altitudes, but above 35,000 feet and 400 MPH it comes into its own and surpasses either of the other two types of engines in performance.

Up to this point, the discussion of modern thermal jet units has been confined to British and American developments which have, to a certain extent, proceeded hand in hand. Equally important in the discussion of the subject of jet propulsion is the story of the development carried on by the Germans. During Hitler's regime, a tight "Iron Curtain" was maintained on the activities in German aviation, especially in the field of jet propulsion. By the latter stages of World War II, the threads of the story of German developments began to be woven together into an interesting and amazing tapestry revealing unusual accomplishments in all of the major fields of jet propulsion de-

velopment including the turbo jet, the pulse jet, the ram jet, and the liquid propellant rocket.

As early as the year 1934, development work on the turbo jet engine had begun in Germany.

Junkers, who were leaders in the field of German aviation, started their preliminary turbo jet research and development work in 1937. Late in the year of 1939, Junkers had accumulated sufficient engineering background to begin preliminary layout work on the most outstanding German turbo jet engine developed during the War—the Jumo 004. By the end of 1943, both the Juno 004 engine and the Messerschmitt ME 262 were ready for mass production, and several other turbo jet and turbo prop engines were under development.

In the summer of 1944, ME 262 squadrons were formed and went into action against the Allies in Western Europe. The British and Americans had obtained vague information on German turbo jet developments from prisoners of war and were, therefore, aware of the existence of turbo jet aircraft in Germany before they went into action against Allied aircraft. Late in the Summer of 1944, Allied Intelligence teams were able to piece together a fairly good picture of German turbo jet development from the battered parts of an ME 262 airplane which had crashed in Allied territory. Thus, the "Iron Curtain" of secrecy had been cracked, although not yet rendered asunder.

Non-Rotating Power Plants
The Pulse Jet Engine

In reading about pulse jet engines one may come across many strange and high sounding names, such as resojet, aeropulse, intermittent ram jet, aeroresonator, autopulse and pulse jet. The principle of operation of all these engines is basically similar except that the aeropulse and autopulse work on the principle of forced oscillations which are generated by timed ignition, while in the other engines the necessary compression and ignition occur in the phases of operation as will be described for the pulse jet.

The pulse jet engine shown in Figure 6 is a very simple engine consisting of a tubular combustion chamber equipped with an air-intake valve system in front and with a discharge nozzle in the rear. The engine has only one moving part, namely, the air-intake valves.

The operating cycle of the pulse jet engine is divided into the following phases:

Starting Phase—The pulse jet engine is started by compressed air from an external source. The compressed air actuates a fuel metering system which during starting reduces the fuel flow to the combustion chamber to a predetermined amount; at the same time, compressed air with enough velocity to aid in the atomization of the fuel is injected into the chamber. This carefully adjusted mixture of fuel and air now in the combustion chamber is ignited by a conventional spark plug (used only during starting).

Charging Phase—After ignition, the pressure in the combustion chamber rises and exerts equal forces in all directions, keeping the air-intake valves closed. The force exerted rearwardly meets no resistance and the gases are discharged through the narrow end of the combustion chamber and the rear discharge nozzle. The inertia of these escaping gases reduces the pressure in the combustion chamber below atmospheric thus creating a suction effect causing the air-intake valves to open allowing a fresh charge of air to rush into the venturi section. Similarly, after each engine discharge, fuel is drawn into the combustion cham-

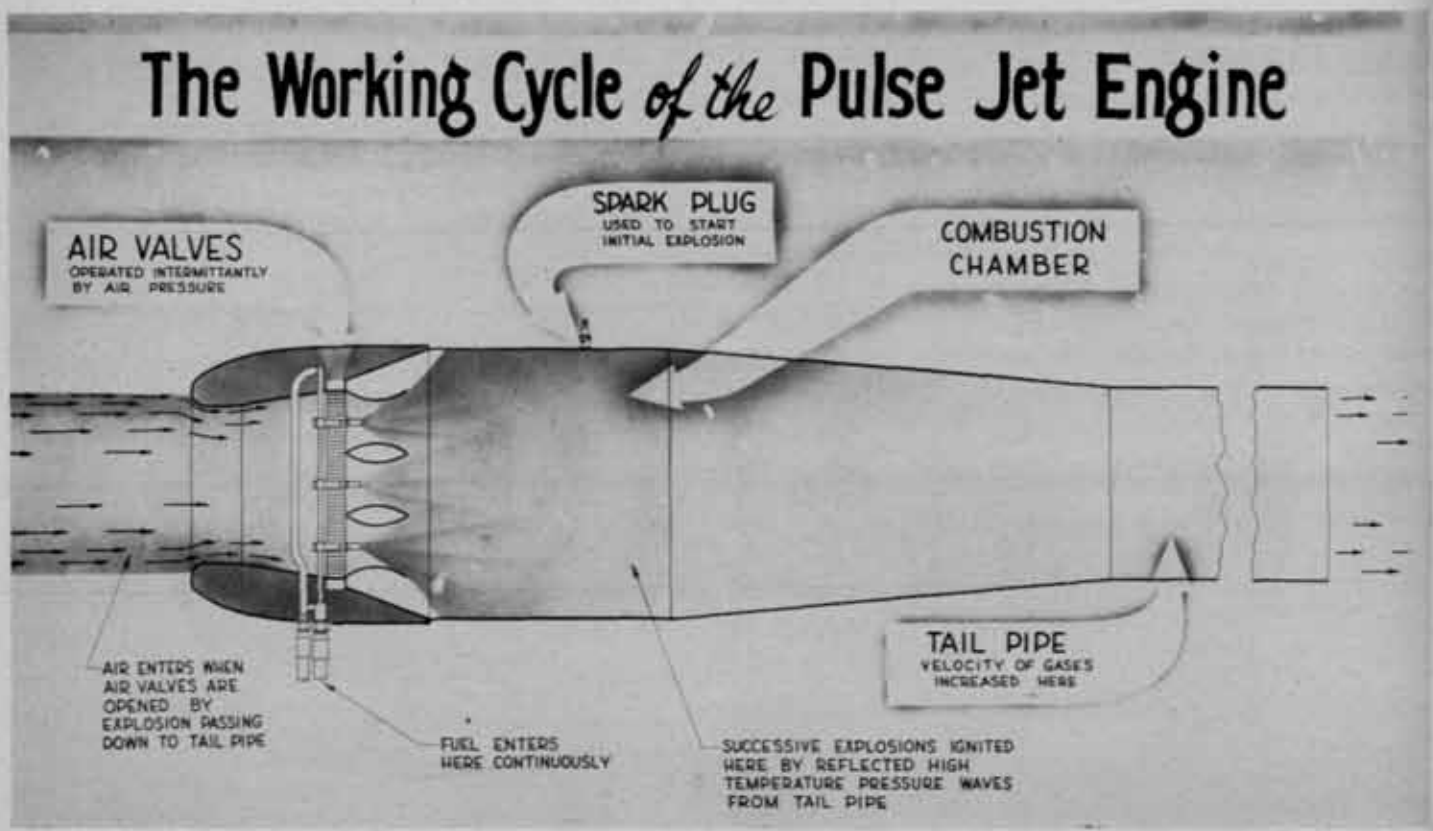


Figure 6.

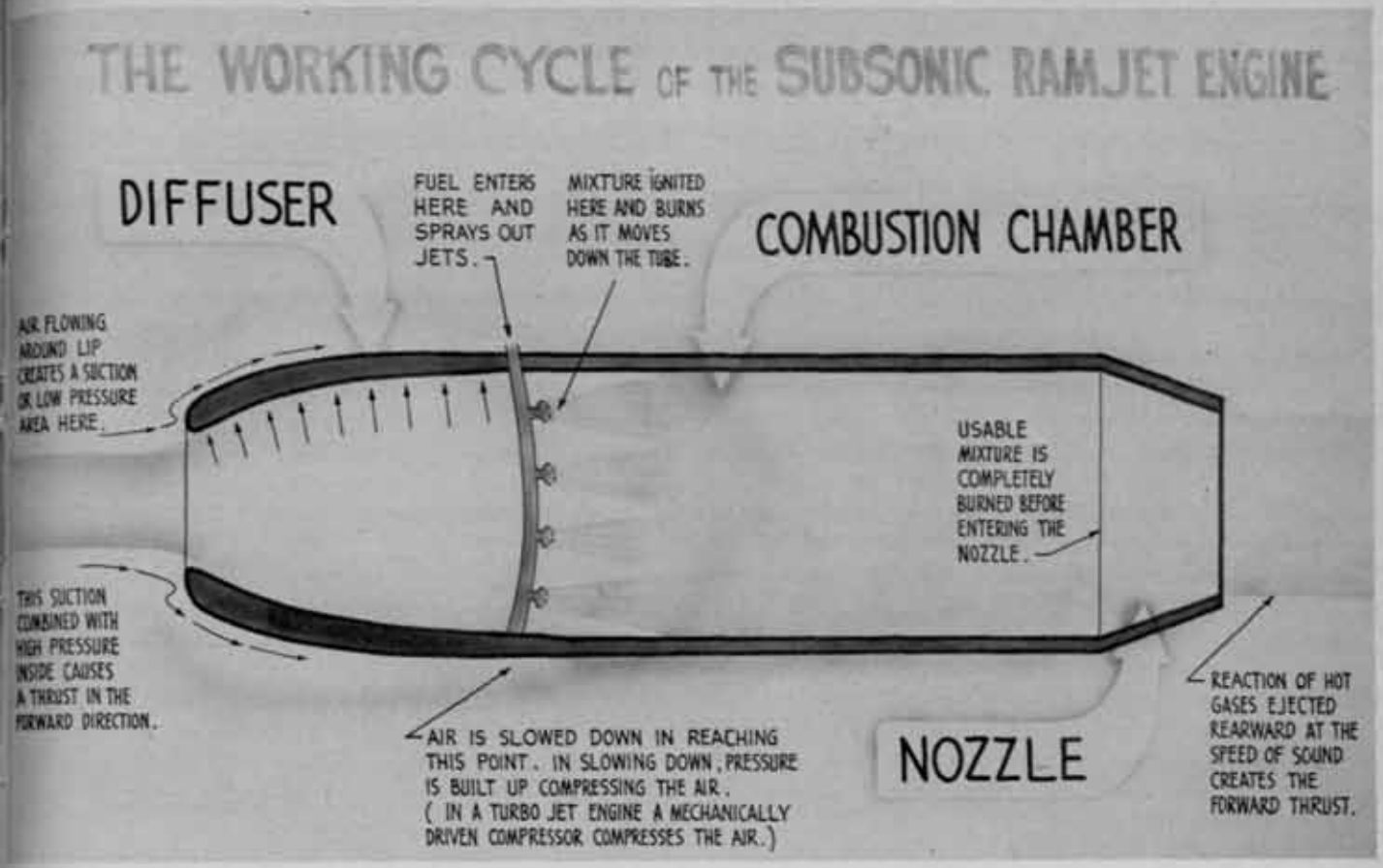


Figure 7.

ber by the difference in pressure between the inside of the combustion chamber and the fuel metering system.

Exploding Phase—The fresh mixture of fuel and air is ignited by means of the residual flame left in the combustion chamber after the initial discharge. As in the Charging Phase, after ignition the pressure in the combustion chamber rises and exerts equal forces in all directions, closing the air-intake valves. The high pressure spent gases exhausting from the discharge nozzle give the pulse jet its forward thrust. The charging phase occurs again and the cycle of operation repeats itself. The timing of the cycle of operation of the pulse jet engine is governed by its frequency, which is dependent upon its construction. In the pulse used in the V-1, the cycle of operation repeated itself 40-50 times a second, other designs of pulse jets have frequencies of over 200 times per second. Once the starting phase is properly initiated, the pulse jet commences to cycle and produces thrust at zero flight speed. The pressure in the combustion chamber is controlled by the rate of fuel injection and this, in turn, controls the discharge velocity of the gases and thus the propulsive thrust.

On June 13, 1944 the first V-1 robot bomb employing the pulse jet engine fell on England, approximately twenty-five miles north of London. On June 15, 1944 the first V-1 bomb fell on the City of London and scored a hit in approximately the geographical center of the city. These attacks which continued for approximately three months until the Allied Forces on the Continent captured the launching ramps may be considered to mark the dawn of a new era in warfare—The Era of the Guided Missile.

The German pulse jet engine had a very short life and poor altitude performance. The noise and severe vibration did not make the pulse jet a very suitable system for piloted aircraft. Nevertheless the Germans had planned to install two of these pulse jets in the ME 328 and there were other single projects intended to be used as piloted flying bombs and ground strafing aircraft. In fact, the Japanese actually contemplated employing the German V-1 as a piloted "Kamikaze" airplane to be used in suicide attacks against the Allies.

The Americans conducted no research or development work on pulse jet engines before the war and it was not until about one month after the first V-1 fell in England that the Americans had an opportunity to examine Hitler's new secret weapon. Badly damaged parts of two German pulse jet engines were received at the Power Plant Laboratory, Wright Field and within two weeks after arrival at the Power Plant Laboratory engineers evaluated the German engine as to its principle of operation and had a "Chinese copy" of the German design fabricated at Wright Field and running on the test stand. The close cooperation between the Army Air Forces and American Industry, enabled the Ford Motor Company to start a development and production program by the end of October 1944. Although the American version of the German pulse jet was basically a Chinese copy, its performance was greatly improved through further development and refinements. Unfortunately, the American version of the V-1 never became operational against the enemy.

The Ram Jet Engine

The ram jet, or athodyd, is perhaps, one of the simplest

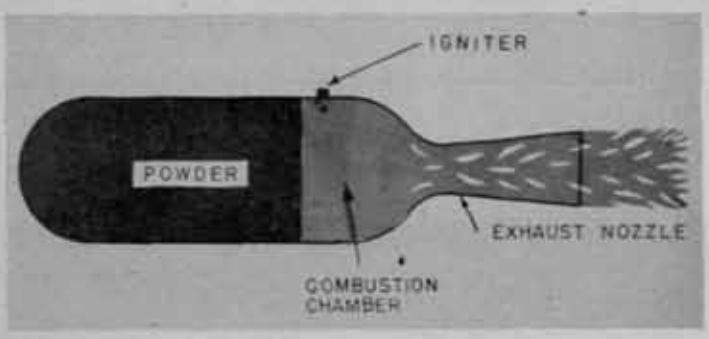


Figure 8—Schematic Diagram Solid Propellant Rocket.

power plants under development. Ram jet engines are divided into two classes, subsonic and supersonic. Basically, the principle of operation of either type is the same. The major difference between the two types is in the design of the ram jet diffuser for supersonic operation. Figure 7 illustrates the working cycle of the subsonic ram jet. Exclusive of the fuel system, this type of power plant has no moving parts and utilizes the basic principle of operation common to any internal combustion engine, including that of the family car. The automobile engine operates on a four-stroke cycle; intake, compression, power and exhaust. In the case of the ram jet, the complete cycle of operation is applied to the air flowing through the ram jet in a continuous path with no interruption. Air moves into the ram jet at high velocity (INTAKE), once inside, it is slowed down by diffusion and compressed, creating a high pressure (COMPRESSION). By the addition of heat to the air through the combustion of a fuel, the outlet velocity of the air is made to exceed the inlet velocity by a wide margin. This increase in velocity produces the necessary thrust for forward motion. (POWER AND EXHAUST).

The ram jet differs from the other jet propulsion units in that no thrust is produced at zero speed. Forward motion is required for ram pressure since the thrust of the ram jet increases rapidly with increasing ram pressure. Because of the increase in performance with increase in ram pressure the ram jet engine appears to be the most suitable power plant for propelling airplanes through the sonic barrier to attain speeds in excess of 1500 MPH. However, in order to attain the designed speed at which the ram jet engine will operate most efficiently, auxiliary launching devices, such as rockets and catapult, will be required.

By the Fall of 1944, while developments in this country were in the talking stage, the Germans built and flight tested a ram jet designed to produce a gross thrust of 4400 lbs. at 500 MPH. In all of the research and development work done by the Allies on ram jet power plants, only liquid or gaseous fuels were considered. It wasn't until shortly after the fall of Germany that investigations revealed that the Germans were working on ram jet experiments using solid fuels, such as coal, as well as liquid fuels. One of the major advantages which the Germans saw in the ram jet engine was that it would adapt itself easily to the use of solid fuels which is not the case with other types of internal combustion engines whose operation would be affected by the soot and ashes resulting from the combustion of a solid fuel. The Germans devoted only the last eight to ten months before the fall of Germany to this project. They designed a ram jet engine which contained crushed charcoal in a wire grate basket which, in turn, was suspended in the combustion chamber. The wire basket had front and rear grated walls permitting an access of draft air to the fuel. During these crude experiments and other experiments similar in nature but with different fuels and configurations of fuel briquettes, the Germans proved that the ram jet could be driven with crushed solid fuel and that the magnitude of thrust obtained by the use of solid fuel is of the same numerical order as that obtained when the ram jet is operating on liquid or gaseous fuels. Approximately a year ago, the Army and Navy became interested in the use of solid fuels for ram jets because the highest possible performance of this fuel had not been attained by the Germans and because its performance might be improved by rebuilding the ram jet power plant to conform more closely to aerodynamic conditions.

The Rocket Engine

Up to this point, all of the engines under discussion can be termed as "air breathing engines" that is, the operation of these engines depends on an external source of air supply. Naturally, all air breathing engines are limited in their maximum altitudes of operation. Therefore, in order to remove this altitude restriction, we must resort to engines which have self-contained air and fuel supplies. Such engines are classified as rockets.

There are two main classes of rockets—the solid-propellant and the liquid-propellant. The principle of operation of these two types of rockets is essentially the same. The fundamental propulsion system of a rocket consists of a body of hot gases which exerts a high pressure on the walls of its combustion chamber. This chamber has a discharge nozzle, so that the gas pressure on the forward end of the chamber is not balanced by a corresponding backward pressure at the discharge nozzle. The rocket, therefore, moves forward under the resulting force while the gases are ejected through the discharge nozzle. Another way of looking at the principle of operation is as an example of Newton's Third Law of Motion, in which the action expended on forcing the gases through the discharge nozzle is balanced by an equal reaction forcing the rocket forward. The faster the gases are ejected backward, the faster will the rocket be pushed forward.

The solid-propellant rocket contains all the propellant in the high-pressure combustion chamber. Figure 8 illustrates a schematic diagram of a solid-propellant rocket. This type of rocket is very simple. The powder charge is contained in the combustion chamber where it is detonated, burns and forms gases which escape from the discharge nozzle and produce the propulsive thrust. Rockets of this type are used as fireworks for military weapons, such as the bazooka, rocket projectiles, for take-off assist on aircraft and many other applications. The main disadvantage of this type of rocket is that once it is fired, the rate of combustion cannot be controlled nor can it be *stopped and refired*, as is the case of the liquid-propellant rockets.

The liquid-propellant rocket is the more interesting of the two types of rockets, in that future long-range guided missiles will use this type of rocket for their power plant. Figure 9 illustrates a schematic diagram of a liquid-pro-

pellant rocket. Since the propellant of a liquid-propellant rocket is stored in tanks, a feed system is necessary to force the propellant from the tanks to the combustion chamber. Various feed systems have been developed, namely, the pressurized-gas system; the gas-generator system, and the turbine-pump system. Usually two different fuels, such as liquid oxygen or gasoline, are admitted to the combustion chamber where they react spontaneously and the products of combustion escape through the discharge nozzle, thus producing thrust. With the use of liquid-propellants, the chemical reaction can be started and stopped at will and the burning rate of the fuel can be controlled, thereby controlling the propulsive thrust.

The main applications for liquid-propellant rockets are as assist take-off devices for large aircraft and as the main power plant for the propulsion of large guided missiles, such as the German V-2, and piloted aircraft.

Rocket research was carried on in America, England, Germany and other countries for many years before World War II, but it was the extensive rocket research in Germany that produced the first rocket propelled fighter airplane to be used as an operational weapon against the Allies. On August 16, 1944, Allied bomber formations were attacked by several of these rocket propelled ME-163 fighters. The attack occurred at such a high speed that the Allied crew men could not give any information about this fighter. After several more encounters, one of the ME-163's was shot down. From the report of the pilot who shot down the ME-163 and from other reports, the Allies were able to form a fairly accurate picture of this rocket fighter.

The Messerschmitt 163 is very short and stubby. Its total flying time with "off and on" rocket operation was about 30 minutes, but only 10 minutes with full "rocket on" power. This airplane attained a speed, in level flight, of about 600 MPH at 30,000 feet. However, this true rocket type fighter never became of much value operationally because of its limited range and undeveloped nature.

Of all the various forms of rockets which have reappeared during World War II, the A-4, commonly known as the V-2, was the most spectacular. The V-2 was the first ionospheric rocket ever to be built as a result of work started in 1938 by the Germans. The first successful launching of the V-2 rocket took place on October 3, 1942, over a range of 150 miles. Development and firing tests were continued until June 1943 when large scale production of the V-2 was ordered. The V-2 became operational against England in August 1944 and was essentially the same as the experimental prototype of June 1943.

Control of the V-2 rocket was effected by two different methods. The first control system consisted of a mechanical arrangement of pre-set controls. This system was elaborated on by a second control system which provided, in addition, for the radio direction of the missile along its flight path. It is interesting to note that the dispersion pattern (50% zone) for the V-2 controlled by the mechanical control system only was a circle with a diameter of 4900 yards. In the case of the radio controlled V-2, the lateral dispersion was cut in half and the dispersion pattern (50% zone) became an ellipse with a major axis of 4900 yards along the direction of flight (range) and a minor axis of 2200 yards

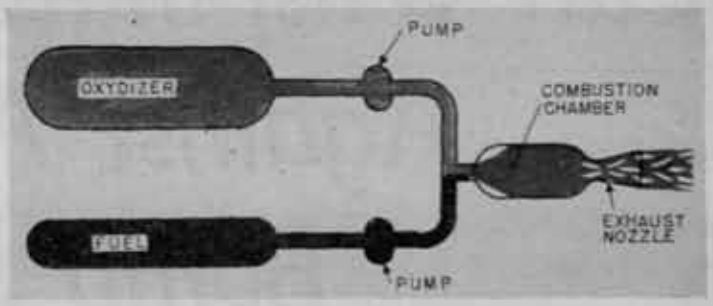


Figure 9—Schematic Diagram Liquid Propellant Rocket.

(deviation). On the basis of these dispersion patterns, the performance of the V-2 rocket missile was considerably better than that of the largest long range artillery whose range is only about one-half that of the V-2. Therefore, with the advent of the V-2, the former superiority of long range artillery over rockets and accuracy has disappeared. When the war ended, the Germans were working on a 100-ton A-9 rocket, which they hoped to use against New York City.

Summary

In the jet propulsion development race which was conducted on both sides of the Atlantic during World War II, the Germans eventually capitalized on their initial advantage in the field of jet propulsion, and, as a result of their feverish concentration on the development of jet propelled fighters and guided missiles as a last ditch defensive measure, they emerged as leaders in the field of jet propulsion when the War came to an end. The Allies were able to put only one jet propelled fighter into operational use—the British Gloster Meteor, which was used over the English Channel against the V-1 robot bomb. The Germans, on the other hand, put into action the following jet propelled devices: The twin-engined ME-262 fighter, the single-engined Heinkel "People's Fighter," the Arado, the rocket propelled ME-163 fighter, the pulse jet engine propelled V-1 robot bomb, and finally, the rocket propelled V-2 guided missile.

Although the Germans and the British have led the way in the field of jet propulsion in the past, American scientists and engineers have been closing the gap in technical knowledge and experience very rapidly since the end of World War II. Today, the United States is in a position to assume leadership in the field of jet propulsion development if the Army and Navy are able to carry out the ambitious research and development program which they have outlined for the future. The success of this program is not conditioned by the availability of engineering and technical knowledge in this country, but by the availability of funds to carry out the program. Therefore, to a large extent, the success of the jet propulsion program of the United States will be determined by the interest which the American people evidence in the program and their desire to maintain American air power supreme.

Part II of this Article will discuss the future of jet propulsion as applied to piloted and passenger carrying aircraft and guided missiles. (July-August issue.—Ed.)

Can Washington Be Defended Against An Atomic Bomb Attack?

By Lieutenant Colonel David B. Parker, C. E.

No problem of the world today is of more import and entails more difficulty than that of defense against the atomic bomb. Much evidence tends to prove that no defense is possible, that none will ever be found. My previous articles in the COAST ARTILLERY JOURNAL have stressed the insuperable power of the bomb and concluded that man's real hope lies in establishing an effective international control of atomic weapons. To be sure, there are certain passive measures which can mitigate the effects of atomic explosions but their application to a large city seems overwhelmingly difficult and expensive. The first reaction of anyone thoroughly familiar with the military use of atomic energy, therefore, is that defense is completely impracticable but let us make a careful examination of the known facts and see whether that first reaction will be confirmed or refuted.

To start, let us determine what type of atomic attacks might be made on the city of Washington, and what the results might be.

There are two types of attack which have so far been tried out: the airburst of an atomic bomb dropped by an airplane and the underwater burst of a bomb suspended beneath a ship in a harbor. Both of these attacks would be extremely effective against Washington. The future may see the development of other types of atomic attacks, particularly in connection with the spread of radioactive materials but the two types just described illustrate all the characteristics with which this article need be concerned.

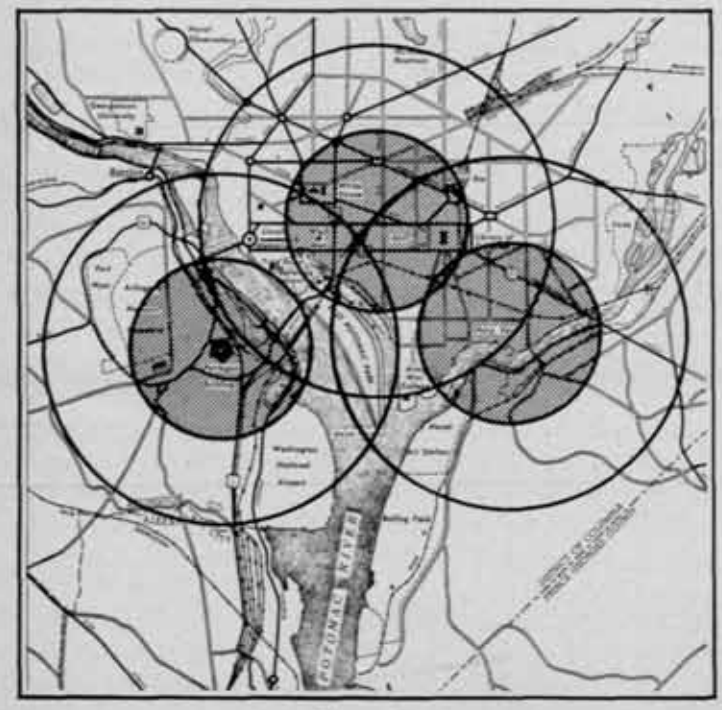


Figure 1.

Figure 1 shows how three airburst bombs might be used to eliminate Washington's usefulness as a city. The aiming points are first, the "Federal triangle," in which most of the critically important government buildings are located; second, the Navy Yard, where a large proportion of Navy ordnance material is manufactured and, third, the Pentagon Building where most of the War Department headquarters are installed. The inner circle around each aiming point shows the area which would be completely devastated—the only structures in this area which could possibly remain standing after the blast would be particularly strong reinforced concrete frames and even these would be completely gutted by blast and fire, their interiors ruined and their occupants for the most part killed. The radius of complete destruction shown on the map is purposely a *conservative* one; it is a one-mile radius although the results of the bombs in Japan and at Bikini indicate that a one and a quarter-mile circle would probably be more applicable to a city such as Washington. The larger circle in each case shows the area which would suffer heavy to moderate damage and in which nearly all exposed persons would be killed. The larger radius is 2 miles and is again on the conservative side. Even outside the larger circle, there would be a great amount of damage and casualties from flash burn, fires, concussion, collapse of buildings, etc.

Note that Bomb No. 1, on the Federal triangle, would completely eliminate the Capitol, the White House, the State Department, the Navy Department Building, the Departments of Labor, Interior, Agriculture, and Treasury, the F and G Street metropolitan shopping area and many other important places. Bomb No. 2 on the Navy Yard would wipe out the Naval gun factory and the important industrial and residential areas of southeast Washington and Anacostia. Bomb No. 3 would destroy the Pentagon, the Navy Annex, and a good part of Gravelly Point. The great residential areas of northwest Washington and Arling

Figure 2.

ton, to name but two, would be relatively undestroyed; but would the city have even one tenth its value as the nation's capital after those first three bombs? Even if it would, there is another, and in many ways even worse fate which might befall it.

Look at the Figure 2. This map shows the effect of two *underwater* bombs exploded in the Potomac and Anacostia Rivers, respectively, at any time when a five to thirty mile wind is blowing from the southeast. The enclosed areas are those which very likely would be covered by a deadly deposit of radioactive particles carried in the dense rain and mist resulting from the explosion in shallow water. It is impossible to predict the exact amount of radioactivity which would be deposited on any particular spot but the enclosed areas conform to everything we now know about the bomb and are certainly not an exaggeration. Wherever the radioactive particles fell, there would be a deadly, unseen, unfelt radioactivity which could kill or permanently injure persons in the affected area.

How would the five bombs just described accomplish their destruction of life and property? The ways in which the atomic bomb kills and destroys have been summarized in print many times already but it may be useful to recapitulate them once more.

The atomic bomb causes damage to *structures* by

A. Blast

B. Fires, from

i. heat radiation at the moment of explosion.

ii. indirect causes such as collapse of buildings and wiring, overturning of stoves, etc.

The bomb causes injury to *persons* by

A. Burns, from

i. flash radiation of heat at moment of explosion.

ii. fires started by the explosion.

B. Radiation injuries resulting from the instantaneous emission of gamma rays and neutrons.

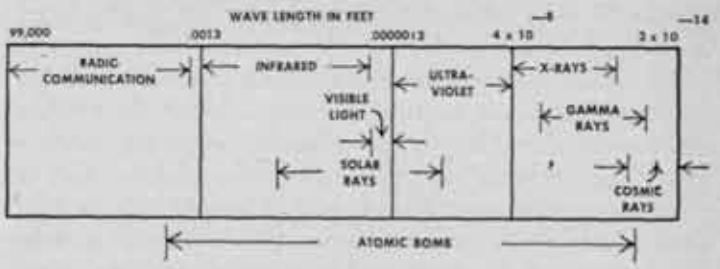
C. Radiation injuries resulting from fission products and induced radioactivity.

D. Mechanical injuries from the collapse of buildings, flying debris, etc.

E. Direct effects of high blast pressure, i.e., straight compression.

The blast from an atomic bomb differs from that of an ordinary TNT explosion principally in magnitude, and therefore in the size of the area over which it is felt. This great power results in a unique destruction feature termed "mass distortion" of buildings; an ordinary explosion can damage only part of a large building, but the atomic blast is so large it can engulf whole buildings, no matter how large, pushing them over as though by a giant hand.

The flash radiation of heat which causes a large percentage of the injuries to persons, and also causes fires, is unique with atomic explosions. Technically, the radiations run the whole gamut from the infrared heat rays of long wave length through ultraviolet rays to gamma rays of exceedingly short wave length. Following is a simplified spectrum diagram which shows how the various radiations differ and overlap:



All these rays are similar in character, differing only in wave length (and frequency, i.e., number of rays per second); they all travel at the speed of light, which is 186,000 miles per second.

Burns are caused by the infrared and ultraviolet rays. It is difficult to say which causes the most burns but ultraviolet rays are in general more effective biologically. The rays come in such an intense flash of such short duration that the surface temperature of an exposed person or object is raised to a very high degree, but the heat does not penetrate beneath the surface. Flash burn of Japanese casualties was very similar in appearance to severe sunburn. The rays which cause the burns travel in a straight line from the explosion and therefore shielding can be effected by interposing some object between the explosion and the surface to be protected. For example, persons who were facing the explosion were burned only in front, and generally only in exposed places—even one layer of clothing often provided protection from flash burn (unless the victim were close enough to the bomb to be charred completely).

Probably the most significant injuries caused by nuclear explosions are those generally called "radiation injuries," referring to the effects of the penetrating short-length waves, viz., x-rays and gamma rays, and also the radiations of nuclear particles, viz., neutrons and electrons. These radiations are unique new phenomena which have never before been

exhibited by any other type of explosive. Gamma rays and neutrons, the most effective of these nuclear radiations, are generally very penetrating and do not produce burns or other injury to the skin. They destroy cells inside the body, and deaths from this cause are comparatively slow, coming for the most part from 3 to 45 days after exposure. These rays are not stopped, like flash burn, by a layer of clothing; gamma rays may penetrate many inches of steel while neutrons, within their range, may penetrate many feet of steel.

The penetrating radiations which have just been described are emitted in huge quantities at the moment of the bomb's explosion but they also are deposited in the vicinity of the explosion so that they remain a hazard for many days, weeks, or months. When the explosion takes place, the atoms of the explosive material break down into lighter atoms which continue, for varying lengths of time (from a fraction of a second up to many thousands of years) to emit the deadly radiations. These atomic particles are spread around the scene of the explosion unless they are carried away by air currents, as in the case of the bursts at Hiroshima and Nagasaki, where the bombs were exploded many hundreds of feet in the air. But Test B at Bikini was a fearful illustration of the power of residual radioactivity. At the time of this writing the radioactivity on some of the target vessels is still significant.

The radiations from the residual particles are generally similar to those emitted at the instant of the explosion except that neutrons are not included. Although the radiations at the moment of explosion cause their injury by penetrating the body in the manner of x-rays, some of the residual radiations take effect only when the radiating particles enter the body by ingestion (breathing or eating) or through a surface cut. The amount of long-life fission products which can be taken into the body without causing death is extremely small, and since some of them have a half-life of many thousands of years the menace is something new and significant. There are many fission products whose radioactivity threat can be utilized, each one with different characteristics—i.e., with different half-lives and different intensities and types of radiations.

The action of these radioactive fission products is such that they might be utilized without the explosion of an atomic bomb itself. For the purposes of this article, however, the development of such a weapon need not be considered separately from the effects of an underwater explosion which by means of favorable air currents deposits a radioactive mist over a target area.

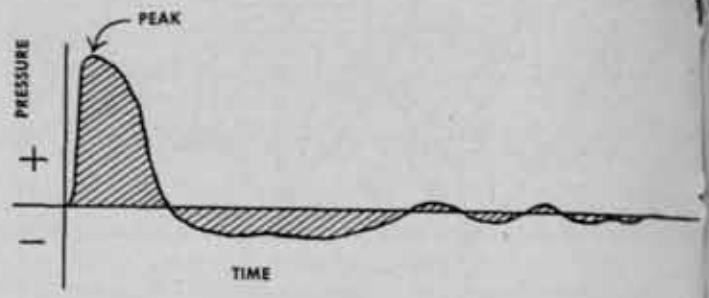
The physical effects of atomic bombs against which protection must be provided can, therefore, be summed up in three groups:

A. Blast (i.e., air pressure wave)
B. Heat
C. Radioactivity, both instantaneous and residual

The problem is whether we can build buildings in Washington which can withstand such attacks, and, if not, what we can do to protect the inhabitants of the city, short of wholesale evacuation of the entire area.

First, we should examine the possibilities of making buildings blast resistant.

The destructive effect of a blast pressure wave depend not only on the peak pressure—the highest pressure valu at any time during the passing of the wave but also upo the length of time during which the pressure acts. Th cumulative effect is, in fact, the product obtained by multi plying the pressure by the time during which it lasts; i.e. P x T, where P is the pressure and T is the time. If a graph is drawn to show the value of the pressure at variou times after the moment of explosion, it might look like this:



The product P x T is seen to be the area under the curve (shaded), and is easily measured once the curve is drawn. Note also that the positive pressure of the explosion is immediately followed by a negative, or suction, phase, which lasts longer than the positive phase.

The pressure wave spreads out from the point of explosion in the form of an expanding spherical surface. A building facing the explosion receives the impact first on its front wall, followed almost immediately—since the wave travels very fast—by the impact on the sides and then on rear. If the bomb is exploded high in the air, as it was in Hiroshima, the roof may be the first to receive the blow. If the building is comparatively large compared to the bomb, as would be the case if a TNT blockbuster exploded a hundred feet in front of the Empire State Building, the pressure, or shock, wave may strike only a portion of the front wall, and that portion will be shattered while the rest of the building remains undamaged. If however the bomb is comparatively large in respect to the building, as was the case of the large buildings hit by the a-bomb in Hiroshima, the shock wave will envelope the whole building so rapidly that it may be pushed over in a heap, in the direction of the blast.

The question is: how can a building be made strong enough to resist the shock of an atomic bomb blast wave? It should be pointed out immediately that the pressures generated in the immediate vicinity—within a few feet—of an atomic explosion are so tremendous that it is entirely impracticable to attempt to design against a *contact* burst. The most that can be hoped for is to design a structure which will resist the blast from a reasonable distance; this distance may well be as much as a quarter of a mile.

When the blast wave generated by the explosion of an atomic bomb strikes a structure, differences are created between the pressures on the windward and leeward sides. It is these differences which make up the loads on the structure which may cause it to fall or collapse. The differences may be between the front and rear of the structure, in respect to the direction of the blast, or between the outside and inside if the structure is completely enveloped by the

wave. The loads, or stresses, have two phases. The first is a shock of short duration during which high pressures on the windward side predominate; this shock can be counted as completed after the length of time that it takes the front of the blast wave to travel from the windward to the leeward side. The second phase is a wind load exerted by compressed air moving at high speed; this load diminishes fairly rapidly and the wind impulse is completed after about one second of time.

There are many complicating factors which cannot be described here. For example, windows and doors in the structure have a major effect on the blast damage. Some of the buildings in Japan were not knocked down because the walls had a large percentage of window openings and the blast swept right through the buildings without exerting quite enough pressure on the frame to collapse it.

There appear to be four ways in which structures can be made blast resistant:

1. By designing above-ground buildings to take the blast
2. By building deeply underground
3. By using a tunnel with very strong walls
4. By using small units well dispersed (this is not really a design solution)

Studies of the effects of blast have first led to the conclusion that the *shape* of the structure plays a large part in its strength. A spherical or cylindrical shape is the best, because:

(a) such shapes create rapid diversion of the blast wave and in this way reduce the effect of the impulse,

(b) the stresses (bending moments and shearing forces) are much smaller than in buildings composed of straight elements.

In general it can be said that the diameter of the structure should not exceed 100 feet—and few of our modern buildings come into this category! A combination of a cylindrical hall with two spherical ends looks like a good solution.

Structures with re-entrant angles, i.e., irregular indentations, are much more affected by turbulence than smooth curved shells and should be avoided. If it is necessary to build a building with a very long aisle, like a modern mill, it should be constructed along anti-earthquake lines: as rigid as possible, and capable of resisting forces acting from any direction. It is obvious that walls should be stiffened, with extra partitions or braces, columns should be reinforced, and roof trusses should be extra strong.

The *material* with which the building is made is also of great importance. Not only must protection against radiations be considered, as will be described below, but also the mass of the material in relation to its strength or stiffness. The dynamic loads set up by a large explosion are resisted not only by the static strength of the structure, but also by its mass and its period of vibration. The theory surrounding these factors is complicated but a few illustrations can be cited. What is desired is maximum rigidity with a given mass. Rigidity does not depend on mass alone. For example, in Nagasaki it was found that buildings with heavy brick walls which had only a small core of reinforced concrete or concrete beams imbedded in masonry, did not have great resistance because the rigidity was far too small for the amount of mass. Reinforced concrete seems the best solution at present, and in part explains why the few building frames which stood up near the blasts in Japan were all earthquake-proof reinforced concrete frames (interiors and fixtures were completely gutted by the blast). What is needed is the exact opposite of what is desirable in an airplane, where aluminum and other light materials give the maximum stiffness with the minimum mass. An aluminum building in Hiroshima would have collapsed long before a concrete building of the same strength but much greater weight, because the heavier building's elements would have had a much greater moment of inertia and therefore would have been slower to respond to the blast pressure wave.

The foregoing has given some idea of what a tremendous task it would be to make all important buildings in Washington capable of withstanding an atomic blast, even if we confined ourselves to distances from the actual burst of at least half a mile—recognizing that anything closer is positively doomed. Imagine trying to place all the business of the Congress, the White House, the War and Navy Departments alone in buildings such as we have just described, with maximum dimensions of 100 feet! It would be far easier to abandon the city as we know it today, and disperse its activities over an area 100 miles on a side. In any case, reasonably complete protection would involve reconstructing virtually everything in the city. The cost? Well, one estimate of the present value of all public structures in Washington is a mere matter of 1,500,000,000 dollars.

All things considered, it appears that design of above-ground structures to resist atomic blasts poses an academic question. Only in the case of a small number of very critical installations is it probable that special design features such as have been indicated above will be utilized. Individual persons and corporations when constructing homes, factories and other buildings can not endure the tremendous additional expense to design their buildings to withstand large explosions. Only the government can hope to secure even its most vital installations by protective construction or by use of underground facilities.

It is underground that the most effective and probably the easiest protection can be found, for earth or rock covering protects not only against blasts but also fairly effectively against the radiations from an atomic explosion. It is significant that small, family-type air raid shelters in Hiroshima, comparatively close to the bomb's explosion, were almost unharmed, and the occupants suffered no ill effects (it should be noted that by the phrase "comparatively close" is meant a distance of at least half a mile from the point of detonation). When and if an atomic war becomes imminent, many citizens will start burrowing as they did in Europe during the last war; only now they must burrow far deeper and still must hope for the bomb not to fall too closely.

Underground construction seems like a fairly good bet for the protection of persons only and not—except in rare instances—for the protection of matériel. In the last war, the subway tubes of London saved thousands of lives. In an atomic war similar underground corridors would afford an appreciable degree of protection, particularly if the ground surface were not contaminated by radioactive ma-

terials. With this knowledge in mind, it would seem worth while for the government to undertake construction projects which could protect, at least to some degree, large numbers of citizens in the event of a future war. Such a project would be, for example, the construction in Washington of a highway or railroad tunnel underneath the Potomac River, linking the District of Columbia with Virginia. Such a tunnel was considered in the past but was shelved for economic and engineering reasons (bridges provide a cheaper and better solution to the traffic problem). However, the possibility of an atomic bomb attack on Washington—which would certainly be one of the first targets in the United States—suggests that the tunnel is worthy of more consideration. The cost might be around twenty-five million dollars but it would afford partial protection to several thousands of persons, which indicates that it is economically desirable if the danger of atomic war is considered great enough. But there are two reasons for arguing against such a construction project:

(a) A future attack may come so swiftly that warning cannot be given in time for people to reach the shelter.

(b) If radioactive materials are deposited on the ground around the entrances to such a tunnel, they will be a serious hazard to those occupants who may survive the bomb blast.

We have seen that the blast problem is as difficult as it could be but now let us turn to one that is not quite so difficult. In Japan, the largest single cause of death from the atomic bomb blast was heat—both flash heat at the instant of explosion and heat from the secondary fires started by the collapse of buildings. However, flash burns were inflicted only on persons who were exposed in a direct line to the explosion. In general, any shielding—whether it be underground shelter, the walls of a building or even a layer of clothing—which protects from the blasts and penetrating radiations, will protect from flash burns. Flash burns will continue to be the major casualty factor when a surprise attack is made on a city but if any warning of the attack is given, nearly all persons should be able to gain shelter from the flash burns unless they are so close to the explosion that the blast and penetrating radiations are more significant anyway. It goes without saying that fireproofing is an essential in any place which may be subjected to an atomic bomb attack; a great part of the damage in Japan was caused by the fires which followed the explosions.

But if our hopes of finding safety are not already laid low by the potency of an atomic bomb's blast and heat then radioactivity will administer the coup de grace. Here we have a completely new weapon whose destructive power seems virtually unlimited. It is, indeed, the first weapon which actually points to a practical means of swiftly ending all life on earth.

Nearly everyone is by now familiar with the concept of radioactivity. Thousands of volumes could be written about the details of its production, use, and effects, even though the subject is still brand new and its ramifications virtually untapped. Instead of trying to summarize some of these details again, let us compare radioactivity to the predecessor which it most closely resembles: poison gas. These points of comparison show why poison gas does not remotely approach the sinisterness of radioactivity.

A. The bulk of gas required to kill a given number of persons is thousands, maybe millions, of times greater than that of radioactive materials.

B. The really lethal power of gas remains for only a few hours or days under the most favorable circumstances, but the half-life of, for example, plutonium is 24,300 years.

C. When an atomic bomb explodes as in Test B at Bikini, it spreads the radioactive fission products around the surrounding area with an efficiency far surpassing the dispersal of gas or smoke by the best bomb or shell ever devised; the area is measured in square miles, not square feet.

D. Gamma rays and neutrons can penetrate many inches or even feet of steel and other materials; any airtight material of course is a complete barrier to gas.

E. Once a bad dose of radioactivity has been received, there is no therapy which can effectively prevent death or permanent injury.

What sort of a picture does this make of our atomic attack on Washington? First, of course, it means that radioactivity will add greatly to the casualty count; this is true whether an air burst spreads its radiations in a few seconds or an underwater attack spreads contamination over the city's grounds and buildings which may kill for days, weeks, months, or years (depending on the concentration and the type of radioactive material which falls on a certain spot—there are scores of different fission products resulting from each explosion). Second, it means that an attack such as that shown on the second map would *compel evacuation* of the city until either (a) the radioactivity had dissipated naturally, a matter of many years, (b) the radioactivity were removed by washing, etc., which is virtually an impossibility, or (c) safe areas, where the contamination is not too bad, were mapped out by use of Geiger counters to permit limited access to the city.

Suppose we had the billions of dollars necessary to construct underground shelters for everyone in Washington. Suppose these shelters to be deeply underground and as elaborately contrived as those in the Maginot Line, so that they were self-sufficient for many days or weeks. Then, if warning of the attack were given so that all citizens were in the shelters at the time the five bombs shown on our maps were detonated, what would happen? Would everyone survive? Would the city be able to live and work after the attack were over?

There is a good chance that everyone in deep, strong shelters would survive the immediate effects of the explosions, both air and underwater. A shelter fifty feet underground might survive even the blast from a bomb directly overhead, if the altitude of burst were several hundred feet as in Japan. The air blasts of course would level much of the city and the sheltered survivors would emerge from their caves to a scene of unparalleled destruction. Their most pressing problem however, would be to escape the radioactivity which the underwater bursts would have distributed throughout the city area. It is probable that the strength of this radioactivity immediately after the attack would be sufficient to keep all persons in the shelters for a number of days—for even to walk or drive across the contaminated city streets would cause exposure to a serious dose

of gamma rays. Since we have postulated elaborate and self-sufficient shelters, we can presume that the citizens could remain in them for the necessary number of days for the outside radioactivity to decay to a point at which people could escape from the shelter—*but they could not remain in the city*. They would have to get out and stay out, for the dosage of gamma rays is accumulative even with the weakest rays. They could not hope to remain in the shelters for the time required for the city to become inhabitable. In short, these elaborate shelters would save many lives at the moment of attack but they would not save the city itself.

It is possible to calculate the amount of steel or other material which will shield a person from dangerous dosages of radioactivity, both instantaneous and residual. The thickness of a building's walls necessary to provide protection from the radiations of an air burst at, say, half a mile distance, would not be much greater than the thickness required to make the building blast-proof. However, in the case of the lingering radioactivity deposited by the mist, shielding becomes more difficult. A tank, for instance, which could drive through a heavily contaminated area might have to have as much as several tons of lead covering to protect its driver from gamma rays and without a Geiger counter in hand, one could never tell just how many rays he might be receiving. Also, remember that it is next to impossible to remove this radioactive contamination; over a large city area, it would collect at focal points, especially after rains, and might not be brought under control for generations.

Aside from the protective measures already discussed, mainly concerned with construction of bomb-resistant buildings or shelters, there are certain other preparations which could assist our capital city in surviving. These measures might become of great significance in the case of hysteria, fire, or some other hazard which is not a direct result of the bomb explosions proper. They involve:

Training of citizens in how to avoid danger (i.e., what type of shelter to seek, what areas to avoid, etc.)
Survey of contaminated areas with proper instruments
Fire fighting
Food conservation
Supply of the city with necessary medical and other supplies
Control of panic
Evacuation plans
Water purification
Medical help

Preparedness in respect to factors like these might save many lives, particularly those which could result from causes such as:

A. Lack of warning of the attack.
B. Wandering from areas of low radioactivity into dangerous areas in the conduct of badly controlled rescue work.
C. Working in areas of borderline radioactivity without adequate control.
D. Being abandoned in areas of borderline radioactivity because of injury or neglect.
E. Spread of secondary fires.
F. Contamination of food and water supplies.
G. Panic in evacuation—mobs and traffic jams, etc.
H. Lack of good emergency communications systems.

The first item is of course the most important. A good warning system could actually reduce the casualties (but not the damage) from an attack by 50 per cent. Discussion of what form such a warning system may take is not in the province of this article. The problem will get increasingly critical when an enemy can launch a supersonic rocket-propelled atomic missile at us from a distance of ten thousand miles, as seems inevitable in not too many years as we shall be hard pressed to devise a warning system of any value. Further, we must not forget that in the next war, the aggressor will give his first notice of warlike intentions with the flash of his first bomb. Diplomatic maneuvers of the old type and ultimatums are things of the past.

What does it all add up to? The prospect is pretty grim. It is too expensive and impracticable to put everything underground. It is too expensive and impracticable to disperse our cities over wide areas and on the alignments which would best avoid atomic bomb attacks. It is too expensive and difficult to build even a fraction of our buildings with walls and roofs which can withstand the blast and avert the deadly radiations. We probably will not be able to de-contaminate an area on which a good portion of fission products has been deposited. A determined enemy with a few score atomic bombs, and modern means of delivering the bombs to their targets, could wipe out enough of our cities to paralyze the nation. Our chance of survival would depend on our ability to retaliate.

Can we defend Washington against an atomic bomb attack? Well, if you are a Washingtonian and you want to be sure to survive a forthcoming attack, your best plan is to buy a one-way ticket to the West Coast.

Now that we have examined the difficulties consistent with protecting a city against an atomic bomb attack, we can summarize the measures which Washington might adopt, beginning right now, to increase its defensive strength.

The first thought is a negative one: the design of above-ground structures does not appear feasible for any except unique installations. The small size of building necessitated, the cost of construction, the poor appearance and lack of utility of such construction rule it out, either for new construction of private or government buildings or for replacement of present structures, including even those which now house some of our most important functions. A better answer, for almost every case, is an underground job. Better protection is gained underground than in even the best of above-ground anti-bomb buildings, and the cost is no greater for the amount of protection gained. The cost is, however, very great, and it does not seem possible that private enterprise can support underground construction on any useful scale. Even the government, and especially in these days when we are trying to slash the budget, will have to go slowly. But we should start right now to put our most vital items underground, or at least provide alternate underground facilities. The principal War Department command posts, for example, and communications centers should have positions which are as invulnerable to atomic bomb attacks as modern engineering can make them.

Next in importance to this very limited number of critical installations, is the protection of as large numbers of persons, both military and civilian, as is possible. Here again the underground structure is the best solution. We have already mentioned the possible construction of a tunnel underneath the Potomac River which could serve as a bomb shelter in time of war and as a useful traffic artery in normal times. One step further would be construction of a complete city-wide subway system, similar to those of New York, London, and Paris. Subway tubes, particularly if they were constructed with an eye to serving as shelters and were accordingly placed deeper than would be necessitated by train requirements alone, could provide fairly adequate protection for very large numbers of persons. Underground parking areas similar to the one already built in San Francisco would be equally useful. The cost of a subway system is, of course, enormous. In Washington it could be built only at government expense. In view of the difficulty in obtaining the comparatively modest sums required for such road improvements as the K Street overpass and the Fort Drive Project, we can see that some sharp stimulus would be required to convince both the government and its citizens that huge outlays of money for tunnels and subways are really needed right now. Anyone who has studied the power of the bomb in detail, and who can grasp its significance, needs no further stimulus—he is willing to sacrifice a little of his standard of living, by bearing heavier taxes, to achieve some protection until we can successfully outlaw the bomb and other weapons of mass destruction; we must continually try to educate more people to this way of thinking.

Smaller underground shelters can be constructed by private organizations and individuals. We have already pointed out that the most modest air-raid shelters in Japan, consisting only of shallow trenches covered with logs and a comparatively few inches of earth, afforded fairly good protection against the high-altitude bomb bursts. Of course a low-altitude burst will destroy any but deep underground shelters, directly beneath the bomb; but, ruling out near-misses, cheap shelters will give full protection against flash burn and very considerable protection against blast and radiation which otherwise could be very lethal over long distances.

A step which is a little easier, though not as effective, is to plan for gradual dispersion of our buildings and facilities. Already at least one important building in Canada has been located away from a metropolitan area in order to make it a less-likely target. We can do the same thing in Washington, from this point forward: long-range planning for the city should incorporate the locating of future buildings in suburban areas and the moving of as many government functions as is practicable to other areas entirely. It will be many years before such a program will affect any appreciable fraction of our installations, it is true, but that is no reason for not starting it now. It is the duty of the District of Columbia government to study the effects of atomic destruction, to educate the citizens and to work for appropriate amendment of local building and zoning regulations. With the government leading the way, private industries, public utilities, and organized labor should plan gradual dispersion of plants.

With more immediate effect, we can begin our education and organization of the civilian populace in defense against atomic attacks. At first we shall have to overcome a numbness resulting from the flood of material about the atomic bomb which has lately been released; we shall have to show that the bomb has not, in fact, been over-advertised, that its terrible import should not be blunted by a mere torrent of sensational verbiage. We should start with the basic facts about the bomb itself; how it hurts persons and things, what the radiations are and what it takes to fend them off, what the chances are of survival under various conditions. We should prepare full-scale disaster plans, and integrate them between cities and states. We should amass the equipment which atomic attacks will cause us to need suddenly and in large quantities; first among such items is the Geiger counter, or radioactivity measurer, without which any work in a radioactive area would be virtually impossible. We should revive and greatly strengthen our air-raid precaution organization, which should plan the mass evacuation of the non-essential urban population and conduct disaster-plan drills similar to fire drills in schools and on ships.

There is great need also for particular preparation along medical lines in the civilian defense plan. In addition to the types of bomb attacks we have assumed in the foregoing, there is possibility of a "silent" atomic attack, in which a bomb is smuggled in and used by saboteurs, or in which radioactivity is spread over our land, buildings, and supplies by some means other than by a tremendous bomb blast. A constantly alerted medical organization must be always ready to detect and identify, at specific localities, installations, and potential target areas, the ionizing radiations which may be released. The medical organization should furnish advice as to the nature and severity of the hazards and the medical measures required to counteract and rectify such conditions. It should advise as to the adequacy of and health requirements for the construction and operation of underground (particularly self-sustaining) shelters. It should advise as to the sufficiency of protective clothing against heat, ultraviolet radiation, and radioactive contamination. It should provide medical care and treatment of the sick and wounded and institute such therapeutic measures as may be appropriate. It should advise as to the radiological hazards and health measures and standards, required in the event of exposure of personnel to ionizing radiation, blast and flash effects. It should advise concerning contaminated food, shelters, installations, water supplies, utilities, and other essential services; and should advise the military as to the psychological methods and procedures appropriate to minimize disorder and confusion of personnel in bombed areas. It should provide for dispersion of medical facilities and supplies.

Above all, we should have the best warning system which human ingenuity can possibly devise. No amount of our national budget spent in developing better radar and other locating and warning equipment should be too large; no energy should be diverted from trying to perfect interceptor weapons of all sorts. We know that the next attack will come suddenly and swiftly. We know that no matter what precautions we take, we are bound to suffer heavily. But just a few seconds of warning may, in a possible attack of the future, save the lives of half of Washington.

ELECTRON TUBES

By Doctor Harold A. Zahl and Doctor John E. Gorham

"Had it not been for one particular Allied invention, we would not be in the position we are today," Adolph Hitler somberly stated only a few months before the collapse of Germany.

The invention so "honored" was not a super-gun, tank, battleship, or airplane—it was only a modest vacuum tube, the highly efficient microwave magnetron which, among other things, served as the genesis of airborne search radar equipments which led in the attack driving the dreaded Nazi submarine fleet from the high seas and thereby allowing the flow of American men and goods to Europe to be thrown against the German bastions and turn the tide of battle.

As we fought yesterday, today we live in an electronic age. Perhaps we are entering an atomic era, but close reflection will show that even with the wonders of nuclear energy, the miracles of the past and those in store for us in the future, can and will be more correctly described in terms of electronics—the heart and soul of which is the electron tube. Today we marvel at the prodigious power industry, world-wide radio, television, air transport, telephone service from our own automobile—and, militarily, fire-control, proximity fuses, and even atomic bomb construction—all stem or depend heavily upon a glass or metal chamber in which electrons or ions are made to do man's will.

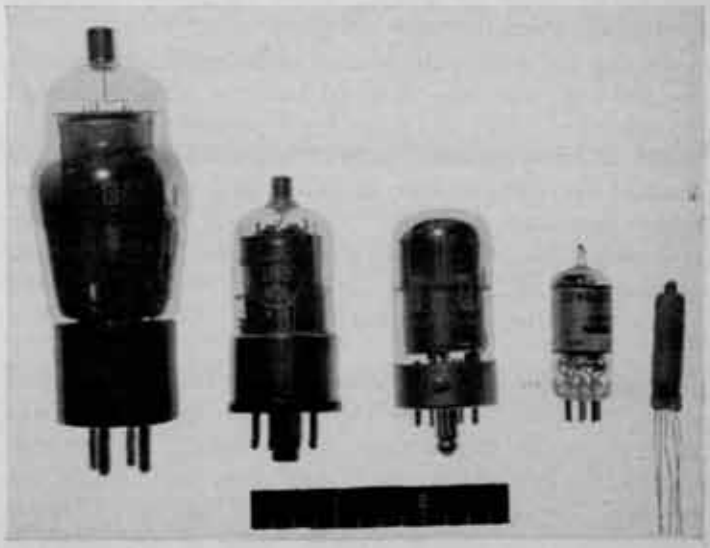
The story of the electron tube does not specifically start in an inventor's attic or in the research laboratory of a university or industrial corporation. As with all things in science, the inter-relationship with the past is ever-present as through the centuries knowledge is built up and finally applied by a practical but creative mind. The jig-saw puzzle of science is of infinite extent and each generation of man works out a portion, but the whole picture will never be seen. The electron of yesterday was no more confusing to William Hittorf and William Crookes 80 years ago than are today's mystery particles—the mesotrons—to American physicists.

To select a convenient starting point for the story on electron tubes, the pages of history may be turned back 300 years to the time of Otto von Guericke who in experimenting with suction pumps found, to his disconcertment, that he could raise water to the third floor of his house but not the fourth. With his interest thereby aroused, he continued with his work until he had invented a crude air pump with which he could create a vacuum. His experiments reached a dramatic climax when he assembled two bronze hemispheres carefully fitted edge to edge and removed the air from the sphere thus formed. In 1654, before the Imperial Diet assembled at Ratisbon, two teams of eight horses, each harnessed to one of the hemispheres, pulled in opposite directions and were unable to separate them. The demonstration ended with sixteen exhausted horses and with von Guericke nonchalantly opening a stopcock, following which the Magdelburg hemispheres fell asunder without any external force.

With the trail blazed through the birth of the vacuum pump 300 years ago, one may perhaps wonder why the signing of the Declaration of Independence was not broadcast from coast-to-coast with television in full color on a home projection screen. The facts are that for over 200 years evacuated chambers were little more than playthings. When high voltages were generated with static machines, beautiful and peculiar discharges could be created with these tubes, but no one seemed curious enough to go beyond that—contrast, for example, the tremendous effort today being placed on cosmic rays which to date have not been used in one single invention either for man's expanded living or as a machine to cause his death.

It remained for the curiosity of William Crookes, about 80 years, ago, to awaken the sleeping beauty of electronics and take it from the display cabinet. In a series of inspired experiments and lectures, Crookes brought out a number of facts which for centuries had missed observation. Though in error on many of his interpretations, he stimulated scientific thought. Crookes himself thought he had discovered a fourth state of matter to be added to gases, liquids, and solids—namely, cathode rays. In fact, Crookes should really have discovered X-rays, but missed the point when on numerous occasions he found that photographic film close to his discharge tube was fogged although well protected

Electron Tubes, low drain filamentary series. Group view showing progressive reduction in size of tubes. Left to right: Standard, "GT/G," Lock-in, Miniature and Subminiature Type.



from light—X-rays begging to be discovered. His solution was to store his film in another room—his problem thus solved.

Expanding on the experiments of Crookes, and through assuming a more scientific attitude, Wilhelm Roentgen announced the discovery of X-rays in 1895. This discovery marks the real beginning of electronics, for then in rapid succession, followed numerous brilliant experiments and applications of the knowledge acquired. X-ray tubes were constructed, a cathode ray tube was built in 1897 by Ferdinand Braun, and at the turn of the century, Cooper-Hewitt came forth with the mercury-arc rectifier which found immediate application in the power industry.

In 1904 the physicist Richardson was lecturing on the peculiar property of certain materials which gave off negatively charged particles when heated to incandescence. A man named Fleming was in the audience. It occurred to Fleming that here was a possibility for rectification since such thermionic currents could effectively be made to flow in only one direction. Thus the Fleming Valve was born, with the source of electrons (cathode), and a second metallic element (plate), the combination comprising a diode destined to play a major role in industries yet to be born.

In 1908, Lee de Forest made the all-important contribution of introducing the control element (grid), into the Fleming tube and with this invention, modern radio was born, for everything was now available for detection, amplification, and generation of oscillations; and when W. D. Coolidge in 1913 showed the advantages of a copious source of electrons, particularly in such tubes as X-ray and oscilloscope design, electronics was ready for a great forward movement, requiring only the proper stimulus.

The stimulus came under tragic circumstances when in 1914 the war dogs of William II sprang at the throat of France, and World War I was on. In four years of war, the vacuum tube passed through development stages which would have required twenty years of normal time—from a pigmy it grew into a giant, since the requirements of military communication led in the direction of commercial radio broadcasting which quickly followed the close of the war. Then came the talking moving picture with its photocells, amplifiers, and myriads of other tube types. Industrial electronics began to flourish while the infant television continually cried for more attention.

During the 1920's the leaders of industry foresaw that the electron tube was destined to be a major factor in everyday life. More and more funds were directed into research and development. In 1929, expansion was placing a demand for vacuum tube engineers and physicists never before visualized, but in 1930, top-flight engineers were in among those constituting the breadlines, and for years, development lay relatively dormant. Television remained "just around the corner," but the corner was hidden in a fog.

Again a stimulus was needed, for the vacuum tube had much, much more to give. Again it was Europe that was to serve as the unwelcome exciting agent. In the mid-thirties, the roll of the war drums could be heard in the distance. The airplane had become of age, and Goering planned to eclipse the sun with the wings of his Luftwaffe.

Facing the United States was the ominous threat of a World War II with its bomb-laden airplane—and the threat of indiscriminate bombings of cities with non-combatant women and children as victims. The first step was naturally defensive—airplanes must be detected, perhap then they could be destroyed, in part, at least. For the Army, the responsibility of detection was then entirely in the hands of the Coast Artillery. Of the meagre funds available for research and development, the Coast Artillery gave generously to the Signal Corps for work on detection projects. Detection by heat was practical only under fair weather conditions—sound detection only told where an airplane had been—and ranges were hopelessly inadequate.

Again the answer was provided by the electron tube. Short waves of undreamed of frequencies could now be generated and were ready to serve. A sharp pulse of very high frequency waves could be generated and directed into space—and the echo returning from any object intercepted would give the instantaneous position of the object—radar was born.

During May 1937 the first radar set capable of tracking aircraft in azimuth, elevation, and range, made its military debut at Fort Monmouth, New Jersey, in a demonstration before the Secretary of War, the Military Affairs Committee, Chief of Staff, Chief of the Air Corps, Chief of Coast Artillery, Chief Signal Officer, and others.

In August 1937, the Signal Corps placed the first development contract ever placed by the Army for a vacuum tube primarily for radar—later to become famous as the Westinghouse WL-530. Over four years later the original investment almost paid for itself more than a million-fold when a pair of these tubes served to generate the radar pulses which gave warning of the impending attack on Pearl Harbor, though in one of history's great tragedies, the warning went unheeded.

In November 1938, the SCR-268-T1 was turned over by the Signal Corps to the Coast Artillery Board at Fort Monroe, Virginia, for service tests. With great vision the Coast Artillery accepted this new electronic device and radar became an instrument of war for the Army. Airborne radar was inaugurated shortly after, when the Signal Corps installed a "cut-down" SCR-268 into a B-18 bomber for trial. As a by-product of the Coast Artillery decision, a gigantic research and development program on vacuum tubes was started, for it was apparent that higher frequencies meant smaller equipments and the SCR-268 with its convoy of vehicles could hardly be called a miniaturized type.

As industry went into production on low frequency radar equipments, government laboratories and industrial research and development groups worked feverishly to open up the shorter end of the wavelength spectrum. Radar and vacuum tube development became almost synonymous. With the forming of the NDRC and with valuable contributions from England, the microwave spectrum was suddenly opened and 10 cm tubes became a practical reality. Toward the end of the war, 3 cm and later even 1 cm tubes found their way into military equipment. With microwaves came back the crystal detector of World War I fame, accompanied by newcomers, the multi-cavity magnetron, local oscillators, including klystrons, long persistence oscilloscopes, TR and anti-TR tubes—all were born within a short space before

the outbreak of war on 7 December 1941, or soon thereafter.

Those concerned with new types of vacuum tubes well knew the terrific potentialities associated with their products in the production of weapons of war. New designs were frequently restricted for use in gear in which operational use only over water or friendly ground territory was permitted to avoid risk of capture. When certain tubes of secret design were finally flown over enemy Europe, directionally exploding charges were incorporated into the equipment, so if capture appeared imminent, or if bailing out was necessary, the vacuum tubes could be destroyed or mutilated beyond possible recognition. Early secret tubes always included instructions to the effect, "if the enemy is closing in, demolish all tubes with an ax (author's note: ax not always provided with equipment), or throw into deep water." The war records show at least one occasion where the Allied departure was so abrupt that demolition consisted of pistol shots hurriedly fired into a new type of cathode ray tube, no ax or deep water apparently available within the time limits specified for the retreat.

Another story is told of how once two British scientists bringing important secrets of the multi-cavity magnetron to this country were so fearful lest they be interrupted by German agents, or lest their mission even be known, that for a time after docking in New York they lived the life of ordinary tourists, visiting parks, museums and the cinema —continuously watching to see whether anyone was following them before delivering their priceless secret to the American destination.

As the war progressed, in addition to the use of vacuum tubes in equipments or ammunition, the field of countermeasures reached considerable proportions since by neutralizing the enemy's own communications or radar, or what was even more important, using such devices for deception —our own offensive measures could be made far more effective. An entire line of new types of vacuum tubes was developed for this purpose, which among other uses, resulted in thousands of lives being saved when the Allies invaded Normandy. The invasion was certainly the biggest fake in all history, since electrical falsification was used to completely bewilder the Germans—phantom sea and air fleets were seen by German radars, purposely not jammed; real sea and air fleets were protected by jamming signals while German radio communications were jammed or not jammed depending upon what effect was desired in particular areas.

Perhaps the most spectacular of the countermeasures tubes of the latter stages of the war was the resnatron development in this country and used by the RAF. A pair of these tubes was capable of generating 50 kilowatts of power in the medium-microwave band then used extensively by the Germans in their fire-control radar system. By means of a huge horn made with chicken wire this energy was directed from England across the channel and over the continent, providing a sector filled with jamming radiation in which Allied aircraft could expect safer travel because of the disturbances caused to German radar. Due to the high energy density in the area in front of the horn antenna, individuals walking in that region immediately acquired an artificial fever because of radiation absorption, and if they should be carrying metallic objects of approximately one-half wavelength (1 foot) such as watch chains, screw-drivers, etc., sparks would fly from both ends. In operation, the resnatrons required the facilities of a power-plant adequate for a small city and the intricate circuits and maintenance problems required the constant attendance of top-flight engineers and physicists.

In contrast with the resnatron is the subminiature tube made famous through its use in the proximity fuze. The size of these tubes approximates one inch of a lead pencil and they must operate unattended *after* being shot from artillery or dropped in a bomb from an airplane. Because of the great success of the proximity fuzes, during the last month of the war, one-half of the total dollar volume being spent by the Signal Corps for vacuum tubes was for subminiature types.

Between the extremes of the resnatron and the subminiature tubes, approximately 1600 types of vacuum tubes were used by the Army in various electronic equipments during the past war. To give total numbers of tubes produced would be like describing the number of hours required for an infantry column to walk to the nearest fixed star, assuming a paved highway. Signal Corps procurements alone exceeded $400,000,000. During the war, an average of 600 new development projects were continuously under way. Each day saw production lines for new tube types open up with empty sockets in equipment awaiting the first deliveries. A Joint Army-Navy Preferred list was carefully policed by each Service to avoid the establishment of unnecessary production, but yet the demands continually came, for the new types opened up methods of accomplishing hitherto impossible military requirements—victory rode with electronics.

Magnetrons

The magnetron may be considered the core of all microwave radar sets operating at frequencies above 2000 megacycles (below 15 cm wavelength). Upon the achievement of compact and highly efficient magnetrons in 1940 there instantly appeared such a demand for other microwave types of tubes such as klystrons, TR tubes, and crystal rectifiers that these latter may be considered the children of the magnetron. Dr. A. W. Hull conceived the magnetron type of tube in 1921, and during the following twenty years it remained primarily a physics laboratory device under more or less purely scientific investigation. Although Japanese and German physicists pooled their results with those of American men of science the magnetron known to the world in 1940 was still limited to relatively low average powers at efficiencies of 10% or 15%. It was hardly more removed from the realm of pure science than was nuclear fission in the same year.

Prior to 1940 no high power transmitter of short waves existed. It was known that if such a high power transmitting device could be made, *radar equipment could be made smaller in size and, what was even more important, the accuracy of radar detection and tracking would be greatly increased.* A great deal of research and development effort was expended along these lines, and then, in 1940, British scientists working at the University of Birmingham hit upon a method of constructing a magnetron which increased its efficiency and power output to such an extent as to make

the development of high power at short wave lengths a practicability.

Whereas the previous magnetrons had consisted primarily of a central cathode and a surrounding anode in the form of a simple metallic cylinder, with the anode sometimes split into a number of parts rather than being a single cylinder, the new magnetron was constructed on an entirely different basis. The cathode remained essentially the same, but the anode structure was made from a solid block of copper in which holes (cavities) and slots were cut. Furthermore a seemingly simple device (when viewed in hindsight) gave this construction the requisite power output and efficiency; this device is a series of wires connecting the cavities to each other, and the process is referred to as "strapping."

In radar sets, the range at which a target may be detected is dependent upon the amount of power available at the transmitter. Magnetrons have now been constructed which develop millions of watts, and operation at frequencies as high as 24,000 megacycles (24,000,000,000 cycles per second) is not uncommon. Use of these tubes enabled the development of airborne radar with practical size antennas and reflectors (2 ft. diameter) as contrasted with the relatively enormous arrays required for low frequency airborne equipment and which could be mounted only on the largest aircraft. Using the 24,000 megacycle magnetron, airborne radar sets have resolution sufficiently high to show details of docks, harbors, and even of city areas. Magnetrons have also been constructed to operate at frequencies as low as about 300 megacycles.

Magnetrons are used not only in radar but in communications equipment also. Another use, although destructive in this case, was made of the high power generating abilities of magnetrons during the war by generating signals for jamming enemy equipment. The high power transmitted by the jammer saturated the enemy receivers so that the detection ability of his radars was seriously reduced.

The impetus the war gave to magnetron development has not been dissipated. Academic, industrial, and Service laboratories are busily engaged in pushing forward the frontiers of higher power pulse and continuous wave magnetrons and higher frequency tubes. For example, scientists at Columbia University have recently succeeded in generating 40,000 watts pulse power at a frequency of 50 billion cycles per second.

Klystrons

The microwave (very short waves, usually above 2000 megacycles) receivers used in present day radar and communication sets are generally of the superheterodyne type. In this receiver, a signal generated within the receiver itself is combined, or "mixed," with the signal being received. The generator within the receiver is termed a "local oscillator" and is adjusted to have a frequency slightly different from that of the incoming received signal. The difference frequency resulting from the mixing process is then amplified and after further processing finally appears on the cathode ray tube or in the audio device.

At the microwave frequencies, ordinary tube types cannot be operated as oscillators. In the standard type tube, and at these frequencies, the time taken for an electron to flow from the cathode through the grids to the anode (electron transit time) becomes an appreciable fraction of the time for one cycle. However, in the velocity modulation tubes the construction is such as to overcome this difficulty. The name applied to one of the most prominent forms of velocity modulation tube is the "Klystron," made by the Sperry Gyroscope Company. Other firms use different trade names for their form of this tube but the term Klystron has come to be almost synonymous with this particular type of device. Unlike the high powered magnetron, the klystrons are generally limited in continuous power output between some 20 milliwatts (.020 watt) and several hundred watts. However, the ability to adjust their frequency of operation, and their reliability, have made them a "natural" for the local oscillator job.

Essentially the klystron comprises a cylindrical tube with an electron "gun" at one end to act as a source of electrons, and an electrode at the other end to collect these electrons (hence termed a collector) or to cause them to be reflected back to a part of the original tube (hence termed a reflector). Between these two elements, are two sets of grids, each "set" actually being composed of 2 grids. The space between the two "sets" of grids is termed the "drift space." Associated with each set of grids is a cavity, perhaps more properly termed a resonator, whose dimensions are such that at microwave frequencies it behaves much like the common LC (inductor capacitor) circuit of low frequency radios.

When the tube is connected in circuit the electrons, as they pass the first set of grids, are given a varying acceleration, the result of which is to cause the electrons to assemble in "bunches" as they pass down the drift space. Now, as these "bunches" of electrons pass the second grid set they act to shock-excite the cavity associated with these grids and set up oscillations which are then fed into the output circuit and to wherever required.

TR Tubes

A considerable saving in the bulk of radar sets may be achieved if the same antenna is used both for transmitting and receiving. (The SCR-268 and SCR-547 used separate antennas but the SCR-545 and SCR-584 both used a single antenna.) However, in general, if the power from the transmitter reaches the receiver input circuits and tubes, the latter will no longer function properly. Microwave receivers which use crystal rectifier mixers are subject to damage by peak powers of only one watt. If the receiver is disconnected from the common antenna during the time the transmitter is on, then connected when the transmitter is off, the damaging effects from the transmitter may be avoided. However, gun laying radar sets must be able to receive echoes from targets as close as 500 yards or less. This is equivalent to saying that the receiver must be in operation within three millionths of a second from the time of initiation of the transmitting pulse. No known mechanical switching device will perform this rapid on and off switching operation. Furthermore, unless precautions were taken, some of the received energy would not get to the receiver but would be lost in the transmitter circuits and tubes which are connected to the common antenna.

The required switching action has been almost univer-

sally accomplished by the use of tubes called TR (transmit-receive) and ATR (anti-transmit-receive). These allow the transmitter energy to reach the antenna but prevent it from reaching the receiver, and conversely they permit the received energy to reach the receiver without loss in the transmitter. These tubes consist mainly of a two-electrode spark gap enclosed in a glass envelope which also contains a small amount of a gas such as argon or hydrogen and water vapor, at a pressure of approximately 15 millimeters of mercury (atmospheric pressure at sea level is 760 mm of mercury). When the transmitter is emitting its pulse of energy the spark gaps in the TR and ATR tubes "fire" and effectively open circuit the receiver input so that the transmitter energy cannot enter. The low pressure in the tube enables the gap to fire at a low enough voltage to protect the receiver before the transmitter power builds up, and the water vapor acts to insure quick "recovery," or cessation of firing, immediately after the transmitter pulse. When the transmitter is not operating, the connection of these tubes in the circuit is such as to cause operation as though the transmitter were no longer connected, hence almost all the received energy is passed to the receiver.

The use of the TR and ATR tubes is not entirely "free," but the loss of power (approx. 1 decibel) is easily tolerated in view of the major advantages gained from their use.

Resnatrons

The major portion of German radar equipments were operated in the frequency band 400 to 600 megacycles. For jamming operations against this equipment during operation Overlord (D day ETO) a tremendously high powered equipment capable of operating from the English coast and "knocking out" radar sets on the Continent was highly desirable. The equipment known as "Tuba" was the answer, and Tuba depended for its efficacy upon an electron tube designated the "Resnatron." (The term Tuba is derived from the fact that the antenna equipment used to project the jamming signal bore a resemblance to a magnified version of the musical instrument by that name.) The total equipment used to make a Tuba field installation required 13 vans to transport. In one version the antenna equipment resembled a megaphone 150 feet long, and at its termination 6 feet wide by 18 feet high.

At the beginning of hostilities, the Resnatron was still but a theory in the research laboratories of the University of California. Even by the end of the war not more than two dozen resnatrons had been manufactured, but their "Big Bertha" powers of approximately 75 kilowatts maximum average continuous power in the band from 350 to 650 megacycles made them the Allies' most powerful radio jamming transmitter tubes at those frequencies. One of the peculiarities of these tubes, in so far as their military operation was concerned, was the fact that they were probably the only tubes sent out for field use that had to be continuously evacuated during operation. The usual electron tube always comes in an already evacuated and sealed envelope, and the user merely plugs it in, but these tubes were so constructed that they had to be connected to a vacuum pump, and the pump kept in operation whenever the tube was placed in use.

Crystal Rectifiers

Microwave crystal rectifiers are universally used as mixers (see section on klystrons) in all radio receivers operating above 1000 megacycles. Their appearance resembles nothing so much as a miniature of the galena and "cat whisker" used at broadcast frequencies in the crystal sets of the 1920's. In addition to vastly superior performance at microwave frequencies as compared to the 1920 model, they are mechanically rugged and must pass production tests of a three-foot drop on a hardwood block—shades of the jittery early model where the least jar of the table would plunge all listeners into silence and require several nervous minutes of relocating the cat whisker! The modern version is fixed and sealed at the factory and not again adjusted.

The cat whisker in modern crystal rectifiers is a short length of tungsten wire so bent as to supply the proper force of contact and have suitable radio frequency impedance characteristics. However, the crystal is not galena but extremely pure silicon since this was found to have the lowest noise figure for maximum receiver sensitivity. At lower frequencies of, say, up to 100 megacycles germanium is used since its higher noise figure is not important in second detector applications and it can withstand back voltages as high as fifty, compared to less than ten for silicon. Crystal rectifiers are used at microwave frequencies since no tubes presently exist which do not actually add more noise to the receiver than do crystals, in spite of any amplification the tubes may have.

Electron Beam Tubes

Cathode ray tubes underwent great improvement during the war. The detection of distant targets by radar required good visibility on the tube screen for signals lasting approximately one millionth of a second and recurring a few hundred to a thousand times a second. Prewar cathode ray tubes gave very faint presentations compared to those obtained with present tubes. The sharpness of focus to aid in resolving targets was also increased considerably. In PPI (plan position indicators) radar presentations the echo patterns are recorded over 360 degrees of azimuth relative to the radar set whose location is indicated at the center of the tube screen. The radius vector sweeps through 360 degrees a few times a minute and the echo pips are "painted" along the radius at distances proportional to distances to the targets. In such applications the cathode ray tube screen material is made to have a persistence such that the echo pips remain visible just a little less than the time for one rotation of the set antenna, for ease of plotting of data.

Still another type of electron beam tube, the storage tube, is more distantly related to the ordinary cathode ray tube. Storage tubes work on the principle of recording a pattern of electrical charges on glass or other dielectric (non-conducting) material in roughly the same way as pips are recorded on a cathode ray tube.

The traveling wave tube is a new development in beam type amplifiers. It consists of an electron gun, a long closely wound helix that bears a remarkable resemblance to a screen door spring, and an electron collector cup. Radio frequency energy is coupled into the helix at the gun end and coupled out at the collector end. When voltages are ad-

justed so that the electron beam travels through the helix at a speed equal to the axial speed of the radio frequency wave, considerable amplification is obtained at microwave frequencies. The most unusual feature about this new tool is the extremely wide bandwidth of 20% of the center frequency, or 800 megacycles width at 4000 megacycles operating frequency compared to a klystron bandwidth of about 10 megacycles at 4000 megacycles. This amplifier bandwidth appears to be limited only by the coupling circuits and not by the tube. The possibilities for use in broadband microwave relay amplifiers to replace the two complete sets now required at each relay point, and many other applications requiring great bandwidth, make this tube most interesting.

Receiving Tubes

Receiving tubes did not undergo as radical changes as did microwave tubes during the war. However, negative grid amplifier tubes at 3,000 megacycles, practically unknown at the start of hostilities, were developed to the point of practical use in tactical equipment. This performance was achieved by use of "lighthouse" construction in which the cathode, grid, and anode are in the shape of discs separated by approximately 0.005 inches and are integral parts of larger discs to which separating cylinders of glass are butt sealed. This construction leads to exceedingly low radio frequency impedance compared to that of the usual lengthy wires through glass presses in conventional tubes. The miniature tube sprang into wide use and will play a major role in postwar electronics design. It is characterized by a bulb diameter of about 11/16" and a ring of short stiff pins passing directly through a glass button base. From the Service standpoint it has several advantages: lack of bases cemented to the bulb; relatively low impedance leads by virtue of the extreme shortness possible with the button base; and improved ruggedness because of small size, lightness, and better bracing that can be used. In general, miniature tubes already exist that perform as well as or better than most of the larger prewar tubes.

Subminiature tubes are about 7/16" in diameter and 1" long. They were mainly used in hearing aid devices before the war but because of their use in shells and bombs in V.T. proximity fuzes, several hundred million were produced during the war. Fuze tubes were developed to be rugged enough to withstand being shot from guns (many thousand times the acceleration of gravity) and were characterized by minimal power drain. Although they were designed for a life of only a few hours their actual time of use is measured in seconds. Recently, an effort has been directed towards obtaining longer life and higher performance figures. At present, subminiature voltage amplifiers are as good as those of many larger tubes, but their power capacities are still considerably less. The small size of subminiature tubes immediately suggests the possibility of exceedingly compact equipments and hermetically sealed amplifier strips that are completely replaced after failure rather than being torn down and repaired. (See picture.)

Inter-Service Coordination

Army-Navy coordination of research and development and standardization is handled through the Panel on Electron Tubes of the Joint Research and Development Board and the Joint Army-Navy Electron Tube Committee, respectively. Through the Panel on Electron Tubes representatives of the Services coordinate all electron tube research and development projects in a very detailed manner. The Panel Secretariat disseminates information on all experimental tube work in this country and abroad, and several thousand projects are covered in the Panel on Electron Tubes Index and Technical Information Books. Survey articles were prepared on enemy tube programs and thus brought order to the chaos caused by the thousands of reports on captured tubes that seemed to come from every direction.

Every tube of interest to the Army and Navy is procured under Joint Army-Navy Specifications prepared by the Joint-Navy Electron Tube Committee. The main features of JAN tubes are improved mechanical and chemical designs to insure operation under severe Service field conditions. Also, interchangeability with respect to Service equipments is insured by use of JAN tubes, whether they come from Army or Navy supply depots. It is expected that in the postwar period commercial airlines, railroads and industries will find JAN tubes especially suited to their requirements.

Extract From An Address By Major General Edward S. Bres

At the present time, on purely a voluntary basis, the Organized Reserve Corps numbers approximately 503,000 officers and 630,000 enlisted men. Of this number it is anticipated that sufficient officer personnel for units will be obtained. However, it is probable that only a negligible percentage of enlisted personnel will volunteer without some type of training pay. Financial compensation for members of the Organized Reserve Corps is not authorized for other than active duty. However, the War Department will seek enabling legislation from the present Congress to permit inactive duty training pay. This bill will allow pay for the ORC for each training period equal to that of the National Guard, depending on the amount of training involved.

PIPOLOGY

By Lieutenant Colonel Leonard M. Orman, CAC

Pipology may be defined as the art of interpreting the various types of pips that appear on radar scopes. This is not an exact science, but an art in which the operator cannot be expected to attain absolute perfection. It is probably the most difficult, and yet most interesting phase of radar operation.

Composition is a closely related word but not so all-inclusive and answers the questions: what, how many and friend or foe? Given enough time, almost anyone can get the range and azimuth of the target but it takes skill, imagination and above all, experience to determine composition. With continued experience and increased skill, predictions should be about 80% correct. Trying to identify every echo that appears will give the practice needed. Whenever possible, someone should find out what the target is, or was, to obtain a check on the accuracy of the estimate.

Ability to interpret pips comes both from knowledge gained through study and from endless hours of practice on the radar. It is important to recognize a target in the shortest possible time.

Pips are of various types. Each type lends itself to interpretation. In general there are four characteristics of pips which will give information useful in interpretation. They are:

1. Size of pip.
2. Shape of pip.
3. Bobbing or fluctuating in height.
4. Movement in range or azimuth.

The A scope is most satisfactory for observing size and fluctuation of pips, and expanded or short range A scope for observing shape, while movement is best seen on the PPI.

Composition

The first thing to determine obviously is the friend or foe status of the contact. This can be done only by using the IFF interrogator. The next step is to notice the rapidity and the extent of the echo's fluctuation. Consider the height of the echo, remembering the effect of range and fades; then note the depth or thickness of the echo. If the echo is saturated, reduce the gain. Look at the top and sides of the echo for any indication of two bumps or many little bumps. What is the speed at which the echo is moving? Look at everything and draw on your entire background of knowledge and experience to interpret what you see.

For radar sets equipped with a PPI scope in a permanent or semi-permanent position, the operator is first taught the location of fixed echoes on the PPI and is shown how these fixed echoes compare with the objects they represent on the map. As soon as the operator can identify each and every fixed echo, the next step is to have him memorize the outline of each fixed echo as he sees it on the indicator. After the operator is acquainted with every fixed echo on the indicator screen and can mentally duplicate the visual outline of each, the next step is training in identification of moving echoes.

Estimating the Size of Ship Targets

First of all, upon what does the size of the pip depend? The answer is, unfortunately, quite a number of things, the most important of which are:

1. Range of the target.
2. Size of the target.
3. Height of the antenna (especially where surface targets are concerned).
4. Height of target.
5. Whether the target is bow or broadside.
6. Atmospheric conditions.
7. Material composing the target.
8. Correctness of tuning.
9. Matériel condition of the radar set.

Due to the many variables involved, it is not possible to determine the exact size of the target in every case, but you can always make a reasonably accurate estimate. This much you do know: if you have a large and a small target at approximately the same range, the larger target will produce the larger pip, other variables being equal. Thus, the only *positive* thing that size of pip will tell you is relative size of various targets at the same range.

The best way of determining the approximate size of a target is to observe the range at which it was first detected. This method is especially good with micro-wave surface search radars such as the AN/MPG-1. Radio waves from these radars travel in practically a straight line. At any given range it takes a certain size object to give back an echo that is just visible on the screen or scope with your radar tuned up as well as possible. Therefore, various types of targets or types of ships first become visible on the scope at some definite range. The echoes come from the ship's mast and upper superstructure first. The superstructure offers approximately the same size target regardless of the direction from which it is seen.

Each radar will have its own characteristic ranges for detecting the various types of targets, depending on how high the antenna is mounted, the power and the sensitivity of the particular set.

An estimate of the approximate size of targets at less than the maximum range can be made by considering the

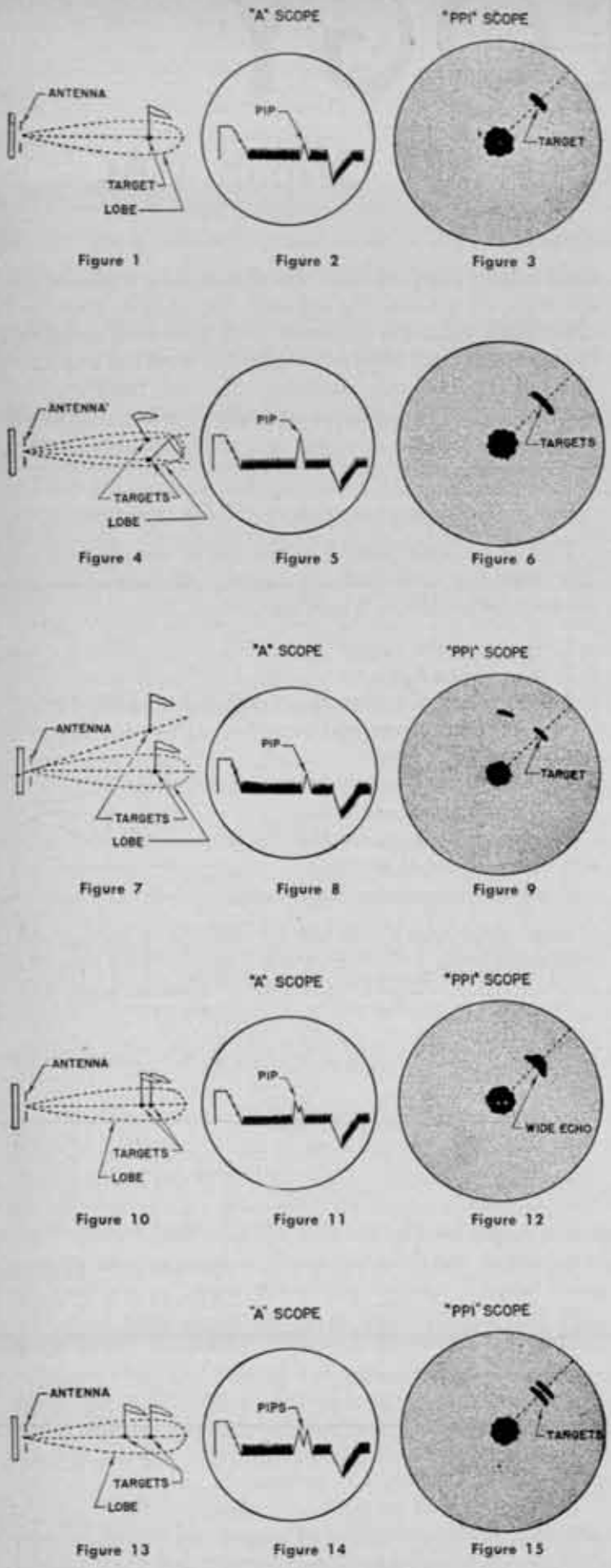


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13 Figure 14 Figure 15

strength of the echo, the range, and the target angle. To facilitate this process a log should be kept for recording these data.

The bouncing motion of a pip provides another means of estimating the approximate size of a ship at sea. A large target usually shows up as a slowly bobbing pip, varying in size from medium to large. A smaller object usually gives a more violently fluctuating pip, and especially if the sea is choppy, may produce an echo that will flutter between a medium-sized pip and no pip at all. Of course, roughness of the sea affects the amount of fluttering of pips and this must always be taken into consideration.

Another way of occasionally identifying the type of moving object is by tracking, and plotting its position over a period of time to determine its speed.

Here are some examples of information which might be obtained from a radar. An object is detected at 9,000 yards. On the PPI it shows up once every two or three revolutions. When examined on the range scope, the pip is fluttering rapidly. From tracking and plotting the target, its speed is determined to be about 35 knots. Since the target was not picked up until it was fairly close, this indicates that it is a small target: the rapid fluttering also indicates a small target. From the speed of 35 knots you can assume the target to be a small, fast boat, probably a PT. The same type of target, had it been stationary, might have been a buoy.

Estimating the Number of Ships

Azimuth and range resolution. Targets at the same range will present separate pips only if they differ in azimuth by a certain minimum angular distance. This angle is called the azimuth resolution of the radar, and it varies from set to set since it is proportional to beam width. On the other hand, targets at the same azimuth will present separate pips only when they are separated in range by a certain minimum distance. This distance is called the range resolution of the radar, and it also varies from set to set since it is proportional to pulse duration.

Figure 2 shows the picture appearing on the range scope with the antenna trained on a single target, while Figure 3 shows the picture appearing on the PPI under the same conditions. Examine carefully the pip's size. Now carefully check the pip's size on Figures 5 and 6 with the antenna trained on two targets within your beam, both at the same range.

On the range scope, the pip is much higher as a result of more reflected energy reaching your antenna, while on the PPI, the pip is much wider. The pip is not deeper (thicker) since the time base represents *only* the *range* of the target. Figures 5 and 6 show only one pip, since the targets were too close together for the azimuth resolution of the radar used.

Figures 8 and 9 are the pictures appearing on the range and PPI scope respectively, when the targets are still at the same range, but with their azimuth difference great enough to obtain azimuth resolution, as indicated in Figure 7. Here, a new pip will appear as the antenna is trained to the azimuth of each individual target; their energy will not be cumulative since difference in azimuth is greater than the antenna's effective beam width.

Next, again consider Figures 2 and 3. Here again you see the antenna pointing on only one target, as noted in Figure 1. Compare these pips carefully with those appear-

ing in Figures 11 and 12. Notice that the pips in Figures 11 and 12 are deeper as a direct result of a range difference between the two targets. Should the two targets under observation have even a greater range difference, the deep pip will appear split, as shown in Figures 14 and 15. Here, the number of individual peaks will indicate the number of targets.

Effect of range on azimuth resolution. As shown in Figure 16, the ability of a radar to separate two targets close together in azimuth improves as the range decreases, because the angular difference in their azimuths is increasing. Notice that the two ships are covered simultaneously by the effective part of the lobe when at a range of 18 miles. On the other hand, when the same two ships close to five miles, the effective part of the beam cannot touch them at the same time, and they can be seen as two separate contacts. The azimuth resolution angle, in other words, intercepts a smaller distance at short range than it does at long range. Keep counting contacts as the range closes.

Effect of sweep length on range resolution. Due to the fact that pictures are traced on scopes by a relatively large spot of light rather than by a tiny point of light a certain amount of definition is lost. Regardless of the range scale in use, the size of the electron beam spot remains the same; consequently, it becomes increasingly difficult for this beam to trace a clear picture of the two contacts on the same azimuth as they move closer to one another on the scope. Therefore, the longer the range scale, the closer the contacts will move to one another on the range axis and the more likely they will be to blend into a single contact. This effect is more noticeable on the PPI or B scope than on the A type.

The PPI drawings in Figure 17 illustrate the point that a four-ship contact may look like one ship when seen on the long-range scale, like two when seen on the medium-range scale, and like four on the short-range scale, due to improving resolution. Study composition on the shortest scale possible.

Effect of receiver gain on range resolution. The range resolution will always be best when the gain control is turned low enough to prevent saturation. You cannot read composition on a saturated echo (one so high on the range scope that the top is squared off), so turn the gain down momentarily when necessary. Do not make the mistake of leaving it low, since this will decrease the sensitivity of the radar. (See Figure 18.)

To help get a clearer concept of resolutions, let us consider the topic from another point of view, analyzing the effect of both azimuth and range resolution at the same time rather than one at a time as previously done.

One-pip areas. The diagrams in Figure 19 illustrate the fact that the azimuth and range resolutions of the A scope are superior to those of a PPI on the same radar. Furthermore, they illustrate the size and shape of areas within which no resolution is possible; let us call these one-pip areas. Notice that the range resolution does not vary with range as long as the same range scale is used. Also notice that the width of the one-pip areas increases with range, the azimuth resolution expressed as an angle does not vary with range, but the actual width or intercept of this angle does increase. Therefore, the one-pip areas are narrow at short ranges and wide at long ranges. For any given range, there will be a one-pip area of a certain definite size and shape, and if you detect a group of ships at that same range, they will give only one pip no matter how many ships there are if their disposition can be completely fitted into this area.

Figure 16

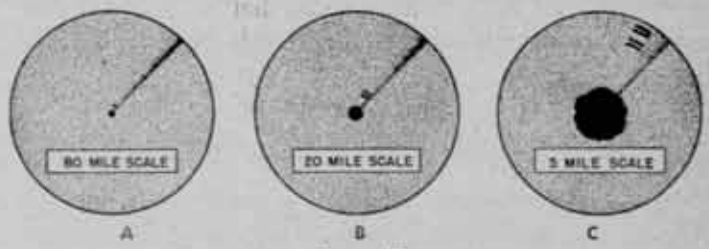


Figure 17

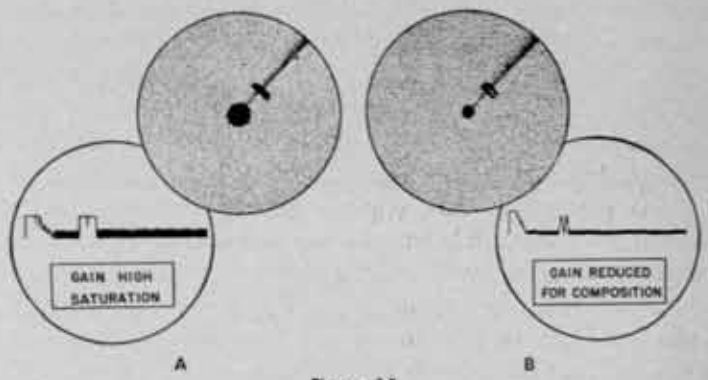


Figure 18

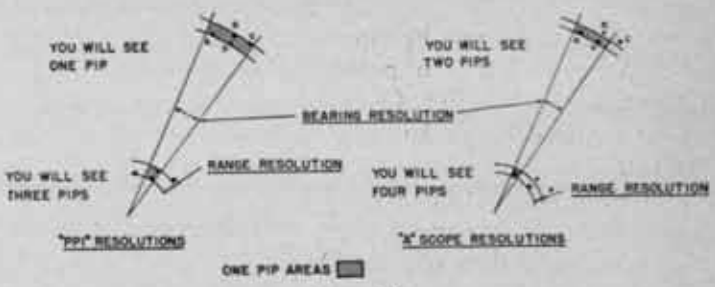


Figure 19

Now let us consider Figure 19 more closely. The group of ships when at long range just fits inside the one-pip area of the PPI, and as a result only one pip will be seen on that indicator (this would be true of 300 ships too, if they were disposed within the one-pip area). However, two pips will be seen on the A scope because the one-pip area of that scope is smaller and the disposition cannot be contained by it. In this case, targets A and D will show as one pip which can be resolved in range from another pip formed by B and C. Thus by using the A scope you know there are at least

two contacts instead of the single one shown by the PPI.

After this group of ships closes to a shorter range, you will be able to tell much more about its composition. Even the PPI will then show three pips. Since B and D can be enclosed by the one-pip area, they will give only one pip.

When B and D are in the one-pip area neither A nor C can fit in it; therefore, they will be resolved, and three contacts will be seen; A, B-D, and C. The A scope again shows its superiority in the field of composition. Notice how small its one-pip area is at this range. Only one ship at a time can be enclosed by it, with the result that four separate contacts can be recognized. In other words each contact can be resolved from the next in both range and azimuth.

The importance of checking composition frequently as the range closes is thus established. At any instant one pip may become several.

Incidentally, the reverse of this is true even in the case of a closing contact, if the ships comprising that contact suddenly form a smaller disposition. Radar operators have reported ships sunk because they did not realize that there is more than one way for two pips to become one pip.

Estimating the Number of Planes

One aircraft contact gives a narrow pip which bounces wildly and irregularly. A large plane echo, however, will bounce less erratically than a small one, just as a pip from a large ship will bounce less than a pip from a small ship.

Two planes will usually give a slightly wider pip (wider in range or azimuth), and the pip will rise and fall more slowly and regularly. The echo of three or more planes in formation will have an uneven, jigging motion, distinctly different from two planes in that it is not regular. The echo will not decrease to or near zero, but will vary at or near maximum height.

The number of aircraft can be approximated in larger formations by counting the number of individual pips and multiplying that figure by three or four (this will give only a rough approximation of course). The size of raids can be estimated using the PPI. Operators may become quite proficient at this if they take every opportunity to check their estimates.

An air-group contact may represent planes at some certain altitude, or it may represent a "stacked raid" (planes coming at more than one level).

General Hints on Composition

Inasmuch as air-search radars can detect surface targets, and surface-search radars can detect air targets, a few hints on recognition of these targets will be of value.

Land targets:

1. Not moving.
2. Pip does not bob like a moving target pip.
3. Should be at expected positions.
4. Usually cover greater area on screen than other targets.

Ship targets:

1. Pip height bounces at fairly slow rate.
2. There are normally no fades except when range becomes too great.
3. Speed less than 50 knots.
4. Narrow tent-shaped pip compared with land, although a big rock may resemble a ship in this respect.

Plane targets:

1. Speed is greater than 100 m.p.h.
2. Rapidly bobbing pip.
3. Fades appear periodically on long-wave air search radars.
4. One plane gives a narrow, quickly bobbing pip.
5. Two planes together give a regularly bobbing pip.
6. A mass flight may give one or several large, rapidly bobbing pips. Sometimes it is possible to count individual planes by breaks in the peaks of pips.

Spotting

Mortar echo characteristics. Any reflecting object, such as a projectile, passing through the beam will appear on a PPI scope as a bright spot and will diminish in intensity as the beam passes beyond the direction to the object. In the case of mortars, the beam may flick a projectile two or more times in successive sweeps before the projectile passes above the beam. The same is true for the descending branch of mortar trajectory. The momentary appearance (two or three flicks) and disappearance of a small signal on the PPI at approximately constant range is a typical indication of mortar fire. For low angle fire, the projectile may remain in the path of the sweeping beam for the greater part of its flight; a trace of the direction of flight will be seen on the PPI. Mortar pips can also be detected on the J scopes of the SCR-584. Multiple mortar fire can be more easily detected on the PPI than mortars firing singly. Depending on the dispersion in the mortar positions, the signal will appear as individual echoes or tend to merge into a single large echo.

Artillery echo characteristics. Echoes returned from artillery projectiles are generally weaker than those from mortar shells. Low-angle artillery fire leaves a trace across the PPI when it is flicked by the scanning antenna beam. Since the maximum ordinate of artillery shells fired at low angle usually does not exceed the antenna beam width, the projectile is flicked throughout the greater portion of its trajectory. The principal differentiating feature between low angle artillery fire and mortar fire is that the former has a much greater rate of change in range than does the latter. High angle artillery fire returns a signal very similar to that from high angle mortar fire. Volley fire returns a stronger echo than does a single projectile; if dispersion of the multiple projectiles is sufficient, each projectile will return a separate signal on the descending branch of its trajectory. When the antenna dipole is vertical, low-angle projectiles are weaker than they would be when the dipole is horizontal. High angle artillery fire may be confused with mortar fire.

The adjustment of fire on seacoast targets is simplified somewhat by the fact that a good echo is returned from the splash that is thrown up. These "splashes" may occasionally be observed when firing on land targets, especially if enough dirt or debris is thrown into the air.

Detection of Personnel and Vehicles

Radar sets, in particular the SCR-584, have been successfully employed in combat in the location of ground targets. Road-watching and bridge-watching at night have been sufficiently accurate to permit radar observed interdiction of enemy vehicular traffic in the observed area. At short ranges both hostile and friendly patrols have been located, their size estimated with surprising accuracy, and their progress charted. On one occasion radar data were used to inform an American patrol of the presence of a German patrol about 200 yards to the right, with the result that the enemy patrol was ambushed.

Once an echo on the coarse range scope has been identified as a target, it is brought into the fine range scope (if the set has one) and there studied after the echo is brought to a maximum through a manipulation of the controls. A fluttering, tenuous, cobweblike signal appears for moving targets. The character and texture of the signal will identify the target either as personnel or vehicles; the amplitude, viewed in conjunction with the range, will give an indication of its size. Personnel on foot produce a coarser and more lacelike pip than the fine-grained cobweblike one which is typical of vehicles. The more rapid the motion, the finer grained the signal appears to be. A stationary vehicle may or may not cause a fixed echo. When the engine is started, the resulting vibrations will give a moving target indication. When the vehicle starts moving the signal flutter increases. A moving target signal may appear in a fixed echo. The flutter appearing in the top of the fixed echo pip. Trucks have been located up to ranges of 16 miles, although 10 miles was the average maximum range. Individual troops were detected at ranges up to three miles.

False Contacts

Many pips appear on radar scopes that are false in the sense that they resemble ship or plane pips but are not caused by ships or planes. These contacts should be reported but the operator should state that he thinks they are false and give his reasons. Information on speed of wind and direction of tide will assist here.

Sea Return

The pips shown in Figure 20 are produced by the radar pulses reflecting from nearby waves. These pips are constantly shifting position and appear as rough, high grass. The rougher the sea, the stronger the sea-return will be. In a very rough sea, the sea-return may extend 4,000 to 5,000 yards in range from the radar.

Minor Lobes

The beam of radio waves sent out is not perfectly shaped like a searchlight's beam, it would appear somewhat as shown in Figure 21 (viewing it from above). We have the main lobe in the direction the antenna is pointing, and a series of smaller lobes, not wanted, but unavoidable, pointing in various other directions. When these smaller lobes illuminate a target they also produce echoes, especially if the target is large and fairly close. These minor lobes seldom

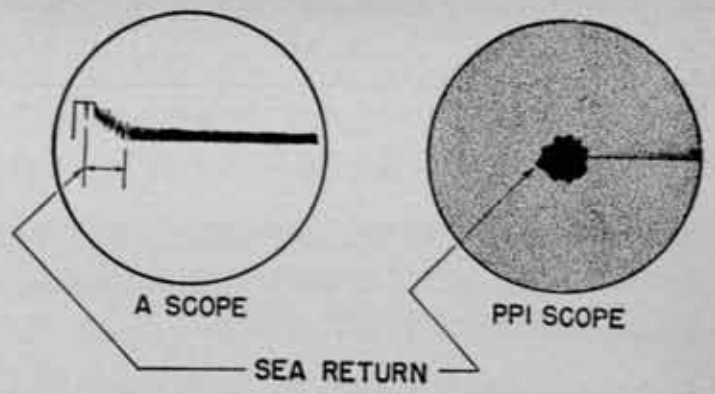


Figure 20

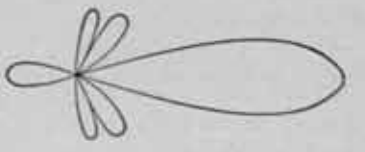


Figure 21

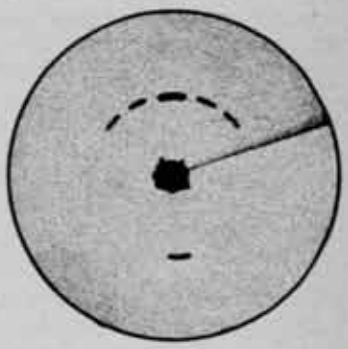


Figure 22

reach out more than 6,000 or 7,000 yards, except when they strike high land. They produce a picture on the PPI as shown in Figure 22.

Note that all pips are at the same range. The largest pip is the actual target; all others are minor-lobe echoes. The minor-lobe echoes may be eliminated by cutting down the gain, but that of course, may also eliminate other small targets from the screen.

Clouds

The radar at times acts as a weather prophet since it indicates clouds, fog, rain squalls, and regions of sharp temperature differences. Some clouds are not visible to the eye; they are called ionized clouds although this is a misnomer. Often an echo from a cloud resembles an ordinary pip from a surface target and at night might lead to a wild goose chase if it were not investigated further. Course and speed of the target should be determined by tracking it. If its course and speed agree with the wind's direction and speed you might suspect it to be a cloud. This, however, is not an unfailing criterion since the air currents aloft often differ from those at the surface.

More positive identification may be obtained by training on the target with the fire-control radar to determine whether it is on the surface or has a position angle indicating an air target.

A rain squall or fog bank may usually be identified by the type of pip produced on the screen. It will be wide in azimuth and thick in range; since neither rain nor fog forms a solid reflecting surface the pip produced is of a fuzzy, lacy nature.

Radar Pulses

Often pips which move rapidly across the screen are seen: there may be one or several. They are usually caused by another radar transmitter of the same wave length and may have the appearance of telephone poles as viewed from the window of a moving train. They are often called "running rabbits." If the interfering radar pulses do not move, they may obscure target pips. At long ranges the radar interference will be picked up only in the direction of the interfering radar transmitter. At close ranges the interference will appear at all azimuths. Radar interference will always be picked up at a range considerably greater than the range at which a returning radar echo may be detected. Hence you might pick up a ship's radar in this way long before its echo appears.

Double Range Echoes

Double range echoes are most frequently detected when there is a large target at comparatively close range. Such echoes are produced when the reflected wave is strong enough to make a second round trip. Double range echoes are weaker than the main echo, and appear at twice the range.

Second Sweep Echoes

Second sweep echoes appear only on some radars. They are caused by echoes from targets at long range; in fact from such a long range that the echo from pulse 1 returns after pulse 2. Since they must come from contacts at a greater distance than that indicated on your scope, their pips are usually smaller than you would expect at the indicated range. Usually they will be from land targets, since that is about the only target that can be seen far enough away to appear as a second-sweep echo.

Miscellaneous Objects on the Surface

Unexplainable echoes, usually at very close range, may be from whitecaps (beyond the sea-return in the direction from which the wind is coming), from birds, from floating objects such as large metal cans or shell cases, and from seaweed.

Beam-Width Distortion and Pulse-Length Distortion

Two types of distortion are always involved in PPI presentation. One is due to the diverging beam of the radar, and can be called beam-width distortion. The other is due to the fact that the pulse is not instantaneous, and it can be called pulse-length distortion. Beam-width distortion results in the widening of all things detected by radar; that is, all contacts appear to spread to the left and right of their actual positions. The stronger the echo, the greater the spread. This is more noticeable on long-wave air-search sets because of their wide beam width than it is on microwave sets. The result of pulse-length distortion is increased depth of target pips on the range axis of the scope. For example, a small navigation buoy may give a pip 300 yards deep on the A scope. As you probably have noticed on the PPI, contacts spread in azimuth more than they thicken in range. This becomes increasingly apparent as range increases.

Ships Near Shore

Ships or rocks close to the shore may blend with the shore and lose their identity completely or appear as a bump on the coast line. The effect is due, of course, to the spreading of all contacts in both azimuth and range.

Other Considerations

Course changes

In many cases you can tell when a target changes its course before this fact is revealed by the plot. The change is indicated by an increase or decrease in the strength of the echo, and is due to increased or decreased presentment. For example: a target may be seen end-on but when the same target changes course so that you are facing its broadside the echo suddenly increases. You will not usually be able to notice any difference in the echo strength as a result of *small* changes in target course; therefore any sudden, noticeable change in the echo will indicate a substantial course change. You should report this without delay, even though you cannot tell which way the target has turned. The fact that it has changed course at all will often be significant.

Moving Target Indicator (M. T. I.)

The moving target indicator kit applicable to some, but not all, of our standard radar sets is a device which enables a radar to filter out echoes from stationary objects and present only data from moving objects. This modification is based upon what physicists call the "Doppler effect." This effect may be compared to the periodic bouncing of rubber balls. If a man throws balls at a stationary wall at one-second intervals, the balls bounce back to him once a second. If the wall is not stationary, however, but moves toward the man, the balls return to him more often than once a second. If the wall moves away from him, the balls return less often. The same phenomenon is illustrated in the change in frequency of a locomotive whistle, which sounds higher in pitch when a train is speeding toward a listener and lower when it is speeding away. Hence radar echoes will be reflected back at a different frequency from a moving object than from a stationary object. Echoes showing this variation can be picked out by sending the radar signals down a mercury delay line which stores them for the interval between pulses. In this manner it is possible to take the string of echoes from the next pulse and compare them in amplitude with the echoes stored on the delay line. As a result, all echoes which are relatively unchanged pulse-to-pulse will cancel out and only those that differ in amplitude will remain. Only echoes from moving targets will be displayed on the scope. This modification will be a welcome addition to antiaircraft radar sets since it will prevent planes from hiding in ground clutter.

From the foregoing discussion it can be seen that there is a lot to be learned to become an expert radar operator. It takes a lot of actual work on the apparatus itself, but operating time alone means nothing unless the operator gets into the habit of thinking, observing, and remembering, making predictions and checking them, and looking for small details. Radar operating is truly an art.

War Damage To Corregidor

By Colonel Homer Case, G.S.C.

In September 1945 Major General William F. Marquat, commanding the 14th Antiaircraft Command and himself a veteran of Bataan and Corregidor, appointed a board of officers consisting of Colonel Reinold Melberg, Colonel J. H. Kochevar, Lieutenant Colonel E. J. Beller, Major J. H. Abbott and the author to determine the causes of the war damage to the Harbor Defenses of Manila and Subic Bays during the investment and capture in 1941-42 and recapture in 1945. In that month, the board visited the five islands of the defenses and most of the remaining batteries and installations. Nearly one hundred photographs showing details of damages were made a part of the report of which this article is a digest. Two of the board members had already visited Corregidor and Fort Drum shortly after the surrender in April 1945.

The board found that the destruction of the defenses was almost complete as a result of an apparently indeterminate combination of Japanese bombing and gunfire, our own demolitions prior to surrender and American bombing, naval gunfire and artillery and mortar fire during the recapture.

During September 1945 the board was able to take detailed testimony from some 50 officers and men familiar with the defenses, who were staging at Manila en route to the United States after nearly 40 months as prisoners of the Japanese. They generally had no notes and their memories were 3½ years old but the natural variations in their stories were not as surprising as the general agreement as to the material facts.

The board was very fortunate in having Colonel L. J. Bowler, Harbor Defense Adjutant, Colonel Wm. C. Braly, S-3, Colonel Napoleon Boudreau, who commanded Forts Wint and Drum in turn, and Colonel Octave DeCarre, who commanded the 92d C.A. (P.S.), during the campaign, accompany members on a tour of the defenses to bring out points that would otherwise have been missed.

Chronology

The following dates are Philippines time:

8 December 1941: Outbreak of war and bombing of Clark and Nichols Fields.

29 December 1941—7 January 1942: First and heaviest bombing of Corregidor.

9 April 1942: Fall of Bataan.

10 April—6 May 1942: Japanese shelling of Corregidor.

6 May 1942: Fall of the defenses.

21 January—17 February 1945: USAAF saturation bombing of Corregidor.

17 February 1945: Parachute and amphibious landings on Corregidor.

7-16 April 1945: Recapture of Forts Drum, Frank and Hughes.

April 1945

When we sailed to Corregidor from Manila, it was the height of the hot dry season and the island looked bare and denuded. Once ashore it could be seen that almost all the leaves and small branches had been torn from the trees by the heavy Air Force bombing during January and February. This was just one aspect of the outstanding impression of the extremely heavy and widespread damage to everything in sight. There was scarcely a square yard of surface on any of the four islands that did not bear the mark of one or more shell or bomb fragments. Not a single undamaged structure was seen.

Since the number of Japanese bombs was limited and since the craters of our own 1945 bombs could be easily identified, this widespread damage could only have come from the Japanese shelling from Bataan during April and May of 1942. Fast growing tropical vegetation and the erosion of three rainy seasons had covered most of them, but Colonel Bowler stated that at the time of the surrender, the shell craters touched each other in the critical areas. Colonel DeCarre pointed out the largest Japanese shell crater of which he had knowledge. It was overgrown and washed in and was not very noticeable.

September 1945

By September, over three months of another rainy season had passed and vegetation, leaves and branches which were broken in April, had grown out thicker than ever. The jungle had overgrown everything except paved roads and concrete buildings. This all hindered the investigation. It took over one hour to find Battery Morrison, a 6-inch battery and two former regimental commanders never could find 3-inch Battery Keyes. Except for some temporary roads that had been cleared with bulldozers, the sidewalks and roads of Topside and Middleside were entirely choked with thick growth.

The first floor of Topside Barracks, 1600 feet long and often called the longest in the world, was occupied by an Infantry company garrisoning the island. (See picture.) The roof was gone but the concrete floors with canvas over the shell holes kept out the rain. As the most obvious

The remains of the Topside Barracks at Corregidor.

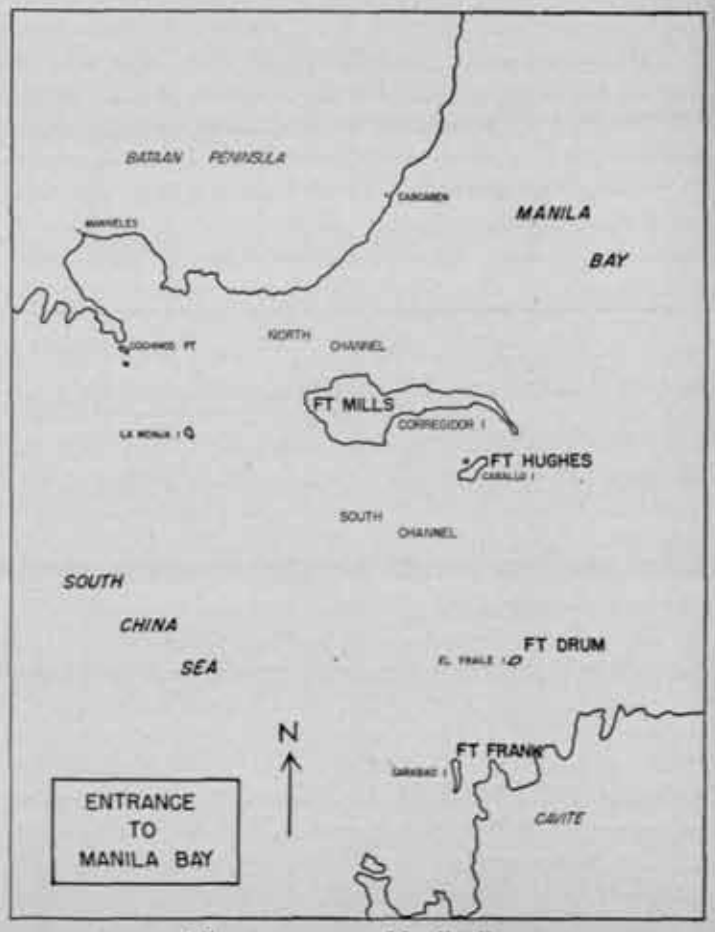
target, it was hit several times by bombs both on 29 December 1941 and later in the war. During April 1942, a shell struck 40 tons of TNT for submarine mines stored in the barracks and an entire battery section was sheared out as if with a knife as can be seen from the picture.

The Nature of the Defenses

The Harbor Defenses of Manila and Subic Bays guarded the entrances to the bays from which their names came. (See map.) Fort Mills on Corregidor Island was the principal fort guarding the 11 mile wide entrance. Here were stationed headquarters and most of the garrison. Forts Hughes, Frank and Drum, called outposts, bolstered the entrance defenses. Fort Wint on Grande Island at the entrance to the smaller Subic Bay was 35 miles northwest of Fort Mills. Since this fort was outside the defensive line up on Bataan Peninsula, it was evacuated on 25 December after being demolished by our troops.

Corregidor is shaped like a tadpole with its head pointing to the west. It is four miles long and about 1½ miles wide at the broadest part. The highest area, about 580 feet above sea level, is called Topside. Here were located the principal buildings as well as the major batteries. Middleside was down the hill to the east and consisted of the hospital, more quarters and barracks. Bottomside was at the narrow neck at the bottom of the hill. Wharves, power plants, the cold storage plant and the native village called Barrio San Jose of which nothing exists today, were grouped there. Just to the east of this is the 300-ft. Malinta Hill, through which runs Malinta Tunnel, with its laterals honeycombing the hill. This elaborate system is a monument to the prophetic vision and great energy of Lieutenant General S. D. Embick, in 1933-4 when he was a brigadier general and harbor defense commander. It provided the essential underground storage, barracks, headquarters and hospitals for the protracted defense.

During the campaign, the defenses were commanded by Major General George F. Moore, who was serving in them for the third time. A Marine regiment to provide beach defenses had been added to the three seacoast and one antiaircraft regiments. The entrance to Manila Bay was in 1941 undoubtedly the most heavily defended harbor entrance in the world having more and heavier guns than either Gibraltar or Singapore. There were a total of six 14-inch guns, ten 12-inch guns, twenty-four 12-inch mortars, two 10-inch guns, eleven 6-inch guns, twenty-nine mobile 155mm guns and at least fifty 3-inch and 75mm guns. Except for those at Fort Drum, the heavy guns were on outmoded disappearing carriages developed in the 1890s. The mortars were valueless against moving targets. Although all were obviously vulnerable to bombing and high angle artillery fire, not a single gun was put out of action by Japanese bombing and the Japanese Navy never fired at them.



The entrance to Manila Bay.

Fort Wint, the "Concrete Battleship," was unique among the coastal forts of the world. Built of reinforced concrete on an underwater ledge, it was 300 feet long and 125 feet wide and shaped like a battleship. To complete the illusion, it mounted four 14-inch guns in two turrets, four 6-inch guns in casemates and a cage mast, all Navy designs of about 1912.

The Japanese Bombing

Our airfields were the first Japanese targets and it was not until 29 December that the first bombing by a large formation of planes was delivered on Corregidor. This attack continued until 7 January but the size of the formations dwindling daily due to the accuracy of the antiaircraft guns. These were high altitude area bombing attacks with two general targets: Topside, especially the barracks and quarters and Bottomside with its wharves and power plants. Not a single fixed battery received a direct hit, although fragments did some small damage and two guns in a 155mm battery were put out of action. The buildings on Topside, mostly evacuated when war came, suffered most. The Topside Barracks, the Topside Cine, the hospital, harbor defense headquarters, and many officers' quarters suffered damaging hits.

The most important effect of this bombing was the cutting of the all important street car line running to Topside.

Japanese Artillery Fire

Japanese artillery caused most of the material and psychological damage to the Harbor Defenses during the campaign.

Late in February 1942, the Japanese moved a few 240-mm howitzers into the Cavite hills south of Forts Drum and Frank and kept these forts under fire until the surrender. During late April and early May, the shelling was almost continuous. Craters made by at least 3000 shells still show on the deck of Drum. They are from 2-4 inches deep and 18-24 inches in diameter. The shells hardly made a mark on the steel turrets. But the cage mast, the two 3-inch seacoast guns and the two 3-inch antiaircraft artillery guns were swept clear by the blasts. There was not a single casualty.

Fort Frank was shelled even harder since its guns were in open emplacements. As far as possible, all personnel lived in the two concrete tunnels that led to the two 14-inch batteries. These gave good protection but late in March while the men were lined up in the Crofton tunnel to take smallpox shots, a Japanese shell went through the earth cover, only three feet thick at that place, and killed 34 and wounded many others. Neither of the two heavy batteries was hit directly, but fragments did considerable damage. By taking parts from Battery Greer, Crofton kept firing counterbattery at Bataan at its extreme range until the end. Battery Koehler, eight 12-inch mortars, received many bursts in its two pits but all pieces were in action on 6 May 1942. Carefully prepared salvos of eight half-ton projectiles did some terrific execution upon Japanese batteries on the Cavite shore. These were located by our Filipino enlisted men who slipped ashore.

Fort Hughes, which was never bombed, was almost out of range of Cavite artillery but received a few shells late in the campaign. All guns were in operation to the end.

Concentrations on Corregidor

By the middle of April 1942, the Japanese had massed over 400 field guns on Bataan, many of which were 240-mm (9.2-inch) howitzers. Ranges to Corregidor targets were under 10,000 yards, batteries were hidden in the forest and ideal observation was available from the air and Bataan Mountain. Heavy concentrations were placed successively on almost every fixed battery and all the located Antiaircraft Artillery and 155-mm batteries. Every building and installation on the island received its share. Shells by the tens of thousands fell by day and night in spite of the long haul from the ammunition ships berthed in Subic Bay and the beaches of Lingayen. Severe as this shelling was, permanent damage to our batteries was less than would have been expected, in large part due to the unceasing work of the gun crews and of the few Ordnance machinists. Damage to observing stations, plotting rooms, power plants and telephone lines lowered the efficiency of the defenses.

Only one of the six 12-inch guns on disappearing carriages was put out of action, but two others could not make full traverse. On 16 April, No. 1 gun of Battery Grubbs, consisting of two 10-inch guns on disappearing carriages, was knocked out of action by a direct hit on a recoil cylinder. Since the other gun was out of action due to a mechanical failure, the battery was abandoned. It thus turned out that these obsolete batteries, complicated relics of the days when they were expected to slug it out with battleships with flat trajectory fire at 7000 yards, suffered no damage from bombing from airplanes that had not been invented when they were designed and but limited damage as a result of high angle artillery fire from land batteries.

The most modern heavy artillery weapons were the two 12-inch guns on barbette carriages called Batteries Smith and Hearn in their later days, the "Smith Bros." before that time. They were never out of action, except one gun for four hours on 7 January from a bomb fragment. Hearn, formerly Smith No. 2, was kept camouflaged with bushy shrubs in wooden tubs when not firing. It was never hit and fired 30 rounds of counterbattery during the night before the surrender. These guns received especially complete demolitions. They were fired with empty recoil cylinders, breaking rocker arms and bending piston rods. The muzzle of Battery Smith has been broken off, possibly from plugging before firing.

The two mortar batteries were so obsolete in 1941 that they were retained for fire on land targets only and well they proved their value for their salvos broke up a landing behind our lines at Cochinos Point on Bataan in March. Their deep pits were easily spotted and the batteries took more than their share of shells and damage. The explosion at Battery Geary, two pits of four mortars each, was the most spectacular result of the bombardment. On 18 April, after it had fired over 100 rounds on Bataan, a heavy 240-mm concentration was placed on the battery and a shell penetrated the powder magazine between the pits. A tremendous explosion completely wrecked Pit B. One mortar was blown 125 feet to the rear. Two others were blown under the concrete gallery, which then collapsed. Chunks

One of the officers inspects a 12-inch mortar under the collapsed gallery roof.

of concrete weighing several tons fell as far away as the golf course, 300 yards distant. On 2 May, a second explosion from shelling wrecked the rest of the battery. The pits have been taken by the jungle.

Battery Way, one pit of four mortars, fired much counterbattery on Bataan and escaped with little damage until the night before the surrender. It was then hit by a heavy concentration which put out three of its pieces and caused 30% personnel casualties. The one mortar continued to fire until one hour before the surrender when the breechblock froze from overheating.

The lighter artillery was the greatest threat to the landing on Corregidor and it was given especial attention. Battery Morrison, two 6-inch guns on the north shore pointing at Bataan, was permanently knocked out on 12 April, three days after the fall of Bataan. It is an interesting fact that Battery Ramsey, three 6-inch guns with fields of fire to the southeast, was but lightly shelled and was never damaged. This battery was never manned.

In December 1941 there were 17 155mm guns in seven semi-permanent batteries on Corregidor. One gun was in a very fine casemate constructed in 1934 by Colonel (then Captain) Abraham Lawrence and his battery. The remainder were in open positions, well dug in. The casemated gun was never hit. Seven of the others were destroyed by artillery fire and others damaged. Most of the positions had to be abandoned and several roving batteries of one or two guns each were organized. Named after their commanders, mostly lieutenants, they would be emplaced in concealed positions, fire 20 or 30 salvos on carefully spotted enemy batteries, and then hastily pull out. Colonel Braly stated that these were the most effective counterbattery weapons of the campaign.

The four 3-inch guns of Battery James, in front of Battery Morrison and aimed at Bataan, were all destroyed in one shelling on 20 April. There were six other 3-inch guns around the shoreline. These were generally unmanned and were never damaged.

Of the 22 3-inch antiaircraft guns on Corregidor manned by the 60th AAA, eight were destroyed by artillery fire and others damaged. Damage from fragments to height finders, directors, cables, etc., made it a constant struggle to keep batteries in action. The searchlights of almost every section were shot out at one time or another.

There were about six seacoast searchlights around the perimeter of the island. A heavy concentration would be

Number 2 gun of the two six-inch disappearing guns of Battery Morrison is now elevated to the top of the parapet.

put on every one that went into action and every one on the north shore was destroyed. The Harbor Defenses Command Post, near the east end of Topside Barracks, was never hit; nor was the C-1 Station, the command post of Colonel Paul D. Bunker, the Seaward Defense Commander, whose death while a prisoner was mourned by many. Communications suffered badly as even telephone cables in trenches 3-6 feet deep were constantly being cut by shell fire. Cable repair crews worked day and night exposed to artillery fire and kept up communications quite well until 4 May.

The entrances to Malinta Tunnel, which gave protection to so much of the garrison, were constantly shelled but damage was small since neither faced towards Bataan. By 1945 large amounts of rock debris had fallen from the vertical cliff above the west entrance, partly closing it. During February of that year much of our own bombing and Navy shelling was directed at Malinta Hill. It is believed that the Navy shells caused most of the slides. However the east entrance is relatively undamaged.

The Japanese landing on Corregidor was made during the night of 5-6 May 1942 and artillery preparations started on 3 May. We had at least 20 75mm and many 37mm guns deployed to repel this landing. The heavy concentrations were placed on their positions and the defensive trench system, especially on the north side of the "tail of the island" where the landing was made. Due to cut telephone lines and the night action, there is no detailed data on damage to the beach defenses but a later reconstruction indicates that about 80% of the guns were destroyed. However enough remained to make the landing a costly one. It is little realized that the Japanese lost about 5000 troops in this operation, mostly from the sinking of barges. One 75-mm battery near the tip, apparently overlooked by the Japanese fires, wrought terrible havoc.

Demolitions

Never before did a commander of our forces have a more clear cut problem of destroying his own equipment. While the rank and file were buoyed up by the hope of assistance, those who understood the strategy of the broad Pacific knew the inevitable end. On 10 April 1942, General Moore issued a definite and detailed directive for the demolition of armament and equipment. General Wainwright's decision that further bloodshed was useless was announced little more than two hours before the noontime hour of surrender but in spite of the short time left and the broken communications, the directives were carried out very completely. The best evidence of its effectiveness is that, as far as known, the Japanese never fired a shot from one of our guns during the battles to recapture the defenses. This in spite of the fact that over one hundred American prisoners worked on the least damaged weapons for over two years under close Japanese supervision. A considerable number of our officers and men were kept on Corregidor and over 70 more were sent from the death camp of Cabanatuan in June. Later a number of civilian prisoners from the Naval Air Base were sent over. Very extensive repair projects were laid out. Battery Hearn was completely dismantled, using a spare barrel and parts taken from Battery Smith. The piston rods were straightened and apparently the gun was ready to fire. Much work was done on the turret guns at Fort Drum. Sabotage by our troops is in part an explanation of the fact that the guns were never fired.

Some well accepted methods of demolition proved less effective than set forth in the manuals. The fact that breechblocks were thrown away and gears, handles, cylinders, etc., broken or dented undoubtedly made up for possible failures in the basic methods of demolitions. It had always been believed that a gun fired with no oil in the recoil cylinders would damage the cylinders beyond repair and cause the tube to jump out of its trunnions. This method was used with six guns on barbette carriages and only two were seriously damaged. It had also been accepted that a disappearing carriage tripped with no oil in the cylinders would be damaged beyond repair. This was done with five 12-inch guns. But three were damaged very little. The third accepted procedure was to fire a gun with the muzzle well plugged. This system destroyed 3-inch antiaircraft artillery and 155mm guns. At Fort Drum apparently but one muzzle was damaged when the muzzles of four guns were stuffed with filled sandbags and fired.

The bores and the external bright parts of most guns were well coated with rust preventative and there was little visible damage from corrosion. No one knows the extent of internal rusting, such as the interior of recoil cylinders but it probably was extensive.

Soon after the surrender, the Japanese started an extensive scrap drive. American prisoners started at the "tail of the island" and worked west, picking up every piece of metal that they could lift. Broken small arms, fire control instruments, tools, machines, mobile guns, searchlights, etc., were loaded on barges and shipped away. Most of the rails from the car line were shipped away. (By 1945 it was difficult to tell just where the line ran.) No heavy salvage equipment was available so no heavy parts from the batteries were taken. It is interesting that none of the 600 tons of lead in the gun counterweights was taken, although lead could easily have been cut up. It can only be concluded that the Japanese did not need lead.

Army Air Forces Bombing

After Manila was retaken, it was important to recapture the forts guarding the entrance to Manila Bay in order to use the port. Defended by an estimated 5000 Japanese, an orthodox landing on the few narrow beaches of Corregidor and the advance up the hill would have been a costly affair so in spite of the small and forbidding landing grounds, it was decided to land airborne troops on Topside. The only open spaces were the golf course and the parade ground, neither larger than 200 by 400 yards and both surrounded by a combination of wrecked concrete buildings and cliffs 400 feet high. However it was felt that the expected casualties (they reached 15% in the actual landing) would be less than those from the long fight up the 580-foot hill.

A heavy air bombardment was ordered to clear the landing areas of the enemy. Concentrations were placed on the golf course and the parade ground, as well as on Bottomside where an amphibious landing was to be made. Bombing started on 21 January and ended on 17 February 1945, just two minutes before the first drop. With no enemy

Fort Drum deck ruptured by an internal explosion caused by pumping a mixture of gasoline and fuel oil through an opening and igniting the mixture with a delayed fuze.

antiaircraft to oppose, accurate low altitude bombing was possible and the areas were churned and rechurned.

While this accurate bombing was not aimed at batteries, it is reasonably certain that four major caliber and five 6-inch guns were seriously damaged by this air attack. During February one of our bombs hit the 6-inch Battery Ramsey and the explosion of a powder magazine left a crater at least 25 feet deep. All three guns of this battery were destroyed.

Ground Combat

The recapture of the four forts took two months and even then there was much mopping up to do. The Japanese found the concrete magazines and galleries excellent for defense and the bitter fighting to dig them out required the extensive use of mortars and grenades. Fragments from these did much minor damage to batteries. Battery Craighill, two mortar pits at Fort Hughes, was cleared out only by pouring gasoline into the pits and setting it on fire.

Fort Drum, the "Concrete Battleship" presented a very difficult problem of attack since there were but two narrow entrances to the inner rooms. Covering with artillery all the ports from which the Japanese could fire, a Navy vessel nosed up to the Fort and pumped 3000 gallons of a mixture of gasoline and fuel oil through an opening. The explosion that resulted from a delayed fuze was so violent that it tore a hole 15 by 20 feet in the upper deck.

Without too many blank spots it was possible to disentangle the complex causes of the damage to the only large harbor defense ever reduced by battle. It is interesting to note that not one shot was ever fired by the enemy navy in the process.

Nearly two years have passed since the visits made to study these damages. By now the broken guns will be rustier and feathery *ipil-ipil* higher and thicker. Perhaps Corregidor will become a battlefield park to commemorate one of the most tragic campaigns of World War II or possibly it will be built again to take its place in the guided missiles age.

Task Forces Frigid and Williwaw Return

Task Force Frigid completed its winter test program in America's northernmost outpost and returned to continental United States the last of April.

The Task Force disembarked at the San Francisco Port of Embarkation after a 2000-mile voyage from Whittier, the Army port at Anchorage, Alaska. The men then proceeded to Fort Ord, whence they departed last September for the Alaska operations.

Task Force Frigid, commanded by Colonel Paul V. Kane of Corvallis, Oregon, was the largest of the three Army Ground Forces units testing cold weather equipment. The other two were Task Force Williwaw at Adak in the Aleutians and Task Force Frost at Camp McCoy, Wisconsin.

Task Force Williwaw, which also departed for its winter test program from Fort Ord last September, returned to continental United States through the Seattle Port of Embarkation a few days ahead of Frigid.

Reports from Alaska say that the past winter has been the coldest in the memory of the oldest resident of Fairbanks. Up to the first of February there had been 25 days of 50 or more below zero temperatures. February itself hit an all time low of 72 below zero.

It was so cold that General Jacob L. Devers, commanding the Army Ground Forces, on his return from an inspection of the northern task forces, said that food froze on the way between the plate and the mouth, that synthetic rubber tires froze and cracked, and lubricating oil in the crank case became a solid.

In explaining the importance of the Alaska tests, General Devers said that the outpost's nearness to Europe via the polar regions gave it great strategic importance particularly in any war of guided missiles and drone planes.

"Army Ground Forces regards these Alaska tests as being very important," the General added. "We don't know that we'll fight there or anywhere else, but we have to gain experience; we have to be prepared."

SPRING INTERLUDE

By Lieutenant Jack C. Berry, CA Res.

The two American soldiers lay in the heavy grass that bordered a spiny, Normandy hedge-row. Their two rifles lay between them, glinting a soft blue in the sifted rays of the sun that filtered through the leaves of a Haw tree above them. A half eaten can of C-Rations had drawn a swarm of flies that buzzed softly now and then as they swirled up from the beans and then settled down again. One of the soldiers had his head resting in the crook of his arm; he was lying on his side, his knees were drawn up so his body was in a half-curl, and his eyes were closed. The other soldier was stretched out straight, on his back, and he held a V-mail letter that he had received at mail call the day before. The letter was from his wife.

And the letter said . . . "We received your letter telling of your promotion the same day that the radios announced the invasion had started—two big events in one day, huh? Oh, darling, now that the fighting has really started over there I am so frightened for you. . . ."

It was warm and lazy there in the sun. Above them the Thunderbolts droned monotonously in formations of eight toward St. Lo to the south. In a little valley below their retreat there was a trickle of a stream that broadened out into a pool of stagnant water. Over this pool, dragonflies hovered and darted like they do in Illinois and Ohio in the spring.

An old Frenchman was sitting beside the pool catching eels. He had a great gob of worms sewed together with thread at the end of his line and he would let the ball settle to the bottom of the pool and lie there for several minutes. When he pulled it up there would be two or three wriggling eels clinging to the worms, their teeth snagged in the threads.

The Frenchman caught all of the eels that he wanted, rolled up his line around his pole, picked up the bucket holding his catch and then plodded toward a dusty road that led to a small village just over the hill from them. He walked around a bend in the road and disappeared from view.

And the letter said . . . "Perhaps the war will end this year and You'll be home for Christmas. Dad says that now that the invasion has started it shouldn't take more than six months to drive the Germans clear back to Berlin. I hope he's right. . . ."

A young French girl skipped around the bend of the road where the old Frenchman had gone. She carried a small stool and a milk pail and there was a little brown dog with her that yapped and jumped at the stool. The girl laughed and swung the stool at the dog and the dog dodged and ran ahead of the girl, barking back at her.

The girl left the road and climbed over a stile in the hedge-row. She didn't see the two soldiers as she walked toward two cows out in the pasture between the hedges. When she reached the nearest cow to her, she put the stool down beside it, sat down and began to milk the cow.

The little brown dog watched her for several minutes and then grew tired of watching so he wandered away. He trotted down toward the pool and stopped to lap up some water. This done, he looked about him and then scampered up to the hedge-row where the two soldiers lay. He sniffed at the half eaten tin of C-Rations and then looked at the soldiers. He didn't hear any objections so he began to gobble at the beans. Finished with eating he wagged his tail in acknowledgement and lay down near the soldier who held the letter. The little dog panted and the saliva dripped from his tongue.

And the letter said . . . "It's really spring at last. Dad has the planting done, and he and Ned are out cultivating this afternoon. Wait until you see the old farm—you'd never recognize it. You remember the old elm near the corner, well we've cut it down, and. . . ."

The girl down in the pasture finished milking the cow and she went over to the other, carrying the pail now half filled with milk. She sat down and filled the pail to the brim from the second cow. Then she chirruped for her dog. The little dog pricked up his ears, gave a backward glance to the two soldiers, and scampered down toward the girl.

The pail was then very heavy and the girl walked much slower than when she had come. She had much difficulty crossing the stile but she finally reached the road and started down its dusty length. The dog trotted at her heels with his head hanging slightly downward as he panted along. The two of them reached the bend in the road and were gone.

The two cows walked slowly toward the little pool and drank deeply of the stale water. When they had their fill they looked about them and then began to eat of the long grass along the bank.

And the letter said . . . "I am sending you another box. This time I'll put in the jar of olives you have been wanting. It's funny how you get cravings for stuff like that—something you don't give a second thought to back here. I'll also put in some fudge, cookies, and. . . ."

Up in the sky the Thunderbolts were returning. Some of them spluttered and they didn't drone all together like they had.

A sergeant led four soldiers carrying stretchers along the hedge-row. When the sergeant reached the two soldiers he stopped and bent over and then he straightened up again.

"Never mind these two," he said, "we'll notify graves registration when we get back."

The five of them continued on along the hedge-rows and soon disappeared.

THE RADIO WAR*

By Air Vice-Admiral E. B. Addison

After the collapse of France in 1940, the enemy erected an elaborate ground system of Radio aids close enough to Great Britain for them to be used by his night bombers when attacking vital targets in this country. By the help of these, German aircrews with but small knowledge of, and experience in, navigating by night, could find and bomb large air objectives such as big cities and widely dispersed industrial centers, and then find their way home again without getting lost. The enemy's ability to use such aids thus constituted a very grave menace to us, not only from the material, but also from the moral point of view. So it was, in the face of dire necessity, that we first conceived the idea of R.C.M.—Radio Counter-Measures—an organization which grew into an immense system involving the absorption of great resources of manpower and equipment and the devotion of much scientific and engineering endeavor.

The Radio War was on, and it promoted much controversy. The idea of jamming wireless communications was by no means novel, but it was a generally accepted principle that there was more to be gained by not inviting interference with our own communications by deliberately jamming those of the enemy. The Royal Navy particularly, and, to a lesser degree, the Army were most loath to start a general jamming campaign; and in the R.A.F. we, too, felt that we had much to lose were we to be deprived of the full use of our normal Radio channels of communication.

This viewpoint was maintained in principle by both sides throughout the War and no large-scale attempt was made by either to jam the opposing main Radio communication systems. From the inception of radio counter-measures, this fear was always uppermost, and every new proposal was closely examined by an Inter-Service Board, one of whose more important duties was to prohibit the use of any counter-measure that they considered likely to precipitate a general jamming war. Methods had, therefore, to be devised which, whilst interfering with the enemy's means of air navigation or control of his aircraft would, at the same time, be sufficiently subtle to obviate his considering them as an excuse for embarking upon wholesale jamming as a reprisal. Time will not allow me to explain all the various means that we adopted to restrict the advantages that the enemy was liable to gain by the use of his radio, so I will limit myself to describing a few of the more interesting methods that were employed.

*Extracted with permission from the Journal of the Royal United Service Institution. The term "Radio" as used in this article also embraces the field of Radar.

The Defensive Phase

One of the most successful of these was the system that we introduced in 1940 for preventing the enemy from making full use of his medium frequency radio beacons of which he had installed a large number along the coasts of Holland, Belgium and Northern France. For this purpose we set up in this country a number of stations at which the beacon signals were received. The received signal was fed into a transmitter which was thereby caused to radiate a signal identical to that of the German beacon. In short, the enemy signal was used to trigger off our transmitter, thus insuring perfect synchronization. The result was that the German air operator, instead of hearing only his own beacon signal, heard a combination of his own plus one or more of ours. Since all the signals heard were in exact synchrony, his direction-finder was unable to give him an accurate response.

The Germans were not long in discovering this trick but even after it was known to them, none but an exceptionally skilled air operator could ever tell whether or not the beacon he was listening to was being interfered with by us. The Germans gave instructions that, in cases of doub the crew of an aircraft were to transmit from the air, and they would then be picked up by direction finders on the ground and be told their position by radio. We countered this by causing the German aircraft signal to trigger of ground stations in this country, so that the German ground direction finder operator in enemy territory actually rea the mean of two or more simultaneous signals emanatin from different localities. As a result, German aircraft wer often given locations over this country which were entirel false. Consequently many of his pilots became completel lost, some landing on our aerodromes and others crashin from lack of fuel whilst endeavoring to return to thei bases.

An even more dangerous practice that the enemy resorte to at this time was the use of long-range navigational beams He installed a number of beam transmitters along the Con tinental coasts opposite our shores and, by means of rotatin aerial systems, was able to direct the beams on to an target in this country within a range of 200-250 miles. Hi *modus operandi* was extremely simple. Beams from tw stations separated by a distance of the order of 100 mile were laid to intersect over the objective. The German pilo would fly up one beam and drop his bombs at the momen of passing over the point of intersection of the other. I was estimated that, by this method, bombs could be droppe

with an accuracy of about 500 yards at 200 miles range without the pilot ever having to see his target or having to worry about navigation once he was on the director beam.

The frequencies on which these beams worked were those of his normal blind-landing systems. This meant that, since all his night bomber aircraft were fitted with blind-landing receivers as part of their standard equipment, and since all his crews were trained in their use, Goering was able to adapt his bomber squadrons to beam-flying very rapidly and so prepare them to attack large area targets by night under any conditions of visibility with but very little extra training.

The task of countering this system with rapidity was a difficult one. We had no suitable transmitters of sufficient power to enable us to obliterate completely the beam signals over the whole of the country. We had, therefore, to resort to subtlety. It was a question of rapid improvisation, ingenuity, hard work and, above all, freedom to act without having to wait for authorization from above. Fortunately all these desiderata were forthcoming. A band of enthusiasts comprising a mixture of serving officers, scientists, radio engineers, and even a well-known London radiotherapy specialist, were organized into a Signals Wing, and given every encouragement and facility from the Prime Minister himself downwards. They were permitted to draw freely upon sources of very valuable aid from the various Service technical establishments, from the G.P.O. and B.B.C., and from certain selected commercial firms. Eventually they were able to impair, to a large degree, the efficacy of the German beams.

Before describing the method we employed, I should explain that a radio beam used for air navigational purposes is not a beam in the usually accepted meaning of the term. The beam transmitter emits two main lobes which extend over areas of hundreds of square miles. One lobe consists of dash signals and the other of dots. These dots and dashes are so timed that, if heard simultaneously and at equal intensity, they combine to form an equi-signal. The two lobes are so spaced that their flat inner edges just overlap, and so provide a central lane which produces an equi-signal to an observer flying along its length. It is this central lane that is called the beam. When to one side of the lane, the observer either hears dots or dashes and then, by applying a simple rule of thumb, knows in which direction to turn to reach the central lane or beam.

Our method of countering this system was to emit dashes which sounded exactly like those of the enemy's beam transmissions. These were not synchronized with the German signals, but were superimposed upon them. When in the dash zone, the enemy pilot would turn in the required direction, but on arrival over the central lane would still hear predominating dashes and so would tend to overshoot. When in the dot zone, he would hear a mixture of dots and dashes, which would not resolve themselves in the expected manner when he applied his rule of thumb.

A curious feature of this operation, the reasons for which were not at first obvious to us, was that the enemy believed we were deviating his beam. This idea became prevalent among German bomber crews, and soon it became obvious, by following the tracks of their formations across this country, that frequently such a phenomenon was, in fact, being produced. We thereupon made use of this effect to our advantage by installing decoy fires around the more vital targets in this country. These fires could be rapidly ignited as soon as it became apparent to which side or other of the intended target the enemy formations were being misled. On some occasions these decoys were very successful indeed in offsetting the central point of the enemy's attacks to open country a short distance from their objective.

Another discovery we made at this time was that the Germans believed their beam signals were of sufficiently high frequency for us not to hear them on the ground in this country. This supposition did, in fact, accord with the theoretical laws of propagation which were known to both us and the Germans before the War. As it happened, however, experience proved that we *could* hear them, and not only were we able, as a result, to decide which of the numerous interfering transmitters deployed all over this country were required to be brought into use for the particular direction in which the beams were trained for the night, but we knew exactly when to bring them into operation, and the frequency on which they were to be brought up. Another very important feature was that, by means of our ground observations, we were often able to plot the general direction in which the beams were laid, and so gain an inkling beforehand as to the probable target for the night. The enemy continued to use this system long after it had fallen into mistrust mainly, perhaps, because he hoped that it would keep our attention away from a new and improved beam device that he was then about to use in his attacks on this country.

The underlying principle of the new beam was similar to that of the old, but it was of greater accuracy, and on a higher frequency. Being on a higher frequency should have made it even more improbable, according to theory, to detect it on the ground but, here again, theory failed and we found we were able to plot it as before. It was, however, a very much more complicated system, and capable of being set up on a much greater number of frequencies than the earlier type. These new beams could not be used by all the German bomber force. The system required a quantity of special apparatus to be carried in the aircraft, and a very high degree of training on the part of the aircrew. Its use was, in fact, confined to a single highly trained specialist unit who acted as Pathfinders to the rest of the force. Their duty was to mark the target and, if possible, start fires in the target area to serve as a luminous guide to the main body—much as our own Pathfinder Force did towards the end of the War.

Our method of countering these new beams was very similar to that employed against the old, but had to be on a very much more extensive scale. Not only was the range greater, but the system involved the simultaneous use of at least five beams, all on different frequencies. Actually seven beams were normally used at a time against a single target. Before we were fully ready with our counter-measures, the Germans made very successful use of this system, but gradually, like its predecessor, it fell into mistrust as our countering methods became more effective.

The Germans then introduced another system in the form of an entirely different type of blind-bombing device

which, in some respects, was a crude version of that subsequently used by our Pathfinder Force for accurate pin-point bombing. This consisted of a single beam, working on a new principle, which was directed over the target and along which the bomber flew. During this process the aircraft was caused to emit signals at intervals which enabled the controller on the ground to estimate accurately its exact position along the beam. When the bomber arrived over the target, the ground controller gave the aircrew the order to bomb.

But this device also suffered interference at our hands although, on its first appearance, we had some difficulty in determining the principles on which it worked. The enemy, however, helped us, as far as the time factor was concerned, by committing the grave error of using it over this country for experimental purposes before employing it on a fully operational scale.

Thus we saw the decline of the German night offensive against our home country and, with it, the closing of the first chapter of the Radio War. The instances which I have quoted of the methods employed by the Germans to assist their navigation over this country, and the various measures we adopted to counter them, by no means represent the full story. There were many more, all of which ultimately demanded a very large effort on our part.

The Offensive Phase

The second phase of the Radio War, that is to say the Offensive Phase, came into being when it was realized that the defensive system of the enemy was becoming so efficient as to inflict serious losses on our night bomber forces. We were now on the offensive and the Germans were sinking all their resources into the building up of the air defenses of their territory. Their defensive organization depended for its success to a very large extent indeed on the use of radio, and with the rapid strides made in this art by the German scientists, Bomber Command was meeting increasing opposition as its attacks grew in intensity. Slowly the toll taken of our night bombers rose as the German defenses became more efficiently developed, until it was realized—and at this stage our scientists uttered a grave warning—that defense was likely to outstrip offense where night bombing was concerned. At this time, too, it was becoming very evident that the use of radio by the enemy was a factor which had to be taken seriously into account in our planning of night raids. The Germans were able to gain very early warning of an impending attack and could follow continuously for a long period the approach of our bombers. Thus he could congregate his fighters well beforehand in the right area and so be ready to inject them, with the aid of inland radar systems, into the bomber stream as soon as it arrived overland.

A knowledge of the methods that the Germans were using enabled Bomber Command, however, to route their aircraft in such a manner that the danger from radar was lessened to some extent. For example, it was found that concentration in time and space caused saturation of the enemy's radar. Again, 'zig-zag' routing made it more difficult for the enemy to guess the probable target by observing the general trend of approach since no conclusions could be drawn.

But our opponents soon learned to modify their defensive systems to counter such stratagems, and although new tactics frequently led to a temporary reduction in our casualty rate, the enemy was quick to re-adjust his defenses to meet every new contingency as it arose. So it became increasingly obvious that a more positive protection against the effects of the enemy's radio systems was required. A number of devices for interfering with the enemy's apparatus, particularly those concerned with the control of his night-fighters, were invented and installed in our main force bombers, but the extra weight to be carried, and the added onus imposed on the aircrews who had to operate the complicated apparatus in addition to their normal duties, tended to outweigh any advantage that they bestowed. Eventually it was concluded that specialist R.C.M. aircraft and escorting night-fighters, fitted with special devices for searching out and destroying the opposing night-fighters, were needed. Thus it was decided, late in 1943, to form a separate Group within Bomber Command, whose main function would be the protection of our bombers at night. This took time to organize, since the apparatus had to be made and fitted into the aircraft and the specialist crews had to be trained.

In the meantime, however, Bomber Command obtained a very welcome respite by the introduction into operational use of one of the simplest and yet most successful countermeasures of the War. For many months previously, we had known that strips of metallized paper when cut to the right dimensions would cause spurious echoes on the German radar apparatus. If, therefore, sufficient quantities of these strips could be thrown out by our bomber aircraft whilst within range of the apparatus, the German fighter control and antiaircraft radar systems would become cluttered up. The sudden introduction on a large scale of this device completely took the Germans by surprise, and for a considerable period had the effect of greatly reducing our casualty rate. Although the Germans never completely recovered from the effects of 'Window' as it was called, they were able, once the initial surprise was past, to re-adjust their fighter control methods to overcome to an increasing degree the effect of this counter-measure. Once again, our losses began to mount.

However, by now, the new R.C.M. Group was rapidly taking shape and as its strength, and skill born of experience, grew, its existence began to make itself felt. So our bomber losses once more decreased and for the rest of the War were never again so high as they were prior to the introduction of 'Window' despite the fact that the nightly effort of Bomber Command attained, during this period, an unprecedented level.

The new Group had three main functions: first, it provided aircraft to accompany our bombers for the express purpose of interfering with the German radar and ground to-air radio-control channels; secondly, it furnished night fighter escorts; and thirdly, it employed aircraft for search purposes with the intention not only of checking how effective were our counter-measures, but also of discovering what new radio devices the enemy were using.

The aircraft employed were four-engined bombers and long-range night-fighter Mosquitoes. All were packed with

a mass of apparatus, much of which had to be specially designed for the purpose. The Mosquitoes, in particular carried 'blackboxes' in every possible available position. These enabled them not only to home on to the German beacons over which the enemy night-fighters used to assemble, but also to home on to the radio apparatus which the German night-fighters carried for intercepting our bombers. The material effect of their operations in terms of enemy night-fighters destroyed and damaged was considerable, but possibly the moral effect of their activities was even greater. The enemy night-fighter was no longer able to concentrate solely on his task of shooting down bombers. Now he had continually to be looking over his shoulder in the fear of being followed, and he became apprehensive, too, of the attractive effect produced by the switching on of his airborne radar apparatus, and so tended to become disinclined to use it as freely as before.

During 1944, as the value of the operations of the new Group became more apparent, it was increased in strength until eventually it comprised as many as fourteen operational squadrons. With its growth came a considerable extension of the scope and nature of its work, and now, for the first time, it became possible to devise many ingenious new forms of operation with the intention not only of destroying enemy night-fighters, but of diverting them from our main bomber force. For example, it was found possible by the use of 'Window' to cause a handful of aircraft to simulate a force of several hundreds. A main force ejecting Window' appeared like an extension 'blob' on the enemy's radar. In this blob the individual aircraft were concealed. By using a small number of aircraft, appropriately disposed in space, to cause a like degree of 'infection' over an area equal to that occupied by a main bomber force, a similar sort of blob could be made to appear on the enemy's radar. Thus we were able to mount decoy raids simultaneously with those of the main force. The enemy had to choose whether to concentrate the bulk of his fighters on any one of the raids with which he was threatened (in which case he had to *guess* the right one), or divide them up to cover all the raids (in which event the force available to attack any one was proportionately reduced in strength).

Another effective method was to employ 'spoof' aircraft in such a way as to give the appearance of the main raid splitting before reaching its target. The enemy would see on his radar a large force of aircraft approaching, whose head would suddenly divide into several prongs, each of which pointed at a vital objective. He now had to guess which of these prongs constituted the real menace.

Yet another method was to infect an immense area with 'Window' just before the main force was due to arrive. This was done by the 'spoof' aircraft preceding the main force by a short distance and then fanning out as they approached the target area, 'Windowing' hard as they did so. The main force on arrival would then disappear into the cloud of 'Window' and, until the bombs started to drop, the enemy could not determine the actual objective destined for attack, nor could he discover the direction in which the bombers were heading for home after leaving the target area. This resulted in his being unable to deploy his fighters in time to meet the attack, or to assemble them to catch our returning aircraft.

It will be realized, of course, that this sort of operation entailed the lifting of a tremendous weight and bulk of 'Window' material in each of the 'spoof' aircraft. This quantity would have been too great if enough material had had to be carried to enable the 'spoof' aircraft to drop 'Window' in sufficient quantities during the whole of the time that they were in range of the enemy radar—a distance of anything up to 300 miles. It was necessary, therefore, to conceal the approach of our forces until our aircraft were comparatively near to the target area. This we achieved by putting up a screen of jamming aircraft in such a position that it blinded the enemy's early-warning apparatus on the approach side. This screen would in itself, however, have constituted a timely warning of an impending attack, since it had to be in position some hours before our main force was due to reach its objective. To overcome this disadvantage, the screen was frequently deployed at times when the rest of Bomber Command had the night off. The presence of the screen, therefore, might or might not herald the approach of our main forces; and the enemy, on the grounds both of morale and economy of fuel, eventually became loath to put his fighters into the air as soon as he heard the screen take up its position.

Another use of the 'spoof' forces was to cause attrition of the enemy. On some nights when Bomber Command were not due to attack, 'spoof' bomber forces would go out. The enemy, on first hearing the screen take up its position, would then alert all his defensive organization, his fighters being held in readiness on the ground. Suddenly, out of the screen would burst one blob or more of bombers. Were they real or decoy? If he waited too long he would not be able to deploy his fighters in time to catch the bombers. If he acted immediately he ran the risk of wasting precious petrol and depressing the morale of his fighter force. He had therefore, to guess—and many times he guessed wrongly. On one occasion in particular, 'spoof' attacks were made two nights running on a heavily defended North Sea port. On each occasion the enemy reacted violently, and in force, but each time he found he was striking empty air. On the third night a real raid was launched, but this time he sulked and the port was subjected to a very heavy attack with but negligible losses to our bomber force.

By methods such as these we succeeded not only in partially blinding the enemy but in turning his defective vision to our advantage by laying him open to deception. In this we were eventually aided, as far as the Western Front was concerned, by his evacuation of France and the Lowlands, since not only had his early-warning system to be drawn back but we were able to supplement our airborne R.C.M. by a ground system deployed on the Continent which we pushed up close behind our front line. One of the various ground counter-measures that we employed during this period was the transmission of false instructions to the enemy fighters. Since the fighter crews required to be given quickly and plainly their final instructions after they were airborne, their messages were usually sent 'en clair' by radio telephone (voice). Aircraft accompanying our main bomber streams carried apparatus for jamming these channels of communication, but eventually the enemy countered this by increasing the power of his transmissions to such an extent that they broke through our

jamming. We then resorted to the use of high-powered transmitters in this country to talk to the enemy night-fighter crews. We employed German-speaking operators to countermand the instructions given by the opposing controllers, or to give warnings to the German fighters of bad weather and other impending terrors. Although not always successful, this stratagem did, however, add to the general confusion and troubles of the already harassed enemy night-fighter, and it certainly served still further to shake the declining morale of all but his few select aces.

Incidentally this operation exemplified a principle which is of paramount importance in radio warfare—the necessity of continuously appreciating what the other fellow is likely to do next so as to be ready to meet him as soon as he attempts to do something new. In this instance we imagined that, if our 'ghost voice' was successful in causing trouble, the Germans might well employ a woman controller should the situation become very critical. Consequently, when training our male 'ghosts,' we took the precaution of simultaneously training two women. Sure enough, one evening, during a particularly hectic exchange of opinions between the German controller and our 'ghost' as to the best method of conducting the German night-fighter operations, a woman was suddenly heard to take over control on the enemy side. She was immediately taken to task by our duty female 'ghost' who, for many nights, had been eagerly waiting for just such an opportunity to have her say.

The net result of all these operations was that the dire disasters prophesied by our scientific advisers did not come to pass. Our night bombing was able to continue, not only without crippling losses, but actually with an ever-decreasing casualty rate—and this at a time when Bomber Command's attacks were reaching their highest peak of intensity.

The experience we gained in the use of these various counter-measures was turned to very good account by Bomber Command and the Navy during the Normandy invasion in 1944. Not only were we able to blind at will the remaining German early-warning systems that had not already been smashed by low-flying aircraft prior to the landing, but also to simulate landings and attacks by air and surface craft in sensitive areas in which no invading forces were actually employed. These tactics were successful in helping to delude the enemy as to the real point of invasion and in adding to the state of confusion that existed in enemy territory.

The Future

And now, what of the future? The late conflict has pointed in no uncertain manner to the likely trend of weapon development in the next war—a struggle in which the product of the scientist's brain is likely to play an even more predominant part than we saw during 1939-1945. Perhaps among the most important of these developments will be the production and employment of remotely controlled lethal weapons capable of travelling immense distances at great heights and at speeds hitherto unattainable; capable also of being aimed with a very high degree of accuracy and of being armed with explosives, small in size but of tremendous destructive power.

I have heard it stated that, if we ultimately reach this stage, there will be no means of defense by the attacked nation—the aggressor will have it all his own way and the war will be over before it is declared. It is possible indeed that present methods of defense would be incapable of dealing with weapons of this nature, but surely it is by no means certain that effective counter-measures could not be found for use against them. On several occasions during the late war I heard the belief expressed that some form or other of new apparatus was so intricate that it could not be successfully countered, or such and such a weapon was so predominantly powerful that no means of defense against it was conceivable. Rarely, if ever, were such conceptions eventually found to be true. *The danger lies in concentrating effort on producing a weapon to the exclusion of simultaneously working on methods of countering it or nullifying its effects. Often production of the counter-measure may require more effort and more time than the perfecting of the object to be countered.* If the result of a future war, consequent upon the production of new lethal weapons, is likely to be swift and decisive there will not be time to invent and produce counter-measures once hostilities have started. They must be prepared beforehand. There is a danger—a likely danger now the War is over—that scientific effort may be wholly directed to the production of bigger and better weapons, and so leave none available for what, in my opinion, should be the equally important task of inventing methods of countering them—and perhaps, who knows, in the next war we shall not have time to spare before coming to actual blows.

This is, perhaps, the most important lesson that the Radio War has to teach us, for it may well be that these new weapons will require some form or other of radio control, not only to guide them to their objective, but possibly to explode them at the desired moment. That being so, it should not be beyond the ingenuity of the radio scientist and engineer to devise means of diverting these projectiles, or of causing them to explode before their due time. Scientists, too, must find a way of detecting and following their course at whatever height or at whatever speed they travel, and then, possibly, of firing another projectile capable of being directed unerringly towards the intruder to meet it in mid-air.

Such ideas may sound fanciful—so did the tales of Jules Verne when he wrote them. In my opinion the effects of any product of the scientist's brain are always capable of being neutralized by a fellow scientist working in the laboratory next door. Success in any future war between fully developed nations may well be contingent upon the fulfillment of this theory.

THE ARTILLERY SCHOOL

By Colonel Parmer W. Edwards, CAC

Recent War Department studies on the reorganization of the Army have produced a plan for merging the Antiaircraft, Seacoast and Field Artillery into one branch. Anticipating the enactment of legislation which will formalize this merger, the War Department and the Army Ground Forces have issued directives effecting the reorganization of the three artillery schools into one artillery school. To create one artillery arm having a maximum of flexibility and efficiency in the employment of all types of artillery weapons and accessories will take time. The early integration of our principal educational resources represents a determined assault upon that time factor.

Much information on the reorganization of the artillery schools has been distributed, already. The purpose of this article is to consolidate the facts and to present current plans of The Artillery School for carrying out, in the educational field, its part of the task of integration.

The Artillery School is now situated at Fort Sill, Okla., with the Antiaircraft and Guided Missiles Branch at Fort Bliss, Texas and the Seacoast Branch at Fort Winfield Scott, California. The Artillery Center with headquarters at Fort Sill, has been organized to facilitate control of The Artillery School, the Post of Fort Sill and the AGF troops stationed thereat.

The courses at The Artillery School and its Branches must fulfill the educational requirements of all artillerymen, officer and enlisted, in the field of branch tactics and techniques. Also, they must prepare students for further schooling in the over-all army school system—the officer for The Command and Staff College and the enlisted student for OCS. In general, subjects peculiar to Antiaircraft (and Guided Missiles) and Seacoast Artillery are taught at Forts Bliss and Scott, respectively. Likewise, subjects peculiar to Field Artillery are handled by The Artillery School at Fort Sill. In addition, Fort Sill provides instruction in subjects common to all the artilleries, including staff techniques through the division level and tactics of the combined arms. For reasons of economy, Fort Sill will conduct certain specialist courses which are required by more than one of the artilleries.

As in the past, the program provides general and specialist courses, which are further divided into regular and associate courses. The associate courses are, in the main, condensations of the regular courses and are provided only because our civilian components cannot spare the time from their civilian pursuits to attend the more lengthy regular courses. In addition, the shorter length of the associate courses makes them excellent media for broadening the education of officers of other arms and services. In order to provide a better picture of the scope of instruction now planned in The Artillery School, a more detailed discussion of the principal courses follows:

THE BASIC COURSE. Newly commissioned regular officers first report to Fort Riley, Kansas in the Fall for a basic course in subjects common to all ground arms and services. This course now lasts for seventeen weeks, after which the artillery officers (Coast and Field) report to The Artillery School to begin their basic artillery education. Current plans contemplate that this course will start in January of each year and will be of twenty-six weeks duration, with ten weeks at Fort Bliss, followed by 16 weeks at Fort Sill. For the ten weeks at Fort Bliss and for ten of the sixteen weeks at Fort Sill, emphasis will be upon artillery technique. It is in these periods that the new officer must learn the care, maintenance and operation of artillery matériel and the gunnery skills and tactics necessary for its efficient employment in the battery. This is a broad scope and covers all field artillery weapons from the well known 105 How. to the 8-inch gun, antiaircraft guns and automatic weapons, fire control matériel and radar equipment, and an introduction to the field of guided missiles. The remaining six weeks at Fort Sill will be devoted to common artillery subjects such as intelligence, maps and charts, survey, motors, communication, artillery staff procedures up to the battalion, and other general subjects common to all AGF schools such as Leadership and Methods of Instruction.

It will be noted that no seacoast artillery instruction has been included in the above course. Early in the late war, our seacoast defenses became, generally, the responsibility of National Guard and Reserve units. It is understood that tentative plans of the Army Ground Forces call for our reserve components to assume this responsibility in the postwar establishment, hence the omission of seacoast subjects in this course. However, it is the present thought that seacoast artillery knowledge will be preserved through special courses at Fort Scott, which are available to all components of the military service.

THE ASSOCIATE BASIC COURSE. As described above, a basic artillery course covering all the artilleries requires a broad scope, too broad for the thirteen weeks available for an associate course to be taken by Junior National Guard and Reserve officers. Furthermore, most junior artillery officers of the National Guard and the Reserve are already assigned to type units (field, antiaircraft or seacoast) and, normally, will not have opportunities for diversified training in units of other types owing to the fact that such units will usually be located at inconvenient distances from homes and places of business. Therefore, this course specializes by assigning all officers of field artillery units to Fort Sill for the entire thirteen weeks, while those assigned to antiaircraft artillery units will attend the course at Fort Bliss and those assigned to seacoast artillery units will go to Fort Scott. In addition to junior officers of the National Guard and the Reserve, graduates of the

Officer Candidate School and officers selected from other arms and services will attend this course. As will be seen later, associate students will receive instruction in Subjects of the other artilleries upon their return to school in the Associate Advanced Course or in one of the special courses offered at Fort Scott. The first class reported on 24 March 1947, and it is planned that this course will run continuously, a new class reporting every three weeks.

THE ADVANCED COURSE. The next Advanced Course for artillerymen is due to start about the first of September, 1947, and tentative plans are that it will consist of seven weeks at Fort Bliss, followed by thirty-four weeks at Fort Sill. It has been decided recently that the Command and Staff College at Fort Leavenworth will raise the level of its instruction and the Branch Schools will assume the responsibility for teaching General Staff organization and functions at the division level. This innovation will be included in the next course. While the course will stress tactics and staff functions, some matériel, gunnery and communication subjects will be included but only to provide a review of one artillery for those who have served in the other and to bring students up-to-date on recent developments and changes in artillery techniques. The seven weeks at Fort Bliss will be devoted mainly to antiaircraft artillery tactics. The thirty-four weeks at Fort Sill, according to present thought, will be broken down approximately as follows: nineteen weeks on General Staff organization and functions, organization and employment of associated arms and services, tactics of combined arms and joint operations; seven to eight weeks on common artillery subjects such as communication, intelligence, matériel, motors and artillery staff organization and duties then seven weeks on purely field artillery tactics.

From the above, it will be seen that the new objectives of this course will be to prepare students for artillery command and staff positions from the battalion up to and including the Corps and Army artillery and antiaircraft Brigade level, and for General Staff assignments in Divisions. Students for this course will be obtained from all the artilleries and it is planned that they will attend between their third and tenth years of service.

THE ASSOCIATE ADVANCED COURSE. This course, like the regular Advanced Course, is mainly tactical and designed to prepare artillery officers of the National Guard and the Reserve for higher command and staff positions in field and antiaircraft artillery echelons and for General Staff duties at the division level. Officers from other branches of the army will also be selected to attend in order to continue the process, begun at the Basic level, of broadening the education of all arms of the service. This course will run thirteen weeks and will be conducted wholly at Fort Sill. For associate students, this course will combine for the first time, instruction in both field and antiaircraft artillery subjects. The short length of the course together with its enlarged scope presents a real challenge to faculty and student alike. At present, most students have been trained in one type of artillery, having little more than a general knowledge of the functions of the other (or others). Even when former basic students return to this advanced course, the gap will continue to exist since their Associate Basic Course was a specialized one. While no decision has been reached on how best to alleviate this situation, the matter is under active study. One solution which has been suggested is to require that extension courses in appropriate subjects of the unfamiliar artillery arm or arms be successfully completed before attendance. It will be noted that a similar situation now exists for students in the regular Advanced Course, but this should tend to disappear as students in the current Basic Course return for the Advanced.

THE NONCOMMISSIONED OFFICERS COURSE. This course, started at the beginning of this school year, is a new departure from old custom of offering only specialist courses for enlisted personnel. It is a general course, eighteen and a half weeks in length and given at Fort Sill. The course is open to selected duty noncommissioned officers and is designed to produce leaders and unit instructors for all artillery organizations. It provides excellent preparation for the Officer Candidate School.

SPECIALIST COURSES. It will be noted in the tabulation at the end of this article that many specialist courses have been established or planned at the school and its branches. These courses are for officer and enlisted students and are available to members of National Guard and Reserve units. Some of these courses are unique and warrant special discussion.

At Fort Sill, certain specialist courses are designed to accommodate students from all the artilleries. These courses are designated as Communication (officers and enlisted), Armorer and Artillery Mechanic, Radio Repair and Artillery Surveyor (Master Gunner). Of particular interest are the specialist courses in the guided missile field, offered at Fort Bliss. These courses are for both officers and enlisted men, with an Associate Guided Missiles course for Reserve and National Guard officers. As mentioned before, seacoast artillery tactics and technique are to be preserved at Fort Scott. Note that there are four specialist courses for officers; Submarine Mines, Seacoast Electronics, Advanced Gunnery and an Associate Harbor Defense Course. This latter course has just been recommended to Headquarters, Army Ground Forces and has not been definitely established, as yet. Also, of passing interest, the Navy Department has established a Harbor Defense School at Fort Scott under the administrative supervision of the Assistant Commandant of the Seacoast Branch. At present, this school is for naval officers with our faculty assisting in the instruction. It is believed that this situation presents an unique opportunity for the inauguration of joint schooling on lower levels.

In the army school system, the opportunity to work with troops in practical field exercises is presented only at the Branch Schools. Adequate school troops are an essential requirement for the successful accomplishment of the objectives set forth for the courses at the Artillery School. At the present time, Fort Sill has five battalions of field artillery and one battalion of infantry. In order to complete the picture of the combined arms team in practical exercises, the addition of antiaircraft, armored, engineer and signal troops is considered a must. Of course, the firing of antiaircraft artillery, except in its ground role, is not practical at Fort Sill. But the tactical handling and maneuver of antiaircraft units, particularly the automatic weapons battalion which is now organic to division artillery, in conjunction with the

other arms, is most desirable for all general courses. Firing of all antiaircraft weapons will be handled at Fort Bliss, where a composite antiaircraft battalion and a guided missiles battalion are available. Seacoast artillery firings will be included in the Fort Scott courses and for this purpose they have a minimum of troops, consisting of a Headquarters Detachment, a Mine Detachment and an Artillery Detachment.

The idea of merging all artilleries into one is relatively new, and the plan of The Artillery School for translating this idea into programs of instruction is also new. There are many practical difficulties in producing courses which will insure adequate and balanced teachings in all of the diversified artillery subjects. Not least in the array of difficulties is the need for telescoping about three years of instruction into one. It is believed, however, that the learning capacity of students was never fully exploited before the last war. The Artillery School feels that it has made a good start on the problem, but does not consider that the present curriculum is necessarily the ultimate solution. Analysis and study of the over-all program and of the subject matter in each individual course will be continuous. Changes, deletions and additions will undoubtedly become necessary, and will be recommended, as experience is gained in teaching the new courses and as ideas are exchanged between more closely related artillerymen.

COURSES OF INSTRUCTION

The Artillery School
Fort Sill, Oklahoma

Officers' Courses	*Length*	*Concurrent Classes*	*Class Capacity*	*Course Capacity*	*Yearly Output*
Basic	26 Weeks	—	109	109	109
(10 weeks at Fort Bliss after 17 weeks at Fort Riley)					
Associate Basic	13 Weeks	5	50	250	800
Advanced	41 Weeks	—	60	60	60
(7 weeks at Fort Bliss)					
Associate Advanced	13 Weeks	4	100	400	400
Communication	18½ Weeks	—	40	40	80
Observation Battalion Officers'	18½ Weeks	—	25	25	50
AGF Pilot	16 Weeks	8	14	112	350

Refresher Courses for Senior Officers—To be announced.

Enlisted Courses	*Length*	*Concurrent Classes*	*Class Capacity*	*Course Capacity*	*Yearly Output*
Noncommissioned Officer	18½ Weeks	—	90	90	180
Communication Chief	18½ Weeks	—	60	60	120
Sound, Flash, and Survey	18½ Weeks	—	40	40	80
Armorer and Artillery Mechanic	18½ Weeks	—	90	90	180
Ballistic Meteorology	18½ Weeks	—	20	20	40
Radar	18½ Weeks	—	40	40	80
Air Mechanic	13 Weeks	7	14	98	350
Radio Repair	18½ Weeks	—	60	60	120
Artillery Surveyor	37 Weeks	—	60	60	60

Antiaircraft and Guided Missiles Branch, The Artillery School
Fort Bliss, Texas

Officers' Courses	*Length*	*Concurrent Classes*	*Class Capacity*	*Course Capacity*	*Yearly Output*
Basic	10 Weeks (As part of the Artillery School Basic Course)				
Associate Basic	13 Weeks	—	70	70	210
Advanced	7 Weeks (As part of the Artillery School Advanced Course)				
Radar	37 Weeks	—	25	25	25
Research and Analysis	37 Weeks	—	20	20	20
Guided Missiles	37 Weeks	—	25	25	25
Associate Guided Missiles	13 Weeks	—	25	25	50

Enlisted Courses	*Length*	*Concurrent Classes*	*Class Capacity*	*Course Capacity*	*Yearly Output*
Radar Repair and Maintenance	37 Weeks	—	45	45	45
Fire Control Electrician	37 Weeks	—	50	50	50
Electrician, Guided Missiles	37 Weeks	—	20	20	20
Radar Repair, Guided Missiles	37 Weeks	—	20	20	20
Technicians, Fuels and Fuel Systems, Guided Missiles	37 Weeks	—	20	20	20
Technician, Gyroscope and Servo Systems, Guided Missiles	37 Weeks	—	20	20	20

SEACOAST BRANCH, THE ARTILLERY SCHOOL
Fort Scott, California

Officers' Courses	*Length*	*Concurrent Classes*	*Class Capacity*	*Course Capacity*	*Yearly Output*
Associate Basic	13 Weeks	—	25	25	75
Submarine Mine	18½ Weeks	—	10	10	10
Seacoast Electronics	18½ Weeks	—	10	10	20
Advanced Gunnery	13 Weeks	—	10	10	10
Associate Harbor Defense	13 Weeks	—	(To be decided)		
Seacoast and Marine Power Plant	18½ Weeks	—	12	12	24
Seacoast Wire Communication	18½ Weeks	—	12	12	24
Seacoast Gun Data Computer	18½ Weeks	—	12	12	24
Seacoast Artillery Radar Repair and Maintenance	18½ Weeks	—	12	12	24
Submarine Mining Casemate Electrician	18½ Weeks	—	12	12	24
Submarine Mine Assembly and Planting	6 Weeks	—	12	12	12
Submarine Mine Coxswain	16 Weeks	—	12	12	12
Mine Planter Engineer	37 Weeks	—	12	12	12
Mine Planter Deck	26 Weeks	—	12	12	12

AAF Considers German Terror Weapons Obsolete

In less than two years since victory was won in Europe, the development of new aircraft and guided missiles by the Army Air Forces has reduced the V-1 and the V-2, Hitler's "secret terror weapons," to the status of obsolete weapons so far as tactical use is concerned.

Army Air Forces technicians are convinced that the only practical use of the V-1 and the V-2, in the light of modern scientific advancements, is as research models in the development of new, long-range, supersonic, guided missiles and in the search for defenses against guided missiles.

The warhead of the dreaded V-2 rocket has been removed and the V-2 now carries scientific instruments high into the ionosphere, providing the Army Air Forces with valuable data on the upper air regions. The V-2, which is fired from the White Sands, New Mexico, Guided Missile Proving Ground by Army Ordnance personnel, still remains the fastest guided missile, but Army Air Forces guided missiles experts have pointed out that the relatively short range of the V-2 limits it for possible future use as a first-line weapon. The experiments with the V-2 have provided rocket technicians with valuable data which they will incorporate in future weapons developed for the Army Air Forces.

The development of high-speed jet fighters and the new supersonic guided missiles, such as the GAPA rocket, renders the V-1 "Buzz Bomb" obsolete due to its slow speed and short range.

The first V-1 was used by the Nazis in June 1944, and information provided Army Air Forces technicians by parts of exploded V-1's enabled the Army Air Forces to plan production of an American version of the "Buzz Bomb" by the early fall of 1944. It was decided to build the V-1 along the same principles as the German version in order to save the time needed for development by American technicians.

Contracts were issued to Republic Aircraft Corporation for the air-frame designs and to the Willys-Overland Company for the production. By the following spring, full production had been started.

The Army Air Forces called its version of the V-1 by the name, JB-2. A total of about 1,000 JB-2's were manufactured before the contracts were terminated. By August 1945, the Army Air Forces had a squadron of jet bomb technicians ready for duty in the Pacific to launch the JB-2's against the Japanese.

The War's end terminated the plans for tactical use of the JB-2's and a large number of them was set aside for experimental use. A total of 151 Army Air Forces built JB's and their launching ramps were given to the U. S. Navy, which calls the JB-2's "Loons." More than 200 JB-2's were tested by Air Proving Ground Command at Eglin Field, Florida, where new guiding equipment was added to the original air-frames.

The experiments by the Army Air Forces quickly indicated that the JB-2 was inadequate for tactical use, since new jet fighters were at least 100 miles an hour faster than the "buzz bomb," which could be easily destroyed in combat before penetrating into a target area. The Army Air Forces is concentrating on new, supersonic guided missiles with much longer range than the JB-2.

Some of the Army Air Forces JB-2's will be used as targets for antiaircraft units of the Army Ground Forces at Fort Bliss, Texas, in studies of ground defenses against guided missiles. The rest of the Army Air Forces JB-2's will be used in further tests of guiding devices and for use by the U. S. Navy.

The New Officer Efficiency Report*

By Major General Edward F. Witsell

On 1 July of this year, the Army will inaugurate a new form for the Officer Efficiency Report. While this step will be recognized as long overdue by the majority of those who have given thought to the matter, the announcement will doubtless be met with considerable interest by Army officers in general—and perhaps with some misgivings.

The inadequacies of the present form (WD AGO 67) have been attested by years of experience. It is obvious that the prime requisite of an efficiency reporting system is its ability to furnish the War Department with objective and valid information about each officer in the Army—information that may serve as a basis for important personnel action. The shortcomings of the old system in this respect are spotlighted in the following quotation*:

> "When the emergency came on in 1940, the War Department needed for initiating the mobilization, 150 general officers of ground troops. But efficiency reports, instead of showing the 150 best, showed only that of 4,000 ground officers of suitable general officer age, 2,000 were superior and best. As such a showing was perfectly worthless for the purpose, the selecting authorities reluctantly fell back on personal knowledge, which is exactly what the Army thought it was getting away from when twenty years ago it inaugurated the existing system."
>
> "In the lower grades, General Staff committees charged with selecting from the records the best officers for promotion, found that ninety-five per cent of all officers were in the upper two of the five possible ratings. About all that seemed reasonably certain about them was that they were better than the other five per cent. Without the blink of an eye the records also declared that three-quarters of the field officers were in the upper third and to this absurdity the War Department calmly assented."

Those who sought help from these records, in the trying days of 1940, generally agreed with General Malin Craig that "The existing system is a broken reed, beyond repair of patching. It must be replaced!"

The outbreak of hostilities forced postponement of any effective study of this matter in favor of the more pressing problems involved in classifying and training the mobilizing Army. By the end of 1944, however, the mobilization problem had been licked, and advance planning was being done on the problems of the postwar Army. By the following spring, research psychologists in The Adjutant General's Office were hard at work on the development of scientific techniques and procedures for selecting officers with wartime experience for integration into the peacetime regular Officer Corps. And in July, this group came up with a recommended program which involved, along with such other instruments as the Biographical Information Blank and the standard interview, a new type efficiency rating device called the Officer Evaluation Report.

The reception given this new OER was somewhat mixed, to be sure, but was in the main favorable. Its validity was unquestioned. Its superiority in this respect over the current or other proposed methods was backed up by an imposing array of sound statistical arguments. And while the revolutionary aspects of the new form evoked some critical comment from rating officers—the method compelled him to the often unpleasant task of making factual observations on the men of his command—it was nevertheless generally agreed that the method was impartial, free from prejudice, and capable of furnishing the War Department with definitely objective information about the officer rated.

The OER is comprehensive and complete; while perfectly suitable for the onetime evaluation of the integration program, its length renders it somewhat unfeasible for periodic efficiency reporting. Accordingly, the research group in The Adjutant General's Office was directed to develop a device specially designed for this purpose. Work toward this end began in July 1945.

Personnel research is a scientific discipline with its own peculiar set of technical tools. It has no fancy bag of tricks, no legerdemain, nor transcendental powers of clairvoyance—but employs the well-defined principles of the research method. The problem of the efficiency report was pursued in a manner that is at once straightforward, logical and scientifically thorough. It is logical, for example, to expect that an efficiency reporting system that is worth its salt should produce high ratings of officers of known excellence, and low ratings of officers who are known to be of less competence. In other words, the system should be valid; it should be capable of distinguishing between the best and the next best of the Officer Corps instead of lumping them all together in the same category. It should likewise indicate which are least efficient and which next least instead of merely labelling a microscopic few at the bottom of the scale as "Unsatisfactory." And finally, it should, at long last and without fear or favor, admit that the average officer is truly average!

It is clear, then, that to demonstrate the effectiveness of the rating system it was necessary at the outset to identify some officers who were known to be of outstanding value to the service, some who were known to be near the bottom of the list in general competence, and some who were in between. The men in these groups could then be rated, in the normal manner, by means of any number of different rating devices and the resulting ratings for each man compared with each other and with the man's "true" worth. In this way, the most promising rating system could be selected, analysed and further refined.

Identifying officers of known efficiency, then, presented the first problem. How were these to be selected? Obviously, not on the basis of existing efficiency reports, because that would beg the entire question. By the same token, the opin-

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*Reprinted, Courtesy of *The Reserve Officer*.

*Quoted from *Efficiency Reports* by Major General C. D. Herron, *Infantry Journal*, April 1944, pp. 30-32.

ions or judgments of commanding officers could not be used alone, since these opinions would be subject to the same influences as the ratings themselves. The only sound procedure appeared to be one that would, in effect, allow the Army as a whole to select its best and worst. As finally worked out, a system substantially as follows was adopted. All the officers in a given command—e.g., battalion, squadron, etc.—were assembled and asked to "nominate" from among their fellow officers, the one each considered of highest competence, next highest competence, and so on; and likewise the one each judged to be of least competence, of next least competence, etc. By tallying the independent nominations of each man in the group it was possible to discover the two or three officers in each group who were universally judged to be outstandingly high, the two or three outstandingly low, and the two or three truly average officers. These were men who by definition were of known efficiency—or inefficiency. By repeating this procedure with hundreds of units, involving tens of thousands of officers, it was possible to build up very sizable groups of high, average and low officers. These, then, could serve as the subjects on whom to evaluate the various types of rating devices.

This comparative evaluation was the next step. In one study, five different rating forms, including the WD AGO Form 67, the AAF Form 123, and three new types were tried out on officers selected by the nominating process just described. The results, from every point of view, favored a particular one of the three new devices. It produced ratings that were high for the "high" officers and low for the "low" officers more consistently than any of the other forms. It produced ratings which were less subject to the biasing influences of rank and prestige: all colonels were not rated higher than all captains, and these higher than all second lieutenants. And finally, it produced ratings which were distributed more in accordance with the known facts: fewer men were rated as best, and more as average.

This new form, then, appeared to fill the bill, so it was selected for further study. The men working on this project were fully conscious of the fact that these findings, no matter how encouraging, were based on experimental use only. Before recommending any radical change in official procedures, they would feel on safer grounds if they could study the new form in official use at a regular reporting period. How the rating officer uses any form when nothing is really at stake, and how he uses that same form if it is official and "for keeps" might be two entirely different matters. Consequently, at the regular reporting period of 30 June 1946, all officers in the Zone of Interior, and in one selected division each in the European and Pacific commands, were officially rated on two forms: the regular WD AGO Form 67, and the new form, labelled for this purpose, the WD AGO Form 67-1.

For a sample of nearly ten thousand of these officers, the ratings obtained with the two forms were compared with each other, and with independent evaluations of the rated officers' worth arrived at through the pooled judgments of all fellow officers. Earlier findings were completely substantiated. The new WD AGO Form 67-1 was generally shown to yield more valid ratings than the currently authorized WD AGO Form 67. In particular, it was found that the new form resulted in a much better distribution of ratings which, in turn, provided better differentiation which is of utmost importance. A significant new outcome of this analysis was the demonstration that the new form was much less subject to the influences of bias that operate in an official—as opposed to an experimental—rating program.

Although this definite corroboration of the new form's superiority was encouraging, still further revision was undertaken before releasing it for official use. The rating elements were separated into two parts, one pertaining to job proficiency and the other to personal qualifications. And the apparently distasteful listing of best and poorest officers known was eliminated. The revised form was again tried out, toward the end of 1946, on officers in fourteen different field installations, and again the results were the same. The new form acted essentially the same in all respects as the earlier Form 67-1. It was clearly more objective and more valid than the Form 67. It yielded ratings which were not only more precise indications of the rated officer's real effectiveness, but which also were considerably less biased by his rank. This last version, reduced in size by the elimination of most of the detailed instructions (which are incorporated in a new AR 600-185) and a complete rearrangement in format, is the form officially adopted for use beginning 1 July 1947.

The Efficiency Report, WD AGO Form 67-1, 1 July 1947 (the official label for the new form) consists of two sheets partially perforated at the fold. The first of these, comprising Sections I and II, will provide appropriate authorities with the detailed information necessary for planning the future development of the officer rated. Section I, as in earlier forms, contains spaces for entry of identifying information. Section II asks for detailed information concerning duties actually performed by the rated officer on his present job, a verbal description of the officer with comments by the rating and indorsing officers, rater's and indorser's estimates of the desirability of having the officer perform in various capacities, and recommendations for career development. The reverse side of this sheet is blank, reserved for the use of the career sections of P&A, WDGS and the Arms and Services.

The second sheet consists of Sections III through IX, and contains the actual rating elements. Section III is, for the most part, a duplicate of Section I, and can be executed as a carbon copy. Section IV contains rating elements dealing with the job proficiency of the rated officer. Each element consists of a group of four descriptive phrases, such as:

A. Quick to size up a situation or its merits
B. Fails to cooperate.
C. Shirks his duty
D. Gets results without a lot of fuss

For each such set of elements, the rating officer is required to select one phrase as "most descriptive" and one as "least descriptive" of the officer being rated.

This section of the report is based on a very careful, empirical predetermination of certain scale values for each phrase. The first of these is called its "preference value." It is fairly obvious in the example given above that two of the phrases—A and D—are rather favorable statements to make about an officer. It is equally apparent that the other two phrases—B and C—are rather unfavorable descriptions.

The degree of general "favorableness" of these phrases was determined by experiment, rather than by individual judgment, and sets of phrases were selected such that two would have the same degree of "favorableness," and the remaining two the same degree of "unfavorableness." In other words, two of the four phrases sound equally good and two sound equally bad. However, the two phrases of a pair are selected to differ, as widely as possible, in the extent to which they differentiate between best and poorest officers. This discrimination value of each phrase was likewise determined through experiment.

The system works somewhat like this. The rating officer in choosing which phrase to indicate as "most descriptive" will naturally tend to select one of the "favorable" phrases —unless, of course, he purposely desires to make a really derogatory report. Since two of the phrases sound equally good, he must pick between them; but since the subjective element is equalized, his choice becomes more objective—he has to consider more carefully which one is *most* applicable. If the one he chooses is the one which has a high discriminating value, a point of score is added; if he chooses the other, no score is made. The same holds true for the "bad sounding" phrases. And, of course, if the rating officer goes so far as to pick bad phrases as "most descriptive" and good phrases as "least descriptive"— statistics show that this happens very rarely—the resulting score will naturally be very low.

Section V contains seven 10-point scales covering job functions—administration, staff and planning, command of troops, instruction, technical specialization, operational flying, and school training. This section provides for entries by both the rating officer and the indorsing officer.

Section VI contains more rating elements of the "most descriptive" and "least descriptive" type, this time dealing with the personal qualifications of the officer being rated. And Section VII includes six additional 10-point scales referring to various personality characteristics—adjustment, cooperation, initiative, judgment and common sense, bearing and manner, and force. Here again, space is provided for entries by both rating and indorsing officer.

Section VIII requires the rating officer to indicate the rater's over-all relative rank among other officers of the same grade rated by him. Section IX, which ends the report, calls for the identification and signatures of the rating and indorsing officers.

The extensive research that has gone with the development and evaluation of the new reporting form has insured that it is capable of providing definitely objective and accurate ratings. Thorough field trials to which it has been subjected have demonstrated its operational feasibility. While it is a definite advance over other reports used in the past, however, it is not claimed that it represents the very best that can be achieved. In the months to come, the new report will doubtless be discussed at length, praised, criticized and even damned. Further research is already in progress on some of the knottier problems in this connection. Further improvements may be expected as experience with the new form accumulates.

Newly Appointed CAC Officers, Regular Army

(This Augments the Lists Published in Previous Issues of the Journal and Covers Selections Made 29 May 1947)

Rank Indicated Is Permanent

Majors

Ramey, Hergert S.
Tanner, Charles H.

Captains

Barker, Troy A.
Barrett, John T.
Birch, Wilson H.
Gregory, Clyde
Kiel, Arthur G.
Lash, Eugene L.
Pindar, George F.
Rackes, Adams E.
Redd, Lemuel B.
Thompson, Maxwell H.

First Lieutenants

Anderson, John C.
Bartlett, Kenneth R.
Brinkerhoff, W. A.
Covert, John R. M.
Haine, Walter A.
Hampton, Rex H.
Holmes, William E.
Kressin, Harold R.
Lake, Gerald A.
Meyers, Charles H., Jr.
Parsons, Marcus L.
Scordas, Horace T.
Seabrook, G. W., 3rd
Smoleroff, Eugene J.
Weydell, Angus T.
Wilke, Robert G.

This list does not include a number of Coast Artillery Corps applicants who were commissioned in the arm of their second choice. This procedure was necessary because of the overstrength existing in the Coast Artillery Corps.

SEACOAST SERVICE

TEST SECTION

Any individual, whether or not he is a member of the service, is invited to submit constructive suggestions relating to problems under study by the Seacoast Service Test Section, Army Ground Forces Board No. 1, or to present any new problem that may properly be considered by the Section. Communications should be addressed to the President, Seacoast Service Test Section, Army Ground Forces Board No. 1, Fort Baker, California.

Items pertaining to Antiaircraft Artillery should be sent to the Antiaircraft Test Section, Army Ground Forces Board No. 4, Fort Bliss, Texas.

Any recommendations made or views expressed herein are those of Army Ground Forces Board No. 1 and are not to be construed as representing the opinion of all War Department or Army Ground Forces Agencies.

COLONEL R. E. DINGEMAN, Director

LIEUTENANT COLONEL JAMES T. BARBER
LIEUTENANT COLONEL GEORGE B. WEBSTER, JR.
LIEUTENANT COLONEL FREDERICK N. WALKER, JR.
CAPTAIN RICHARD T. PULLEN, JR.
LIEUTENANT COLONEL WILLIAM L. SCHREIBER
MAJOR FRANCIS J. PALLISTER
CAPTAIN HAROLD R. BRANTNER
1ST LIEUTENANT WILLIAM WHETTON

Fire Adjustment Rule. A member of the staff and faculty of the Seacoast Branch of the Artillery School submitted a slide rule type fire adjustment rule (FAR) for test. While this device involved no radical departure from the accepted doctrine, it did give slightly more accurate results than the Fire Adjustment Board M1 and arrived at a correction somewhat more rapidly. The principal deficiency of the FAR was its inability to provide a graphical record of the shots as they fell, thereby precluding any evaluation of "wild" or "lost" shots by the operator. Because of this lack and a desire to initiate development of a more automatic means of computing fire adjustment corrections, the FAR was not recommended as a replacement for the Fire Adjustment Board M1.

Optical Filters. This Section was directed to survey the requirements for optical filters in seacoast artillery fire control instruments. Recommendations for standardization of the filter materials into either glass or plastic and installation methods of either the "built in" or "external" types were desired. It is believed that the bewildering variety of colored glass filters now in use should be replaced with a single "built in" variable density polaroid filter. This device would be effective in glare reduction and would have the added advantage of being adjustable throughout a wide range of light transmission values by the operator. A device fabricated of optical glass is preferred over plastic because of its stability in temperature extremes.

Remote Recording System for Seacoast Service and Target Practice Firings. This Section is conducting a study relative to the development of a new system for the recording of data used in the analysis of service and target practice firings. It is known that the present system is too inaccurate and cumbersome to be used with electronic radar and computer fire control and position finding equipment. The studies conducted so far have led this Section to some definite conclusions as to the best means of eliminating the errors inherent to the present system.

The design contemplated at present is comparatively simple from a physical standpoint and is operated almost completely from a remote location. The basic instrument used is a Remote "B" Assembly CY-234/MPG-1 which was designed as a spotting scope on which the range and azimuth deviations of a splash from the target can be portrayed. It has been determined that this scope can be connected quickly and easily to a parent AN/MPG-1 or AN/FPG in parallel to the spotting scope of that set. In order that the same data may be available on a Remote "B" Assembly, it is proposed to mount a range and an azimuth dial driven from and reading the same as those dials on the parent indicator console. With the same data and scope portrayal displayed on the Remote "B" Assembly a camera mounted over the face of this instrument could record photographically the deviation of a splash from the target in range and azimuth as well as the range

and azimuth of the target at the instant of impact. This Remote "B" Assembly will be mounted in a trailer separated from the battery radar and connected to it electrically by cable. This will in no way interfere with the normal operation of the battery's equipment. The operating personnel required in the trailer during a firing are one camera operator and an assistant. The development of this unit will not entail radical changes of existing equipment and none in their electrical circuits. Such modifications as are necessary can be made in the field with the use of a Signal Corps Modification Kit and Work Order.

It is essential that some system of this type be used when the "Offset Method of Firing" is used. It is contemplated that this Offset Method of Firing will be used in many if not all of the future target practices. In this method of firing, there is no target; a vessel is tracked three degrees off the center of a radar tracking scope, thus the target is the center of that scope. The following data is presently required to compute range and lateral deviations: the length of the tow-line; the angle target-vessel-splash (angle TVS); the azimuth of the target at instant of impact; the lateral (angular) deviations of the splash from the target at instant of impact measured from the directing point; a replot of the target course. None of the above data can be obtained by visual means when firing by the Offset Method. The proposed system of recording is the only known means by which the above data can be obtained. This system also projects itself into the future for still further changes in firing methods.

The proposed system is designed primarily for use with the radar-computer combination, but is not limited to that method of fire control and position finding. It can be used for recording data for analysis of target practices fired with the conventional Horizontal Base Method of Fire Control and Position Finding. Battalion, Group, or Harbor Defenses Commanders could also use this recording system as a means of determining the condition of troop training and their readiness for combat firings.

ABOUT OUR AUTHORS

Lieutenant Colonel Francis C. Grevemberg joined the 35th Brigade as S-3 in January 1944. He landed with the Brigade at Anzio and went ashore D Day in Southern France with the Brigade forward echelon. He remained with the Brigade until his return to the States in February 1945. (Page 2.)

Captain C. R. Tosti is Assistant Chief for Administration at the Power Plant Laboratory, Engineering Division, Wright Field. In this capacity he is closely associated with the control of aircraft power plant research and development projects. (Page 10.)

J. B. Tuzen is Project Engineer on ram jet and pulse jet engines at the Power Plant Laboratory, Engineering Division, Wright Field. He received his M.S. degree at M.I.T. in November 1945 after studying servo-mechanism. (Page 10.)

Lieutenant Colonel David B. Parker contributes his third article on the atomic bomb. His "Death Takes a Sleeping City," published in the last issue, was reprinted by *Reader's Digest*. Colonel Parker is assigned to the Atomic Energy Commission in Washington. (Page 18.)

Doctor Harold A. Zahl has been associated with the Signal Corps Engineering Laboratories both as a civilian and army officer (during the war) since 1931. At present, he is Assistant Director of Engineering, Research Projects, at the Laboratories. He was awarded the Legion of Merit for his contribution in the fields of vacuum tubes and Radar. (Page 25.)

Doctor John E. Gorham has been associated with the Signal Corps Engineering Laboratories since 1940. He is now Chief of the Thermionics Branch and was recently awarded the War Department medal for Exceptional Civilian Service. (Page 25.)

Lieutenant Colonel Leonard M. Orman runs his string of consecutive radar articles up to eight in this issue. For the benefit of our new readers, he is an instructor in the Department of Electronics and Electricity at the United States Military Academy. (Page 31.)

Colonel Homer Case needs no introduction in Coast Artillery circles. As he states in his article, he was a member of the special board which assessed the war damage to the Harbor Defenses of Manila and Subic Bays. (Page 37.)

Lieutenant Jack C. Berry will be remembered for his story, "Moonlight Cavalry," which appeared in the November-December 1946 JOURNAL. This present story, although written in a different vein, compares most favorably to the other. (Page 43.)

Air Vice-Admiral E. B. Addison joined the Royal Flying Corps as an Airman in 1915. He was Director of Telecommunications in the British Air Ministry until he assumed command of the 100th Group in 1944. In 1946 he was placed in command of the 90th Group which is a Signals Group under the Director of Signals. The experiences of the 100th Group are recounted in his article. (Page 44.)

Colonel Parmer W. Edwards is Assistant Director of the Department of Combined Arms of the Command and Staff College. In addition, he acts as advisor to the Assistant Commandant on Coast Artillery matters. (Page 49.)

Major General Edward F. Witsell as Adjutant General was responsible for the development of the new officer's efficiency report form which he discusses. (Page 53.)

Coast Artillery Journal

Fifty-fifth Year of Publication

COLONEL W. I. BRADY, Editor
LT. COL. DONALD MAC GRAIN, Associate Editor
T/Sgt. Fred P. Presnell, Business Manager
T/3 Beauford Z. Jones, Cir. Mgr.
S/Sgt. Bernice F. Carr, Bookkeeper
Pfc. Thos. G. Nuss, Order Dept. Clerk

The JOURNAL prints articles on subjects of professional and general interest to personnel of all the components of the Coast Artillery Corps in order to stimulate thought and provoke discussion. However, opinions expressed and conclusions drawn in articles are in no sense official. They do not reflect the opinions or conclusions of any official or branch of the War Department.

The JOURNAL does not carry paid advertising. The JOURNAL pays for original articles upon publication. Manuscripts should be addressed to the Editor. The JOURNAL is not responsible for manuscripts unaccompanied by return postage.

The United States Coast Artillery Association

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The purpose of the Association shall be to promote the efficiency of the Coast Artillery Corps by maintaining its standards and traditions, by disseminating professional knowledge, by inspiring greater effort towards the improvement of matériel and methods of training and by fostering mutual understanding, respect and coöperation among all arms, branches and components of the Regular Army, National Guard, Organized Reserves, and Reserve Officers' Training Corps.

News and Comment

This Issue's Cover

Since the 35th Brigade's assignment at Anzio was its most important, the cover depicts the landing of antiaircraft self-propelled guns on that beach. The guns shown belong to the 68th CA (AA) which landed on D day and was subsequently assigned to the Brigade upon its arrival a few days later.

Guns and personnel of the 68th also made the D day assault in Southern France as part of the Brigade.

However the regiment was redesignated as a group and the battalions were made separate units.

To The Editor:

The article by Stefan T. Possony, "Who's Who in the Atomic Race," in your March-April, 1947, number contains a serious error. In his argument that manufacture of atomic bombs must require large electric power facilities, Mr. Possony is on sound ground with regard to the U-235 separation processes; but he betrays a fundamental misunderstanding of plutonium production. ". . . the production of one kilogram of plutonium a day would require a plant capable of delivering between 500,000 and 1,500,000 kilowatts" (Smyth Report).

Mr. Possony errs in assuming that this power capacity is required as *input* to the plutonium plants. Actually, these figures express the atomic power *output* of the piles in the process of making plutonium. In our war project at Hanford, Washington, this power (appearing as heat in the piles) is a nuisance. It imposes the problem of cooling the piles, and limits the rate at which plutonium can be produced. Although the engineering problems are formidable, it is conceivable that future piles may be designed to *deliver* thousands of kilowatts of electric power to distribution lines, and produce plutonium at the same time.

Thus, lack of electric power resources need impose no handicap on plutonium production, which is sufficient for making bombs. It seems important to correct a misapprehension which tends to encourage a false sense of security.

Sincerely,
s/ J. H. Rush
t/ J. H. Rush
Secretary-Treasurer
Federation of American Scientists.

Unit Histories

The following unit histories have been received at the JOURNAL office since publication of the March-April issue:

143rd AAA Gun Battalion
"B" Battery, 143rd AAA Gun Battalion

Other units which have published histories or contemplate doing so, are urged to send copies to the JOURNAL for our permanent file to be used as a readily accessible source of CAC history.

AAA Troops With Task Force Frigid

The following letter was received by Major General John L. Homer from Colonel Paul V. Kane, Commanding officer of Task Force Frigid:

HEADQUARTERS TASK FORCE FRIGID
FORT ORD, CALIFORNIA

29 April 1947

Major General John L. Homer
Anti-Aircraft and Guided Missile Center
Fort Bliss, Texas

My Dear General Homer:

As the operations of the Task Force draw to a close I feel that I should call to your attention the outstanding service rendered during the past winter by the Provisional Anti-Aircraft Battery which was selected from your command.

The battery was ably commanded throughout the entire operation by Major Ernest M. Bailey who has proved himself to be an aggressive and resourceful leader with exceptionally high standards.

The officers and men of this organization have made a substantial contribution to military science through their sacrifices and exposure during the past winter. The smart soldierly bearing, the exemplary conduct and the indomitable spirit of the officers and men of this organization evoked the most favorable comment from observers and inspectors.

During every hour of the day and under the most trying conditions these officers and men maintained the traditionally high standards of the Anti-Aircraft organizations.

You now have in your command one of the largest groups of Arctic trained troops in the Army. I believe this is as it should be because if War should suddenly come to the Arctic Regions it is certain that Anti-Aircraft forces will be in it from the sound of the gong.

I sincerely hope the War Department will make every effort to retain the services of the officers and men who have trained in Alaska this past winter. These men have learned the hard way but they will never forget what they have learned. They would be worth their weight in gold to any commander who might be called on to prepare for operations in the Arctic Regions.

Your visit to the Task Force last winter during the worst weather of the entire season was a tonic not only for the Anti-Aircraft Battery but for the entire organization.

It was an inspiration for the officers and men to have you visit them during their darkest days.

With congratulations on the splendid performance of the Anti-Aircraft personnel of the Task Force and kindest personal regards I am

Very sincerely,

s/ Paul V. Kane
t/ PAUL V. KANE
Colonel FA
Commanding

First Division Society

The society of the First Division will hold its annual reunion in New York City on the 29th and 30th of August 1947. All former members of the First U. S. Infantry Division and any of the units attached to the Division during combat are urged to write for information on the reunion and for a copy of the Division history which will be published this fall, to the Society of the First Division, Box 13, Station C, Grand Rapids 6, Michigan.

To The Editor:

The United States is rapidly and unnecessarily losing the opportunity to secure the services of large numbers of qualified veterans who would make the most competent Reserve Officers with a minimum of training and expense. As an example: at the Pennsylvania State College in the spring of 1947, only 217 individuals are receiving ROTC training leading to a commission, while there are 3884 male undergraduate veterans in attendance at the college. The veterans are enrolled in the Schools of the College as follows:

Agriculture	574	Liberal Arts	1119
Chemistry and Physics	424	Mineral Indus.	269
Education	172	Physical Ed.	133
Engineering	1193		

and the numbers taking ROTC are tabulated below:

Army		*Navy*	
Air Force Adv. ROTC	71	Contract Midshipmen	70
Corps of Eng. Adv. ROTC	11	Regular Midshipmen	20
Infantry Adv. ROTC	36	Naval Aviation	6
Signal Corps Adv. ROTC	3		

In addition, 97 students are taking Basic Army ROTC which does not lead to a commission unless the student continues through the Advanced Course. Of the 3884 veterans, only about one-third served in World War II as officers, the greater part in the Air Forces; consequently, over 2,000 potential Reserve Officers are being lost in one college alone.

The veteran who has seen combat as an enlisted man and who then receives the advantages of a college education would make the most efficient Reserve Officer in the event that we are required to fight another war, for modern warfare requires increasing numbers of officers who are both leaders of men and competent technicians. If the situation at the Penn State College is indicative of the situation at our other major universities, the Reserves are each year losing thousands of combat veterans with college degrees. The present lack of interest in ROTC should be investigated without delay and remedial measures taken before the total reservoir of college students with wartime service experience is dangerously depleted. If the ROTC programs are not immediately strengthened, the next war will again find us with insufficient numbers of good Reserve Officers at a point when time will not be available to undo our mistakes.

John Davis Morgan, Jr.
Major, Engineer Reserve
0-460520

71st Division Society

Major General W. G. Wyman is desirous of hearing from all former members of the 71st who are interested in a division society.

Further information may be obtained from the Secretary of the 71st Division Society, Fort Monroe, Virginia.

By addressing a letter to Colonel Rolfe at the above address it will also be possible for former members to obtain a copy of the Division History.

National Guard

The following National Guard Coast Artillery Corps units have been Federally recognized since publication of the March-April JOURNAL. The units are shown by city and state:

Alabama—
- Medical Detachment, 104th AAA AW Battalion, Florence;
- "A" Battery, 104th AAA AW Battalion, Florence;
- "B" Battery, 104th AAA AW Battalion, Sheffield;
- Medical Detachment, 464th AAA AW Battalion, Talladega;
- "B" Battery, 464th AAA AW Battalion, Anniston;
- Medical Detachment, 711th AAA Gun Battalion, Mobile;
- "B" Battery, 711th AAA Gun Battalion, Bay Minete;
- "C" Battery, 711th AAA Gun Battalion, Luverne;
- "D" Battery, 711th AAA Gun Battalion, Atmore.

California—
- Headquarters and Headquarters Battery, 114th AAA Brigade, San Diego;
- Headquarters and Headquarters Battery, 234th AAA Group, Long Beach;
- Headquarters and Headquarters Battery, 251st AAA Group, San Diego;
- Headquarters and Headquarters Battery, 681st AAA AW Battalion, Belmont;
- Headquarters and Headquarters Battery, 728th AAA Searchlight Battalion, San Francisco;
- Headquarters and Headquarters Battery, 746th AAA Gun Battalion, San Diego;
- Headquarters and Headquarters Battery, 951st AAA AW Battalion, Richmond.

Connecticut—
- Medical Detachment, 211th AAA AW Battalion, Bridgeport;
- "B" Battery, 211th AAA AW Battalion, Bridgeport;
- "A" Battery, 283rd AAA AW Battalion, Bridgeport;
- "B" Battery, 283rd AAA AW Battalion, Bridgeport.

Delaware—
- "B" Battery, 736th AAA Gun Battalion, Wilmington;
- "C" Battery, 736th AAA Gun Battalion, Newark;
- "D" Battery, 736th AAA Gun Battalion, New Castle;
- Medical Detachment, 736th AAA Gun Battalion, Wilmington.

Illinois—
- "A" Battery, 693rd AAA AW Battalion, Chicago;
- "A" Battery, 698th AAA Gun Battalion, Chicago.

Maine—
- Headquarters and Headquarters Battery, 703rd AAA Gun Battalion, South Portland;
- Medical Detachment, 703rd AAA Gun Battalion, Portland;
- "A" Battery, 703rd AAA Gun Battalion, Portland.

Minnesota—
- "A" Battery, 256th AAA AW Battalion, St. Paul.

New Hampshire—
- "C" Battery, 744th AAA Gun Battalion, Laconia.

New Jersey—
- "A" Battery, 310th AAA AW Battalion, Jersey City.

New Mexico—
- Headquarters and Headquarters Battery, 111th AAA Brigade, Santa Fe.

North Carolina—
- "A" Battery, 677th AAA AW Battalion, Raeford.

Pennsylvania—
- "A" Battery, 73rd AAA Gun Battalion, Bethlehem;
- Medical Detachment, 337th AAA Searchlight Battalion, Reading;
- Headquarters and Headquarters Battery, 690th AAA AW Battalion, Harrisburg;
- "B" Battery, 707th AAA Gun Battalion, Philadelphia.

Rhode Island—
- "C" Battery, 243rd AAA AW Battalion, Bristol;
- "A" Battery, 705th AAA Gun Battalion, Natick.

South Carolina—
- Headquarters and Headquarters Battery, 228th AAA Group, Dillon;
- Headquarters and Headquarters Battery, 107th AAA AW Battalion, Newberry;
- "A" Battery, 107th AAA AW Battalion, Greenwood;
- "B" Battery, 107th AAA AW Battalion, Clinton;
- "C" Battery, 107th AAA AW Battalion, Newberry;
- "D" Battery, 107th AAA AW Battalion, Hampton;
- "B" Battery, 713th AAA Gun Battalion, Camden;
- "C" Battery, 713th AAA Gun Battalion, Cheraw;
- "D" Battery, 713th AAA Gun Battalion, Florence;
- Headquarters and Headquarters Battery, 263rd CA Battalion, Florence;
- 249th CA Battery, Naval Base.

Virginia—
- "B" Battery, 691st AAA AW Battalion (SP), Franklin;
- "C" Battery, 691st AAA AW Battalion (SP), Portsmouth;
- "D" Battery, 710th AAA Gun Battalion, Hampton.

Washington—
- Headquarters and Headquarters Battery, 115th AAA Brigade, Fort Lewis;
- 115th Operations Detachment, Olympia;
- Headquarters and Headquarters Battery, 700th AAA AW Battalion, Aberdeen.

Summer Training Plans for National Guard

Plans for the summer training of all ground units of the National Guard which are sufficiently organized, manned and equipped have been approved by the War Department.

A 15-day field training period has been scheduled for all divisions and regimental combat teams whose integral units have been federally recognized by April 15. In order to be eligible, these units also must be self-sustaining in the field, must reach an aggregate strength equivalent to 30 per cent of their table of organization strength by May 15, and must be able to muster 20 per cent of their table of organization strength for the duration of the training period.

The type of training to be undertaken consists of individual and specialist training, including small arms familiarization firing, and small unit training.

If funds are available, the National Guard Bureau may authorize the states to conduct local schools or training for ground units which do not qualify for the field training.

Annual Financial Report

In accordance with the constitution of the Coast Artillery Association, the following annual statements of the Association and Journal are published for the information of all Association members and subscribers:

COAST ARTILLERY JOURNAL
BALANCE SHEET—DECEMBER 31, 1946
ASSETS

CURRENT ASSETS		
Cash on deposit		$ 8,161.46
Petty cash fund		25.00
Accounts receivable:		
Merchandise accounts	$ 1,774.90	
Subscriptions	2,728.75	
	$ 4,503.65	
Less reserve for bad debts	500.00	
		4,003.65
Inventory of books		115.52
TOTAL CURRENT ASSETS		$12,305.63
FIXED ASSETS:		
Office furniture and equipment	$ 8,206.16	
Less reserve for depreciation	4,911.49	3,294.67
DEFERRED CHARGES AND OTHER ASSETS:		
Inventory of office supplies	$ 1,145.35	
Deposit with U.S. Government Printing office	171.81	
Deposit with book publishing companies	197.21	
Deposit with U.S. Library of Congress for copyright	12.00	1,526.37
		$17,126.67

LIABILITIES AND NET WORTH

CURRENT LIABILITIES:		
Accounts payable		$ 863.74
Accrued taxes		55.35
Credit balances, accounts receivable		470.91
TOTAL CURRENT LIABILITIES		$ 1,390.00
DEFERRED INCOME		4,534.50
NET WORTH:		
Surplus, Balance, December 31, 1946	$20,650.18	
Less net loss for the year ended December 31, 1946	9,448.01	
Balance, December 31, 1946		$11,202.17
TOTAL LIABILITIES AND NET WORTH		$17,126.67

UNITED STATES COAST ARTILLERY ASSOCIATION
BALANCE SHEET—DECEMBER 31, 1946
ASSETS

Cash in bank		$ 2,148.64
Accrued interest receivable		356.25
Investments:		
U.S. Government bonds	$76,600.13	
Bank stock	160.00	76,760.13
TOTAL ASSETS		$79,265.02

NET WORTH

Surplus balance, December 31, 1946	$77,960.14
Add: Excess of receipts over expenditures	1,304.88
SURPLUS BALANCE, DECEMBER 31, 1946	$79,265.02

The foregoing financial statements were accepted by the Executive Council of the Association at the annual meeting 5 May 1947.

The council also voted in favor of the continued subsidization of the JOURNAL by the Association for the year 1947 on the same basis as in 1946. It was further decided that both the Association and JOURNAL continue to operate in the same manner as during the preceding year.

Largest Multi-Jet Bomber Uses Six Aircraft Gas Turbines

The Army Air Forces has announced completion of the largest multi-jet bomber of conventional design ever built, the Glenn L. Martin XB-48, powered with six General Electric aircraft gas turbines.

The new airplane, which has three jet engines housed in each wing, is a long-range high-speed bomber. Due to the thin wings required for its exceptionally high speeds, the XB-48 is pioneering a new "bicycle type" landing gear especially designed for airplanes flying at speeds approaching the transsonic range.

The powerful XB-48 has a wing span of 108 feet, 4 inches; length of 85 feet, 9 inches, and height of 27 feet, 6 inches. The wings are of a special design developed by Martin engineers.

As the wings are thinner than in an airplane built for slower speeds, there is not sufficient space to house the large main wheels required for safe landings and take-offs. In the XB-48, the two main wheels are placed bicycle style in the center of the ship and retract upward into the fuselage. A smaller wheel is located near each wing tip to give stability during taxi operation. These retract into shallow wells in the wings.

The Martin Company has been experimenting for some time with the tandem-type landing gear, having equipped a B-26 Marauder with the main wheels in the fuselage and out-rigger type balancing wheels. Numerous landings and take-offs have been made at both Martin airport and the AAF's Wright Field at Dayton, Ohio. These have proved the worth and stability of the design for airplanes of very high speeds, engineers said.

In constructing this all-jet airplane, Martin utilized a wealth of data which has been obtained by experimenting for some time with jet engines and the construction of two experimental patrol planes combining reciprocating engines and jets. One is the XP4M-1, which uses two General Electric I-40 gas turbines and two Pratt and Whitney reciprocating engines. Both of those aircraft are now in test flight stage.

Numerous tests have been made with jet engines installed in the tail of a Marauder bomber. During flight the B-26's jet engines were started and stopped under various conditions which might be encountered in flight.

M-1 Slide Rule Text

Lieutenant Colonel James H. Fish, now on R.O.T.C. duty at Michigan State College, has written a text for the use of the M-1 Slide Rule.

Copies of this text may be obtained by writing to Colonel Fish at Michigan State College.

ORC Units Activated

The following list of units reported activated augments the one published in the March-April issue. The location is shown after each unit:

Alabama—"C" and "D" Batteries, 321st AAA AW Battalion, Tuscaloosa.

California—331st CA Gun Battery (HD), San Francisco; 374th Headquarters and Headquarters Battery (HD), Los Angeles.

Connecticut—394th AAA AW Battalion, Hartford; 303d CA Mine Planter Battery (HD), New Haven; 305th CA Searchlight Battery (HD), Bridgeport; 367th CA Gun Battery (HD), New London; 395th CA Searchlight Battery (HD), Bridgeport; 381st CA Mine Planter Battery (HD), New Haven.

Florida—"A" Battery, 651st Airborne AAA Battalion, Jacksonville; 408th CA Gun Battery (HD), Pensacola.

Georgia—Headquarters, "A" and "B" Batteries, 431st AAA AW Battalion, Atlanta; "C" Battery, 431st AAA AW Battalion, Marietta; "D" Battery, 431st AAA AW Battalion, Decatur.

Maine—301st CA Mine Planter Battery (HD), Portland; 345th CA Mine Planter Battery (HD), Portland; 368th CA Gun Battery (HD), Portland; 408th CA Gun Battery (HD), Portland.

Maryland—424th CA Gun Battery (HD), Baltimore; 425th CA Gun Battery (HD), Baltimore.

Massachusetts—Headquarters and Headquarters Battery, 393d AAA AW Battalion, Boston; 343d CA Mine Planter Battery (HD), New Bedford; 355th CA Searchlight Battery (HD), Boston; 365th CA Gun Battery (HD), New Bedford; 366th CA Gun Battery (HD), Boston; 402d CA Mine Planter Battery (HD), Boston.

Mississippi—338th CA Gun Battery (HD), Jackson.

New Jersey—Headquarters and Headquarters Battery, 451st AAA AW Battalion, Newark.

New York—Headquarters and Headquarters Battery, 400th AAA AW Battalion, Rochester; Headquarters and Headquarters Battery, 430th AAA AW Battalion, Brooklyn.

Ohio—Headquarters and Headquarters Battery, 199th AAA AW Battalion, Cleveland; "D" Battery, 199th AAA AW Battalion, Mansfield; "A" Battery, 399th AAA AW Battalion, Toledo; 301st AAA Operations Detachment, Cincinnati.

Oklahoma—Headquarters and Headquarters Battery, 391st AAA AW Battalion (SP), Oklahoma City.

Oregon—Headquarters and Headquarters Battery, 390th AAA AW Battalion (SP), Portland; 346th CA Gun Battery (HD), Portland; 348th CA Gun Battery (HD), Coos Bay; 351st CA Mine Planter Battery (HD), Astoria.

Rhode Island—361st CA Gun Battery (HD), Providence; 370th CA Gun Battery (HD), Providence; 403d CA Mine Planter Battery, Newport; 424th CA Gun Battery (HD), Providence; 425th CA Gun Battery (HD), Providence.

Virginia—Headquarters, "D" and "E" Batteries, 159th Airborne AAA Battalion, Richmond; "C" Battery, 159th Airborne AAA Battalion, Charlottesville; 877th CA Mine Planter Battery (HD), Norfolk.

Washington—333d CA Mine Planter Battery (HD), Seattle; 334th CA Gun Battery (HD), Tacoma; 808th CA Mine Planter Battery (HD), Seattle.

Wisconsin—Headquarters, "A," "B," "C," and "D" Batteries, 388th AAA AW Battalion, Milwaukee; Headquarters, "A" and "D" Batteries, 84th Airborne AAA Battalion, Milwaukee.

Underground Factories are Best Protection Against Air Attacks

On the basis of available evidence presented by Air Matériel Command analysts, the Army Air Forces believes that complete underground structures represent the most practical available protection against air attacks.

By the end of the war the Germans had a total of 143 underground factories in production. Approximately 20 per cent of the entire capacity of the airframe industry, including virtually all the V-weapons and nearly 60 per cent of aircraft engine production facilities had been placed underground.

The most desirable sites were the side of a hill or mountain, as they usually permitted easier installation of sewer systems, were less subject to difficulties arising from ground water, provided more adequate ventilation, and provided more effective exits and entrances for workers, equipment, and supplies.

The Kematen Works was dug into the side of a mountain and consisted of eight tunnels and cross passages. There the manufacture and assembly of ailerons and flaps for the ME-262's was undertaken.

The Mittelwerke and Nordwerke factories near Niedersachawerfen were situated beneath a steep, heavily wooded hill that rose almost 300 feet above the surrounding flat countryside. The main tunnels were approximately 30 feet wide and 24 to 30 feet high with nearly vertical walls and rounded ceilings.

Other examples of complete underground structures were the large converted mine at Kahla, scheduled to produce at peak a large portion of the German fighter program, and the highway tunnels at Leonberg and Eschenlohe, engaged in production of ME-262 parts.

Aircraft engine production was undertaken in a granite quarry near Budapest and at Neckarelz, while sub-assemblies for the JU-88 were constructed in an unfinished tunnel 2,200 feet long in the outskirts of Berlin.

At Niedersachawerfen, the largest and most ambitious underground facility in the world was located in the Harz Mountains. Here the V-1 and V-2 projectiles, aircraft rockets, and parts for engine and rocket bombs were manufactured. Electrical tests were made on the V-2 rocket in one of the tunnels that was 75 feet high.

While the German experience clearly indicates that almost every type of small and moderate size plane can be produced underground, AAF and AMC officials say that no insight is afforded as to the potential suitability of underground construction of aircraft the size of the B-29 or B-36. The Germans had no planes of this size under construction.

Coast Artillery Newsletters

ANTIAIRCRAFT SECTION, GHQ, FEC, TOKYO, JAPAN, APO 500
BRIGADIER GENERAL WILLIAM F. MARQUAT, *Antiaircraft Officer*

As a part of the celebration commemorating Army Week, troops of the Eighth Army and units of the Fifth Air Force joined in an impressive parade on the Tokyo Imperial Palace Plaza, Monday, 7 April 1947. The Army's spectacular, jet-propelled P-80's, making their first appearance in Japan, highlighted the ceremonies. Capable of flying more than 600 MPH, these planes flashed over the reviewing stand three times. This thrilling sight emphasized the compelling need for antiaircraft artillery of advanced design to cope with such weapons.

Headquarters, Far East Air Forces, is sponsoring an Air Defense Conference in Tokyo during the early part of June 1947. Representatives from antiaircraft artillery, Air Force, and Signal Corps units of the Major Commands will participate. It is anticipated that the exchange of information fostered by the meeting will be very valuable.

Recently, the War Department was requested to make available to the Far East Command five exceptionally skilled, civilian technical specialists to serve antiaircraft artillery units. The plan provides for two gun and automatic weapons remote control systems experts, one electronics director man, one gun-laying radar specialist, and one searchlight radar supervisor. If the proposal is approved, it is expected that these men, working through the appropriate technical services, will be able to assist considerably unit maintenance personnel, members of technical instruction teams, and technical services maintenance personnel. In addition, if the program is integrated with industrial participation in the development of new equipment, these specialists will be in a position to suggest modifications to existing matériel or to initiate new ideas pointing toward constant improvement of antiaircraft artillery matériel.

865TH AAA AUTOMATIC WEAPONS BATTALION (SP)
KOREA, APO 712

LIEUTENANT COLONEL EUGENE E. LOCKHART,
Commanding

The 865th still remains in Korea. The battalion has had a change of Command with Lieutenant Colonel Eugene E. Lockhart, formerly with the Military Government in Korea, taking over from Lieutenant Colonel Baldry, who is on his way to the States. Major Reinhard L. Speltz is now the Executive Officer, Major Ralph N. Ross having gone to Special Troops, XXIV Corps as S-3.

There have been quite a number of other changes in officer personnel in the past month due to rotation and new arrivals. Captains Baker, Cook, and Laffitte have returned to the States and Captain John J. Maykovich and Captain Harry Landsman have joined the battalion along with Second Lieutenant Robert L. Vranish and Second Lieutenant William L. Davis.

The battalion training program has been very extensive and M-1 range firing has been completed with 95% qualification.

Recreation opportunities remain limited but with warm weather coming around, outdoor recreational activities have increased. Volleyball, softball and baseball teams have been organized in each battery. A battalion baseball team has been practicing daily and will compete in a league formed of battalion level teams.

The Officers' Mess and Enlisted Men's Club have opened although interior decorating is not completed.

Strength of the battalion is still above the T/O but personnel are being rotated constantly and fewer replacements are arriving.

OKINAWA, APO 331

LIEUTENANT COLONEL F. T. BERG, *Commanding*

The recent revitalization of the antiaircraft artillery has enabled it to make its presence once again known on Okinawa. The training has progressed to the place where firings are now taking place at Bolo Point with machine guns, 40mm, and 120mm. Emphasis is also being placed upon the rehabilitation of vehicles. The 532d AAA Gun Battalion (PS) has completed drawing 120mm guns and fire control matériel.

Many diverse activities occupy the attention of the troops in addition to the primary one of training. The Filipino Women's Compound has been completed and the occupants moved in during February. At the Awase Housing Area, which is operated by the 87th AAA Group (PS), the Post Exchange and the Library were opened for business during the month of February. During March, the Barber Shop, the Swap Shop, and the Commissary were completed and opened for business. Plans have been formulated to establish at Awase in the future, a Noncommissioned Officers' Club, an Officers' Club and a Teen-Age Club. A children's playground and a community garden will be established at an early date. Battery "A," 532d AAA Gun Battalion (PS) commanded by Captain William E. Smith is still continuing its mission of security on the island of Ie Shima.

The following officers have recently joined the Group:

Major Edward Fitzgerald; Captains Emory Goggans, Edward H. Horneij, Hugh E. Jordan, George A. Kellum, Charles L. Ringgold, John D. Skipper, George Skitso, William E. Smith, Alexander A. Zaresky; First Lieutenants George P. Leal, Jr., William R. Sutterfield, Roy L. Wood, William G. Stubenrod.

The following officers departed for the United States for release from active duty:

Captains Charles J. Shea, Earle T. Radish, John B. Cowgill; First Lieutenant Frank Arwood.

The number of dependents of personnel increases every month. New arrivals include the dependents of:

Majors Oliver E. Wood, Paul B. Wolff; Captain Clair Le J. Hall; First Lieutenants John P. McDermott, Roy L. Wood; Staff Sergeant Linton L. Reynolds.

The dependents of the following officers accompanied the Philippine Scout units in their move from San Marcelino:

Lieutenant Colonel Robert H. Kessler; Major Peter W. Pedrotti; First Lieutenant John L. Goff, Jr.

With the departure of Captain John F. Mangan's family for the States, the number of families now totals seventeen.

Lieutenant Colonel Robert H. Kessler has received notice that he has been selected for the next school term at the Command and Staff College.

On 3 February Major General Edward M. Almond, Deputy Chief of Staff, Far East Command accompanied by Brigadier General Frederic L. Hayden, Commanding General, Ryukyus Command visited the AAA Area. On the following day, Colonel Robert G. Gard of General Almond's party visited the Command.

ANTIAIRCRAFT SECTION, HEADQUARTERS EIGHTH ARMY, YOKOHAMA, JAPAN, APO 343

COLONEL M. A. HATCH, *Antiaircraft Officer*

The Antiaircraft Section with the field artillery and historical sections attached is preparing instruction at Army level for Course A, Indoctrination, in the program for the supplementary education and training of officers outlined in War Department Training Circular No. 9, 1946. The subcourse entitled "History of the Army" is being conducted by Captain Albert Adatto, Signal Corps, a professional history teacher. Captain Adatto's presentation will couple the development of the military policy of the United States with the growth of the territory of the country. Lieutenant Colonel K. C. Smith, Coast Artillery Corps is stressing discussion on the current plans for unification in the subcourse, "Organization of the Armed Forces to include Ground, Air and Naval Forces." Lieutenant Colonels F. D. Atkinson and D. E. Means, Field Artillery, are conducting the subcourse on "Organization and Equipment of Associated Ground Combat and Service Units." Emphasis is being placed on the new type division organizations.

The Antiaircraft Section completed recommendations for a proposal to augment the T/E of AAA operations detachments to include the equipment necessary to permit the detachments to function as records sections during target practice. The proposal was based on the administrative difficulty encountered in obtaining authority for records section equipment after the disappearance of the regimental headquarters battery from the organizational picture. The proposal stressed the fact that operations detachments contain a high percentage of personnel with qualifications required for key positions in records sections. Attention was drawn to the high degree of accuracy in orientation and target location required for the preparation of reliable records and how training toward those ends would assist in the development of the efficiency of an operations detachment in its primary role.

138th AAA Group, Yokohama, Japan, APO 503

Colonel D. C. Tredennick, *Commanding*

Since the last newsletter there has been no change in the status of units assigned to the group. The 753d AAA Gun Battalion with the 277th SRMU attached, 209th AAA AW Battalion (SP), 933d AAA AW Battalion (SM) with the 543d MP Escort Guard Company attached, 162d AAA Operations Detachment to which are attached the Eighth Army RCAT Detachment, the 3d SRMU, and the 538th AAA Searchlight Battery, comprise the units assigned to this headquarters. The 82d Chemical Mortar Battalion is attached for operational control only and assists in the performance of the Group's primary mission, security guard.

A new training memorandum was published by Group headquarters and was placed in effect 3 March 1947. Artillery and military subjects are stressed in morning periods while in the afternoon, supervised athletics and recreational events are conducted. Since the institution of this memorandum, accelerated progress has been made in the unit training program. Frequent trips are made to the MITO firing point where tow target and OQ3 missions are flown for automatic weapons units. Results evidence the spirit in which the battalions are accepting the current training program.

An antiaircraft firing point suitable for use both by the 753d AAA Gun Battalion and automatic weapons units, has been inspected and found to be adequate. The area is located near CHOSHI, approximately 100 miles from YOKOHAMA and 35 miles from the MITO firing point on the North Pacific Ocean. It is expected that the battalions will begin using the firing point shortly and that a semi-permanent type camp with the facilities necessary for efficient operation will be constructed. Group headquarters has organized a record section which will be ready when the gun battalion fires its first practice at CHOSHI.

In compliance with an Eighth Army directive, a Troop Officers' School under the supervision of this headquarters will begin operation in the 753d AAA Gun Battalion area about 10 April 1947. It is expected that four separate sessions will be held, the final one beginning 4 August 1947. One-fourth of the total officers in the Group will attend each session, which will be conducted on a six-hour per day basis with three additional hours being devoted to study periods.

The Information and Education Program has been greatly stressed. The distribution of maps, magazines, and materials necessary for the furtherance of this program is rapidly assuming peacetime proportions. Numerous personnel are enrolled in USAFI courses and others attend the AEP school in Yokohama. Battalion I&E officers and noncommissioned officers are briefed weekly by the group I&E officer thereby setting a definite goal and assuring coordination within the group. In addition, Group headquarters publishes and distributes an I&E-A&R Bulletin weekly. This bulletin is increasing in popularity and, at present, has a circulation of three hundred and seventy-five copies. Items of interest to all are used, including personal news, bits on recruiting, insurance, quiz contests, Army history, information on USAFI and AEP, news digests and sports.

The coming athletic schedule will insure full coverage of all forms of sports with pingpong, tennis, hard and softball, swimming, horseshoe pitching, volleyball and boxing among the popular sports to be sponsored.

The 209th AAA AW Battalion (SP) has undergone a transition in personnel. Many draftees and short-time regular army men returned to the States and some "second hitch" enlisted men and experienced noncommissioned officers were received as replacements. On the whole, the organization was strengthened both in efficiency and morale. Recruiting is progressing as evidenced by Sgts. Edward E. Simms and Joseph H. DeGrandis reenlisting for three years and Cpl. James L. Sisco extending his enlistment by 18 months. Two modern Bachelor Officers' Quarters are now under construction, and when completed, will add both to the comfort of the now crowded officers and to the beauty of the camp. These buildings were necessary due to the influx of new officers and because fire had completely destroyed two similar buildings. The officer strength of the organization is now near T/O status. "C" Battery was tested on its MTP training on 21 February 1947 by a team from within the group with observers from Eighth Army present. An "Excellent" rating was received.

The long awaited move of the 933d AAA AW Battalion (SM) has been completed. The new battalion area is located just inside the northern limits of the City of YOKOHAMA. Work on the area took almost a year since many tons of rubble from bombed-out Japanese structures had to be blasted and removed before buildings could be erected. Barracks and buildings are painted white and topped with green roofing, and the area gives promise of becoming one of the most beautiful in this section of Japan. Having completed its mobilization training program, "A" Battery was tested by a team from the Group and representatives from Eighth Army and came through with flying colors. The battery received an over-all rating of "Excellent."

On Thursday, 27 March 1947, at 0930, Lieutenant General R. L. Eichelberger, Commanding General, Eighth Army, reviewed and inspected the 933d AAA AW Battalion (SM). An inspiring talk was delivered by the General to the assembled troops. He praised the Battalion's outstanding achievements in athletics and mentioned that they also led the group in March of Dimes contributions and in War Bond allotments and purchases. Following the address the General proceeded to inspect the consolidated battalion mess hall, "B" Battery, the motor pool, the theater, the enlisted men's recreation club and the Chapel. At the theater the battalion quartet sang for the General and at the Chapel, under the direction of Chaplain White, the quartet, supplemented by the battalion choir, combined

their voices in a rendition of their favorite hymns. The General requested the chorus to sing the "Old Rugged Cross." The whole inspecting party, including the MP escort, listened attentively and at the conclusion of the hymn General Eichelberger commended the group on their fine performance. The General departed at 1030 hours. The battalion will long remember this auspicious visit, and there is no doubt that the impression left on all concerned was a reciprocal expression of mutual well wishes.

The 753d AAA Gun Battalion, sited in the TOMIOKA Sea Plane Base, has an Information and Education Center of which it is justly proud. The Library Section of the center has a wide selection of books, both fiction and non-fiction, totaling thirteen hundred volumes. All popular magazines are available as well as local and homeland newspapers. The Information and Education Section is well stocked with literature outlining the various educational facilities offered to personnel. Newsmaps and news items of interest are prominently displayed.

The 538th AAA Searchlight Battery has searchlights in operation at HANEDA, YOKOTA, and JOHNSON Army Air Bases as homing beacons to assist night navigation. OQ3 planes arrived late in February, were assembled and the RCAT Detachment has begun visiting battalions and firing points to furnish tracking missions when required in the unit training schedules.

The problem of making a mess hall attractive is one that has confronted many a unit commander. This is difficult when an inherited or converted building must be used. In March 1946, the antiaircraft artillery troops newly arrived at Johnson Army Air Base, decided to build a new mess hall. Aluminum walls and ceiling, concrete and lumber were produced, and when completed the interior with newly varnished tables and white cloth tops presented a picture of almost operating room sterility. It was difficult to relax and eat in comfort, to dawdle over coffee and cigarettes . . . something was needed to reduce the coldness of white and aluminum. One day a local artist of national repute (Imperial Academy Award Winner—1944) was discovered painting "ONE WAY STREET" signs in the base utilities section. As his work spread over the walls, the mess hall seemed to take on warmth and life, and the consensus averred that it was "the-best-damned-mess-hall-on-the-base." No other unit has anything else quite like it. In the main panel "Mickey Mouse" is shown making a snow Santa Claus against a winter background . . . the other shows Donald Duck and his family sitting down to dinner with the Wolf in the background. Other murals executed by the artist are landscapes of Fujiyama in cherry blossom time . . . a panel of sketches showing the women of all nations in native dress and a choir-organ panel representing "Evensong."

Group headquarters is fortunate in being housed in a fairly modern seven-story building, complete with elevator and roof garden. The Wakao Building as it is known by local residents, is located in central YOKOHAMA at the intersection of Avenue B and 4th Street, or 34 4 chome Honcho, Naka-Ku, Yokohama, Kanagawa-ken, Japan (Japanese Version). All the facilities necessary for efficient operations are distributed throughout the building. The offices are located on the second floor. Enlisted personnel quarters occupy the uppermost two floors. Officers residing in the building are quartered on the fourth floor. Two clubs, the Skyline Club, and the Officers Club are maintained in the building. These clubs are richly furnished, complete with bars, and are decorated with eye-filling murals executed by well-known Japanese artists. The Skyline Club is located in the penthouse and is devoted solely to enlisted personnel and their friends. It is a blessing on warm summer nights. From this point of vantage an excellent view of YOKOHAMA is to be obtained and many camera enthusiasts use the rooftop to click their cameras contentedly.

As steamers continue to arrive from the United States more and more families are reunited. During the months of February and March the families of three officers arrived in the theater. This swells the group total to twenty-seven families.

The following officers reported to group headquarters for duty during the period of February-March 1947 and have been assigned as shown:

138th AAA Group:

Lieutenant Colonel Ralph A. Stevens, Jr.; Majors Robert A. Moore, Thomas R. Lea, Jr.; Captains James W. Newman, Eldee R. Stark; First Lieutenants Glenn C. Clover, Edgar L. Denniston, Herbert N. Cline.

209th AAA AW BATTALION (SP):

Major David B. McFadden, Jr.; Captains Joseph A LeClair, Jr, Otto B. Lewis, William J. Smith, Charles Damon, Henry T. Johnson, Roy H. Lundgren, William L Wyatt; First Lieutenants Henry W. Martin, William Smith, Gordon O. Robbins, Martin J. Coyle, Herbert W Krueger, Kenneth C. Ring.

753d AAA GUN BATTALION:

Major Richard Farr; Captains Graham G. Kirton, Charles L. Allen, Palmer L. LaPlant; First Lieutenants William Ogg, Charles Tuttle, Oscar W. Andersen, Roy G. Pagnello, Manning L. Quattlebaum.

933d AAA AW BATTALION (SM):

Major Clarence J. Hutson; Captains Cyrus A. Skrien, Harry C. Eisenhart, Daniel M. Recksiek, Christian J. Schell; First Lieutenants Paul W. Allison, Raynor Field, Robert W. Martin, Jack O. Schurtz, Henry W. Elliot, Ira H. Lipscomb, Charles C. Tolbert; Second Lieutenant Charles E. Washington.

162d OPERATIONS DETACHMENT:

Major Martin J. Lechwar; Captain Jack Way.

538th AAA SLT BATTERY (SEP):

Captains Robert C. Dufault, Joseph Redinger; First Lieutenant Jack G. Harkins.

543d MPEG COMPANY:

Captain Arthur A. Grefe; First Lieutenants Harley M. Brown, Sigmund R. Herschbach.

32D AAA BRIGADE, LUZON, P.I., APO 707

BRIGADIER GENERAL FRANK C. MCCONNELL, *Commanding*

February and March, 1947, were significant months for Headquarters and Headquarters Battery, 32d Antiaircraft Artillery Brigade, in that they marked the beginning of the end for this proud unit. As plans went forward for inactivation at a future date, the organizational strength was considerably reduced by current War Department criteria concerning non-Regular Army men.

An inspection of Brigade personnel and their quarters was conducted by the Deputy Chief of Staff, Philippine Ground Forces, General Frank C. McConnell, on 1 February. A Signal Corps cameraman was on hand to take the official picture of Headquarters and Headquarters Battery.

The last day of February brought the inactivation of the Antiaircraft Artillery Training Center, located at San Marcelino, Zambales, Luzon.

On 15 March, the 94th Antiaircraft Artillery Group, one of the oldest and most colorful units in the Pacific, was inactivated.

Major William A. Ryan, who served as Camp Executive Officer, in addition to his duties as Brigade Adjutant, departed for the United States aboard the U. S. Army Transport, *Admiral Hughes*, on 19 March, for separation from the service. Returning with Major Ryan to the Zone of the Interior, was First Lieutenant Charles Y. Roberts, former Supply Officer, who also will be separated from the Army.

Fourteen enlisted men were relieved of assignment to Headquarters Battery and were attached unassigned to Paranaque Replacement and Disposition Center to await orders to return to the United States during the month of March.

The Baguio quotas for February and March allowed twenty-four enlisted men to enjoy eleven days TDY at Camp John Hay, Luzon.

To wind up this two months' period, a gala dinner party for the entire Battery was held in the Fiesta Pavillion of the Manila Hotel. Expenses were paid out of the Battery Fund, which afforded enough for steak dinners and extra trimmings. Excellent food, good music, and a friendly atmosphere all went toward creating the gay spirit that made the evening an unforgettable one.

42D AAA BRIGADE (PS), MANILA, P. I., APO 707

LT. COLONEL LAURANCE H. BROWNLEE, *Commanding*

The Enlisted Personnel of the Headquarters and Headquarters Battery, 42d AAA Brig (PS), are progressing very well in their training. Subjects of instruction are in conformity with current training directives. Lectures are given by noncommissioned officers of the battery. As the instruction goes on, the men's eagerness to learn gives way to quick understanding on their part.

Five enlisted men availed themselves of the opportunity of discharges. They were relieved of their duties with the battery and were sent to Angeles Replacement and Disposition Center where they will be separated.

The efficiency of the men in the Headquarters in M1 and Carbine marksmanship was shown during the target practice at Marikina range which commenced 12 February 1947 and ended 14 February 1947. The first two days were devoted to M1 Cal. .30 firing on the 200 and 300 yards ranges. The third day was devoted to carbine firing on the 1,000-inch range.

From 17 February to 20 February 1947, the first of two groups dividing the Headquarters and Headquarters Battery, accompanied by the Battery Commander, Lieutenant Woodson A. Sadler, went to San Marcelino, Zambales. The purpose of this trip is to familiarize the members of the command with the different weapons employed in the antiaircraft artillery. With the cooperation of the officers and enlisted men of the AAATC, the visiting group was given lectures on antiaircraft artillery weapons and matériel. Besides the theoretical instruction, the enlisted men of the batteries in the AAATC gave an actual demonstration on how to deploy and employ the different weapons and matériel. This demonstration, which was performed with great care was keenly observed, and because of it all the men better understood what an enlisted man is supposed to do when assigned to a weapon or piece of equipment in the antiaircraft artillery. After the demonstration, the men were given the privilege of examining the weapons closely.

The second group accompanied by Lieutenant Colonel Laurance H. Brownlee, left Sunday, February 23 for San Marcelino with the same purpose as the first group. The unlimited cooperation of the officers and enlisted men of the AAATC as shown during the first and second visits of the personnel gave them the best information on employment of antiaircraft artillery weapons and matériel.

About 1 March 1947, most of the unit training was stopped except for a short drill period and athletics. The men began to take over all the duties in the Staff Section of the Philippine Ground Force Command to replace certain American enlisted men who returned to the Zone of Interior.

On 5 March 1947, Captain Leslie G. Callahan, Jr., was assigned to this unit as Headquarters Battery Commander with additional duties as Brigade Adjutant. Lieutenant Sadler assumed the duties of Motor Officer for the Philippine Ground Force Motor Pool. On 26 March 1947 the entire battery attended an exhibition of the latest uniforms under consideration by the Army. Questionnaires were distributed to everyone present for each individual's comment.

70th AAA Group, San Marcelino, P. I., APO 74

Colonel Volney W. Wortman, *Commanding*

The Antiaircraft Training Center at San Marcelino, Zambales, P. I., once designed to accommodate 10,000 officers and men, which was established by direction of Major General W. F. MARQUAT, now, under recent directives from the War Department to accomplish the roll-up of outlying bases, is on the way to complete oblivion. The camp will soon be turned over to the Philippine Government.

There are now barely 300 officers and men left of the 2,000 that were here on the first of February, and the activities incident to closing the post, strenuous as they are, are only a shadow of the intense rush that prevailed during February and early March, when the 81st AAA Group (PS), the 536th AAA Gun Battalion, and the 1st Composite AAA AW Battalion (Prov) (PS) made up of batteries from the 539th, 544th and 570th AAA AW Battalions, were being brought to the completion of their training.

These units, with one exception have all departed from this mountain-fringed valley. The one exception, the 81st AAA Group (PS), until recently commanded by Colonel VOLNEY W. WORTMAN, is the only unit remaining with its combat personnel still intact. It is worthy of mention that the 81st AAA Group (PS) is the only Philippine Scout organization thus far to complete its 26-week MTP program. The other three units: 70th AAA Group, 54th AAA Slt Battery (PS) and the 47th Operations Detachment (PS) are mainly engaged in housekeeping and fatigue duties.

There was hardly a quiet moment during February and early March. There was an almost constant succession of field exercises, target practices at the La Paz firing point, small-arms firings at the rifle range and the roaring of target planes overhead from Florida Blanca. The peace of the country air was being constantly shattered by the boom of the 90's, the sharp crack of 40's and the staccato rattling of machine guns and M-1's on the small-arms range. Now it is quiet again except for the sound of truck motors as the equipment is being hauled to other, more permanent centers.

Numerous parties for the enlisted men were given at Club 70 and at the Red Cross Club, Bahay Kubo, for the Philippine Scouts.

On 15 March, Colonel FRANCIS A. HAUSE, CAC relinquished the command he had held since 1 July 194 to head a War Crimes Commission in Manila. Colonel VOLNEY W. WORTMAN, well-known in Coast Artillery circles for many years, assumed command of the Group on 16 March.

65th Antiaircraft Artillery Group, Fort Amador Panama Canal Department

Colonel Marvil G. Armstrong, *Commanding*

Lieutenant General Barrios of the Chilean Army paid a visit to units of the 764th AAA (Gun) Battalion where he was favorably impressed with the attitude and training of Puerto Rican Personnel. He was accompanied by Major General Porter, Deputy Commander, Panama Canal Department and Colonel E. M. Benitez, Commanding Officer of the Latin American Training Center.

Colonel Paul B. Rutledge CAC Deputy Sector Commander reviewed the Pacific Sector and Department Reserve Troops within the Sector on 2 March. Colonel M. G. Armstrong, Commanding Officer, 65th AAA Group commanded the troops.

Army Day was celebrated by reviews and exhibits at the several army installations with units of the 65th AAA Group participating, the 764th AAA (Gun) Battalion at Fort Gulick and the 903d AAA (AW) Battalion at Fort Clayton. At each of the exhibits, demonstrations of all antiaircraft artillery equipment were viewed by hundreds of interested spectators. In a colorful ceremony, the Army Commendation Ribbon was awarded to Staff Sergeant G. W. Bossler, Battalion Supply Sergeant of the 903d AAA (AW) Battalion, for outstanding service, by Brigadier General Hardaway, Pacific Sector Commander. The reviewing party included President Jimenez of the Republic of Panama, United States Ambassador Hines, Lieutenant General Crittenberger, Theater Commander, Acting Governor of the Canal Zone, Brigadier General Newcomer, Admiral Shafroth, Commanding 15th Naval District and General Porter, Deputy Commander PCD.

Recent publicity was given the 764th Gun Battalion for its accomplishment as the outstanding unit in maintenance of motor transportation throughout the Isthmus.

The 903d AAA (AW) Battalion recently completed practice firing of all automatic weapons and machine guns with excellent results.

The Brooklyn Dodgers visited Panama from 7 to 2 March and were billeted at Fort Clayton. They played a series of games with Panama and Canal Zone teams and won all but one game. Service teams composed of stars from several unit or Post teams met the Dodgers in two strictly service games.

At Balboa Stadium on March 14th, the Pacific side team was trounced 17-0, but at the Mount Hope Stadium on 17 March, the Atlantic side team managed to hold the "Bums" to a 14-14 tie in 10 innings. The game had to be called because the Dodgers had another game scheduled for the period.

Recent CAC returnees to the States were Major J. F. Stabler; Captains S. N. Korecki, A. S. Holder, and H. C. Thaxton all formerly with 65th Antiaircraft Artillery Group.

As one phase of his visit here Assistant Secretary of War Peterson inspected antiaircraft artillery installations of the 65th AAA Group.

South Sector Command

Fort Ruger, Hawaii, APO 956

Brigadier General James E. Moore, *Commanding*

The month of March brought marked changes in the military setup within the Hawaiian Group. Largest major change was the redesignation of the Hawaiian Artillery Command as the SOUTH SECTOR COMMAND. Concurrently the Army Port and Service Command was inactivated and many of the units of that command were transferred to the jurisdiction of the South Sector leaving only the major elements dealing with port activities under a headquarters labeled the 55th Medium Port.

In its new role the South Sector Command assumes not only the responsibility of the island's artillery but the training and tactical employment of all of the army's ground defenses in the event of any state of emergency, plus logistical support to be furnished all troops, troop units and elements within the area of the command.

In a move to conserve both manpower and funds, the South Sector Command takes up the service or housekeeping duties of the ten military installations in the Honolulu area plus certain training and firing areas in various sections of the island where the areas are suited to the character of troops assigned South Sector. The ten posts, many of them long familiar to Coast Artillerymen, are: Forts Armstrong, Barrette, DeRussy, Hase, Kamehameha, Ruger, Shafter, and Weaver; Camps Malakole and Sand Island. Command Post of the South Sector Command is at *Fort Ruger*.

Many details of command have been delegated to the Commanding General of the South Sector in addition to the performance of the tactical missions and include: operation of post, camp and station supply agencies; repairs and utilities functions, including packing and crating, and furniture manufacture; functioning of Post Planning Boards; Military Police functions, including CID activities and loyalty checks of civilian personnel; Caretaking of all Seacoast Artillery installations on the Island of Oahu; operation of recreation facilities including athletic activities among the posts and the rest camp at Fort DeRussy; operation of a labor pool; operation of bakeries, laundries, commissaries, refrigeration plants and warehouses; operation of schools; assignment of family-type and dormitory-type quarters to military and War Department personnel; administration of Civilian personnel; purchasing and contracting; investigations and handling of claims against, and in favor of, the government; and inferior courts-martial.

Headquarters, 98th Antiaircraft Artillery Group

Fort Kamehameha, Hawaii, APO 956

Colonel William L. McPherson, *Commanding*

All units of this group, with the exception of the recently activated searchlight unit, participated in the Joint Army and Navy Exercises conducted in conjunction with the Pacific maneuvers in March 1947. Equipment was moved to tactical positions which had not been occupied since shortly after V-J day. These positions were visited during the Joint Army and Navy Exercises by the Commanding General, AGFPAC, Lieutenant General Hull. Major General Decker, Chief of Staff, AGFPAC and Brigadier General Moore, Commanding General, South Sector Command visited the positions with General Hull.

The exercises aided greatly in familiarizing both officers and enlisted personnel with the problem of providing antiaircraft defense for the vital installations of this island. At the critique following the JANX, attended by high ranking Army and Navy officials, the outcome of the attack was not announced, but the opinion of all was that invaluable training had been achieved by all participants.

Headquarters and Headquarters Battery *98th AAA Group* moved from Fort Shafter to *Fort Kamehameha* as a part of the general reorganization program on the island. The 97th AAA Gun Battalion and the 31st AAA Operations Detachment are also at Kamehameha while the 867th AAA AW Battalion is at Fort Ruger and the 88th AAA Searchlight Battery is at Schofield Barracks.

35th Coast Artillery Maintenance Detachment

Fort Ruger, Hawaii, APO 956

Lieutenant Colonel Charles G. Young, *Commanding*

During the period covered by this newsletter we find many changes have taken place. Late in February orders were received transferring Colonel Leonard L. Davis, Commanding Officer of the Hawaiian Seacoast Artillery Command since 20 January 1947, to the duties of Chief of Staff of the newly activated South Sector Command. This transfer resulted in Lieutenant Colonel Charles G. Young assuming command.

Since the new South Sector Command replaces the former Hawaiian Artillery Command, 5 March 1947 saw the inactivation of Headquarters Battery, Hawaiian Seacoast Artillery Command.

With the activation of the South Sector Command the control of the various Army posts in the South Sector was turned over to the Commanding Officers of tactical units stationed at the various posts. This resulted in the Commanding Officer, 35th Coast Artillery Maintenance Detachment assuming command of the posts of Fort Ruger and Fort Hase.

The mission of this organization continues to be the maintenance of the numerous seacoast installations scattered throughout the island of Oahu. More and more of this mission is being carried out by use of roving maintenance detachments.

The Antiaircraft Artillery and Guided Missiles Branch, The Artillery School

Fort Bliss, Texas

MAJOR GENERAL JOHN L. HOMER, *Officer In Charge*

The following changes occurred during the month of March 1947:

ARRIVALS

Name	*Department*
Colonel John A. Sawyer	Not yet joined
Captain James M. Bouton	Not yet joined
Captain Leo V. Hayes	Gunnery

DEPARTURES

Name	*Destination*
Lt. Col. Carl Lentz	2502d ASU Pennsylvania National Guard Instructors Detachment, Harrisburg, Pa.
Lt. Col. John P. Mial	The Artillery School, Ft. Sill, Okla.
Lt. Col. William H. Morris	WBGH, El Paso, Texas
Major Dale F. Peter	WBGH, El Paso, Tex.
Major George Tollini	Separated from Service
Major William W. Wipf	AAA & GM Ctr., Ft. Bliss, Texas
Captain Harold M. Dudley	AGF Board, No. 4, Ft. Bliss, Texas
Captain Robert L. Lawrence	Separation Center, Ft. Dix, N. J.
1st Lt. Frederick V. McWold	Separated from Service
1st Lt. Norman L. Pruette	O/S Replacement Depot, Cp. Stoneman, Calif.
CWO Wilson O. Richardson	O/S Replacement Depot, Cp. Stoneman, Calif.
WOJG Floyd H. Bartlett	1st AAA & GM Bn., WSPG, Las Cruces, New Mexico

The following changes occurred during the month of April 1947:

ARRIVALS

Name	*Department*
Major Burrell G. Brown	Research & Analysis
Captain Hiram H. Griffith	Headquarters Commandant
Captain Walter L. Roe	Not yet joined
Captain Joseph P. Swanik	S-4
1st Lt. William H. Harden	Not yet joined

DEPARTURES

Name	*Destination*
Lt. Col. James N. Sexton	WBGH, El Paso, Texas
Major William A. DePalo	The Artillery School, Ft. Sill, Okla.
Captain Paul H. Barton	384th AAA Gun Bn, Ft. Bliss, Texas
Captain August Koenig	284th AAA AW Bn, Ft. Bliss, Texas
Captain John E. Morton	Separated from Service
Captain Alvin O. Oyen	The Artillery School, Ft. Sill, Okla.
Captain Gerald E. Renegar	Detachment of Patients, 183 GH, Ft. Richardson, Alaska
Captain Victor F. Thomas	Separated from Service
Captain Joseph A. Tringali	The Artillery School, Ft. Sill, Okla.
1st Lt. Frank S. Benford	284th AAA AW Bn, Ft. Bliss, Texas
1st Lt. George R. Calkin	The Artillery School, Ft. Sill, Okla.
1st Lt. James W. Chaney	Detachment of Patients, WBGH, El Paso, Texas
1st Lt. Brandt Drymon	Separated from Service
1st Lt. Alvin E. Fort	O/S Deplacement Depot, Cp. Stoneman, Calif.
1st Lt. Robert F. Krueger	Detachment of Patients, WBGH, El Paso, Texas
1st Lt. Klare C. Moyer	Detachment of Patients, WBGH, El Paso, Texas
1st Lt. Kirk D. Sievers	Separated from Service
WOJG Lawrence J. Wofford	Separated from Service

69TH AAA GROUP, SAIPAN, APO 244

LIEUTENANT COLONEL JOSEPH C. MOORE, *Commanding*

The 69th AAA Group with its attached battalions is continuing to operate the MARBO Personnel Center and Casual Depot while supporting the mission of the Saipan Army Garrison Forces and maintaining an active Antiaircraft Artillery Training Schedule.

Due to multiple missions of the Group and the decrease in personnel, Group personnel are actively participating in the training activities of an AAA Automatic Weapons Battery and one AAA Gun Battery. Weekly radar tracking missions are being scheduled and weekly target missions for the automatic weapons have been scheduled for early May 1947.

Recreational trips to Japan have been scheduled on a monthly basis by MARBO Headquarters at Guam. The first contingent of men selected from the Group, departed 15 February for a six-day period of rest and recuperation in Kyoto, Japan. Individuals selected for the trips are chosen on the basis of the longest service in the Marianas Bonin Command Area. Those making the first trip included Master Sergeant Arthur W. Mires; Staff Sergeants William W. Ainsworth, James S. Vest; Sergeant James V. Patterson

The Seacoast Branch, The Artillery School

MAJOR GENERAL ROBERT T. FREDERICK, *Officer In Charge*

In January the Academic Department graduated two officers classes in Seacoast Electronics and Submarine Mining. During March, the Officers Advanced Class from the Artillery Center, Fort Sill, consisting of one hundred and seven officer students, was here for three weeks of instruction from 10 March through 28 March inclusive. Upon completion of this course of study at Fort Winfield Scott, these student officers were given two weeks amphibious training at the Naval Amphibious Training Base, Coronado, Calif. to complete their course of study at The Seacoast Branch of The Artillery School.

Eleven current courses are being offered. They are as follows:

a. OFFICERS COURSES:

The Artillery Engineer
Submarine Mining
Advanced Seacoast Artillery (Gunnery)
Associate Basic Artillery

b. ENLISTED COURSES:

Seacoast Artillery and Marine Power Plant
Seacoast Artillery Gun Data Computer
Seacoast Artillery Wire Communications
Seacoast Radar Repair and Maintenance
Submarine Mine Casemate Electrician
Radar Operator
Master Gunner

Plans have been completed by the Academic Department for the work in Extension Courses to be transferred to Fort Sill. The field work will continue to be done here but the supervision will be from Fort Sill. Major Kuhn, a former member of the faculty here, is now on duty with the Department of Extension Courses at Fort Sill.

On 19 May, the new Navy School and Harbor Control for Army Officers will begin. Naval officers and enlisted personnel have been working diligently to complete preparations for the course of study. This is a new officers course in Harbor Entrance Control and is aimed at the preparation of Army officers for joint staff work with the Navy. The scope of study to be attempted is broad and will provide the officer with a working knowledge of Navy weapons and matériel. As a part of this course of study, joint Harbor Control exercises will be conducted in the Harbor Defense Control station at Fort Winfield Scott.

During the summer months two large classes of Reserve Officers and National Guard Officers will be enrolled at the Seacoast Branch of The Artillery School for a course of study. A wide variety of subjects will be offered to these Reserve Officers and the program is aimed at providing them with a complete up-to-the-minute review of policy, weapons, tactics and proposed operations.

Major General Clift Andrus, Commandant of the Artillery School, Fort Sill, visited the School for the first time during the latter part of April.

The following changes occurred during the month of March 1947:

ARRIVALS

Name	*Department*
Captain Russell J. Hutchison	Asst Exec Off, Arty Det, SC Br, TAS
Captain Robert S. Phillips	Writer, Tng Publ Off, Mine Det, SC Br, TAS

DEPARTURES

Name	*Destination*
Major James O. Murphy	Trfd to O/S Repl Depot
1st Lt. Joseph T. Donohue, Jr.	Trfd to Army Ground Forces, Fort Monroe, Va.
CWO Frederick W. Robas	Trfd to Detachment of Patients, LGH, San Francisco, Calif.

The following changes occurred during the month of April 1947:

ARRIVALS

Name	*Department*
2d Lt. Jack W. Stallings, Jr.	Aide-de-Camp, Hq & Hq Det, SC Br TAS
CWO Herbert J. Gans	Reconnaissance Officer, Hq & Hq Det, SC Br TAS

DEPARTURES

Name	*Destination*
Major William F. Kuhn	Trfd to The Artillery School, Fort Sill, Okla.
Major Carroll L. Lancaster	Separated from service.
Capt. Lester B. Townsend, Jr.	Separated from service.
1st Lt. Tom C. Cox	Trfd to Det of Pnts, LGH, San Francisco, Calif.
1st Lt. Willis E. Powell	Separated from service
1st Lt. Roderic A. Varney	Trfd to Detachment of Patients, LGH, San Francisco, Calif.
CWO John R. McDonald	Trfd to 6700 ASU, Arizona Organized Reserve Instr Gp, 505 Luhrs Bldg., Phoenix, Arizona
CWO Thomas H. Miller	Trfd to 388th Band, Fort Lawton, Wash.

COAST ARTILLERY ORDERS

WD and AGF Special Orders covering the period 1 March 1947 through 2 May 1947. Promotions and Demotions are not included.

Major Generals

Donovan, Richard, to retired.

Brigadier Generals

Richardson, William Lloyd, to transferred to AC.
Weible, Walter L., to Hq Third Army, Atlanta, Ga.

Colonels

Adams, Edward Forstall, to transferred to CAC.
Barber, Edward, to transferred to AC.
Bartlett, Laurence W., to AA & Guided Missile Br The Arty Sch, Ft. Bliss, Texas.
Bates, Russell E., to 1242d ASU Office Sr. State ORC Instr for New York, 90 Church St., New York 7, N. Y. Detailed as CAC Instr.
Bell, Clarence O., to retired from active service.
Blain, Arthur C., to retired.
Blumenfeld, Charles H. to Stu Det Industrial College of the Armed Forces, Army War College, Washington, D. C.
Boudreau, Napoleon, to Office, Sr. Instr. ORC State of Texas 415 W. Fourth St., Austin, Texas.
Brucker, Wallace H., to OC of S, Washington, D. C. w/dy in O Sv Supply and Procurement.
Bullard, Abraham L., to retired from active duty.
Bullene, Lathrop R., to First Army 1202d ASU Rectg Det No. 8, Ft. Preble, S. Portland, Me.
Carroll, James B., to Eastern Penna, ORC Instr Gp, Philadelphia, Pa.
Carter, Marshall S., to OC of S, Washington, D. C.
Cordell, Ben E., to Hq AGF, Ft. Monroe, Va.
Deichelmann, Matthew Kemp, to transferred to AC.
Donnelly, Harold Cooper, to transferred to AC.
Dutton, Donald L., to Second Army 2101 ASU, Ft. Geo. G. Meade, Md.
Fairchild, Frederic Henry, to transferred to AC.
Folk, Frank T., to Office Asst Secy of War, Washington, D. C.
French, Charles A., to Fifth Army 5017th ASU Ft. Leonard Wood, Mo.
Gunn, Clem O., to retired.
Hackman, Emory Edwin, to transferred to AC.
Hayden, James L, to reld from IGD and asgd for dy at USMA, West Point, N. Y.
Ingram, Wharton G., to Marianas-Bonin Comd. Guam, Marianas. Mailing address Casual Pers Sec, 16th BPO, APO 249 c/o PM San Francisco, Cal.
Johnson, Harold S., to Sixth Army, Presidio of San Francisco, Calif.
Jones, Clifford R., to AGO Casuals, Washington, D. C. atchd for dy w/WD Pers Records Bd.
Keeler, George E., Jr., to Industrial College of the Armed Forces, Washington, D. C. for dy w/Staff & Faculty.
Kendall, William H., to detailed in Sp S.
Kyster, Olaf H., Jr., to from P. HILRCOM to Stu Det Nat'l War College, Washington, D. C. Rept not later than 28 Aug. 1947.
Lane, John J., to Office of Dir of Plans and Opr, OC of S, Washington, D. C.
McGarraugh, Riley E., to Fulton County High Schools, Atlanta, Ga.
McKinney, Marvin John to transferred to AC.
Metz, Thomas McG., to Hq AGF, Fort Monroe, Va.
Morrow, Samuel Howard, to transferred to AC.
O'Connell, Geoffrey, to retired from active service.
Pendleton, Harry E. to OC of S. Washington, D. C. for dy w/WD Manpower Board.
Russell, Sam C., to Office Dir of Research & Development OC of S, Washington, D. C.
Schabacker, Clarence H., to AGF Pacific, Ft. Shafter, TH. Mailing address Casual Pers Sec 15th Base PO, APO 459, c/o PM, San Francisco, Calif.
Seward, John R., to 4404th ASU N. Mex NG Instr Det, PO Box 1018, Santa Fe, N. Mex. w/sta at Albuquerque, N. Mex. Detailed as CAC Instr.
Tarrant, Legare K., to Office Dir Plans & Opr OC of S, Washington, D. C.
Thomas, Benjamin A., to Reld from detail in CAC.
Totten, Robert, to transferred to AC.
Walbach, James de B., to retired from active Duty.
Willard, Sherman E., to retired from active service.
Worcester, William J., to Resigned.

Lieutenant Colonels

Abrahams, Rolland S., to Atchd unasgd Army Finance Sch, St. Louis, Mo.
Albergotti, Julian S., to South Carolina NG Instr Gp, Columbia, S. C. w/sta at Lancaster, S. C.
Bain, James Gallagher, to transferred to Ord Dept.
Beaver, Francis L., to Far East Comd, Yokohama, Japan. Temp mailing address Casual Officers Co., Cp Stoneman ORD, Pittsburg, Calif.
Black, Edwin Fahey, to transferred to Inf.
Boughton, Roland Wallace, Jr., to transferred to AC.
Clark, Edwin McCord, to relieved from active duty.
Dahlquist, Frederick C., to Sixth Army 6401st ASU, San Francisco Rectg Dist, Presidio of San Francisco, Calif.
Coffin, Ralph Breckinridge, to transferred to FA.
Cozart, Clarence Albert, to transferred to Ord Dept.
Curtin, Richard Daniel, to transferred to AC.
Darrah, James T., to Hq AGF, Fort Monroe, Va.
Davis, Paul C., to AGF Board & Det No. 4, Fort Bliss, Texas.
Dice, John Brazelton Fillmore, to transferred to AC.
Doyle, Phillip V., to AA & Gm Br the Arty Sch, Ft. Bliss, Texas.
Fernstrom, Carl H., to Arty Sch, Fort Sill, Okla.
Ferrill, Harlan Benton, to transferred to AC.
Flynn, Ralph Martin, to Transferred to Inf.
Fultz, William S., to Hq AGF, Fort Monroe, Va.
Gay, Alvin Christian, to transferred to AC.
Grotte, Helmer M., to 2509th ASU MDW NG Instr Det, Washington, D. C. Detailed as CAC Instr.
Hanson, Charles C., to 4309th ASU Office Sr State Instr ORC State of Okla, Oklahoma City, Okla. Detailed as Asst to Sr. Instr.
Harnett, John Stevens, to transferred to CE.
Hayman, Firman K., to detailed in Sp S.
Heinrich, Charles Thomas, to transferred to Inf.
Henry, William J., to transferred to FA.
Hudiburg, Howard B., to AGF Board & Det No. 4, Fort Bliss, Texas.
Iones, Ernest Bryant, to transferred to AC.
Lawlor, Robert J., to Hq First Army, Governors Island, N. Y.
Leidy, Royal L., to Stu Det Comd & Staff College, Ft. Leavenworth, Kansas.
Leis, Donald L., to Philippine-Ryukyus Comd, Manila PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Lentz, Carl, to 2502d Penna. NG Instr Det, Harrisburg, Pa. w/sta at Reading, Pa. Detailed as CA Instr Penna. NG.
Linderer, Lawrence W., to Hq First Army, Governors Island, N. Y.
McKenney, Stewart L., to detailed as member GSC & asgd to WDGS.
Massello, William, Jr., to Comd & Staff College, Ft. Leavenworth, Kans. for dy w/Staff & Faculty.
Miley, Henry Augustine, Jr., to transferred to Ord Dept.
Morgan, John Brown, to transferred to Ord Dept.
Nelson, Russell Manly, to transferred to FA.
Nye, David B., to Arty Sch, Fort Sill, Okla.
Passarella, Pasquale Francis, to transferred to FA.
Peterman, Arthur C., to OC of S, Washington, D. C. for dy w/O Dir of Intelligence.
Pohl, Marion G., to Hq AGF, Fort Monroe, Va.
Pope, William P., to Arty Sch, Fort Sill, Okla.
Porter, Gwinn U., to Ground Gen. Sch, Ft. Riley, Kans. for dy w/Staff & Faculty.
Ratcliffe, Lamar C., to AA & Gm Br, the Arty Sch, Ft. Bliss, Texas.
Rauch, Alfred R., to Hq Sixth Army, Presidio of San Francisco, Calif.
Roth, Arthur, to Air War University, Maxwell Field, Alabama.
Sacerdote, Sydney Emil, to transferred to FA.
Scott, James Armitt, Jr., to transferred to Inf.
Shumsky, Albert A., to detailed as member GSC & asgd to WDGS.
Singleton, Clifton E., to 3349th ASU Georgia ORC Instrs, Atlanta, Ga.
Smith, James Pickett, to transferred to FA.
Splain, John Farley, to transferred to AC.
Thomas, Richard G., to AA & GM Br, the Arty Sch, Ft. Bliss, Texas.
Wilson, C. Forrest, to retired.
Wolfe, Yale H., to USMA, West Point, N. Y.

Majors

Adcock, Charles Warren, to transferred to AC.
Barker, James Wilbur, to transferred to FA.
Baxter, Wyley Lovelace, to transferred to AC.
Beach, Conrad F., to TAG Sch, Carlisle Bks, Pa. f/dy w/Staff & Faculty.
Bogue, William B., to the Abn Sec, the Inf Sch, Ft. Benning, Ga.
Browne, Harvey Seymour III, to transferred to Inf.
Butler, Clifton Lewis, Jr., to transferred to AC.
Butler, James L., to RTC, Ft. Ord, Calif.
Butler, Sanford J., to OC of S, Washington, D. C.
Clark, Robert Evarts, to transferred to CE.
Clifton, John Rodgers, to transferred to CE.
Cole, Norman E., to detailed as member GSC & asgd to WDGS.
Connolly, Donald Hilary, to transferred to FA.
Crane, Richard J., to relieved from active duty.
Davis, Gerald W., to detailed as member GSC & asgd to GS w/troops.
De Palo, William A., to the Arty Sch, Fort Sill, Okla.
Dunn, Joseph F., to transferred to FA.
Eckstein, Paul A., to OC of S, Washington, D. C.
Elam, Charles R., to Philippine-Ryukyus Comd, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Fairbanks, George Chandler, to transferred to Cav.
Duckwall, Richard Lewis, to transferred to FA.
Fiedler, Arthur Albert, to transferred to FA.
Fisher, Thomas Legate, II, to transferred to AC.
Goodrick, Carl H., to Hq Fourth Army, Fort Sam Houston, Texas.

Graham, Frederick Lorimer, to transferred to FA.
Gulick, John McMullan, to transferred to AC.
Hendrickson, Edward Henry to transferred to FA.
Hogan, Charles E., to Marianas-Bonin Comd, Guam, Marianas. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Jones, Bruce Barton, to transferred to Inf.
Lacey, Peter J., to Far East Comd., Tokyo, Japan. Temp mailing address Casual Pers Sec Central Mail Directory, APO 503, c/o PM San Francisco, Calif.
LaRocca, Gerard Anthony, to transferred to AC.
Lattal, Anton, Jr., to CAC CIC Cen Holibird Sig Dep, Baltimore, Md.
Leek, Calvin B., to First Army Hq & Hq Det, HD of NY, Ft. Hancock, N. Y.
Lawrence, Eugene Francis, to transferred to CE.
Lescha, Adolph John, to transferred to AC.
Macaulay, George B., to detailed as member GSC & asgd to WDGS.
May, Charles O. Jr., to Philippine-Ryukyus Comd. Manila, PI. Temp mailing address Casual Officers Co, CP Stoneman ORD, Pittsburg, Calif.
Moyer, Maynard G., to Stu Det WD Language Sch, Peiping, China.
Muit, Robert Pershing, to transferred to FA.
O'Connor, John Peterson, to transferred to AC.
O'Leary, Francis X., to AGF Pacific, Ft. Shafter, TH.
Peshmalyan, Baruyr, to relieved from active duty.
Rimmer, Harmon Porter, to transferred to FA.
Ritchey, Andrew W., to 6601st ASU Calif NG Instr Gp, c/o State AG, Sacramento 14, Calif w/sta at San Diego, Calif. Detailed as CAC Instr.
Schafbuch, Donald V., to Panama Canal Dept.
Schafer, Robert William, to transferred to FA.
Shepard, William McKinley, to transferred to Sig C.
Short, John Joseph, to transferred to Inf.
Silvasy, Stephen, to transferred to FA.
Smith, Grant H., to 267th AAA Gp, Fort Bliss, Texas.
Steiger, George E., to 6701st ASU Calif-Nevada ORC Instr Gp, Presidio of San Francisco, Calif, w/sta at San Diego, Calif. Detailed as CAC Instr.
Stringer, Ralph E., to OC of S, Washington, D. C. for dy w/Civil Affairs Div-Rm 2A312, Pentagon, Washington 25, D. C.
Strother, Tom B., to Far East Command, Tokyo, Japan.
Swartz, Kyle, to Far East Comd, Yokohama, Japan. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Thames, John W., to Seacoast Br, The Arty Sch, Ft. Winfield Scott, Calif.
Thomas, Arnold Ray, to transferred to CE.
Thompson, Estel Averal to transferred to FA.
Vivian, James Alfred, to transferred to CE.
Wardell, Michael Edward, to transferred to Inf.
Wilson, James Arthur, to transferred to AC.

CAPTAINS

Adamson, James Bradshaw, to transferred to Inf.
Anderson, Edward Gustav, Jr., to transferred to CE.
Baker, Hugh C., to Philippine-Ryukyus Comd, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Barkman, William E., to Philippine-Ryukyus Comd, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Barton, Jack, to Hq Seventh Army, Atlanta, Ga. w/sta at Miami, Fla.
Barton, Paul H., to 384th AAA Gun Bn, Fort Bliss, Texas.
Bertram, Roger Alexander, to transferred to CE.
Beindley, Arthur F., to Philippine-Ryukyus Comdr, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Brown, Ernest A., to Sixth Army MP Det Hq SP Trps, Presidio of San Francisco, Calif.
Buckwalter, John Stump, to transferred to AC.
Burt, Roy L., to 384th AAA Gun Bn, Fort Bliss, Texas.
Burton, Lewis R., to Far East Comd. Yokohama, Japan. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Campbell, Thomas E., to AGF Pacific, Fort Shafter, TH.
Chamberlain, Clifton H., to Seacoast Br, the Arty Sch, Ft. Winfield Scott, Calif.
Chavet, Walter A., to AGF Pacific, Fort Shafter, TH.
Chreitzberg, James, to transferred to Inf.
Clark, James P., to Shanghai, China. Mailing address Casual Pers Sec APO 909, c/o PM, San Francisco, Calif.
Cole, Charles Baker, Jr., to transferred to FA.
Collingwood, William Thomas, to CAC RTC, Ft. Ord, Calif.
Connor, Thomas James, to CAC CIC Cen Holibird Sig Depot, Baltimore, Md.
Czerny, William, to USFFE, Tokyo, Japan. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Daugherty, Glen Ercil, to transferred to Cav.
Denham, William Oeland, to transferred to Inf.
Dobson, Robert E., to detailed in CE the Engr Center, Ft. Belvoir, Va.
Douglas, Arthur D., to AGF Pacific, Ft. Shafter, TH. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Elgin, Thomas, to transferred to CE.
English, Everett W., to Philippine-Ryukyus Comd, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Fawcett, John R., to Fourth Army 4202d ASU El Paso, USA Rctg Dist, El Paso, Texas w/sta at Main Sta, El Paso, Texas.
Fleming, Dale Robert, to transferred to AC.
Flick, Ferdinand H., to resigned.
Galman, Herman, to CAC RTC, Ft. Ord, Calif.
Gillespie, Ernest K., to Philippine-Ryukyus Comd, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Grant, Edward C., to Philippine-Ryukyus Comd, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Griffith, Hiram H., to AA & GM Br, the Arty Sch, Fort Bliss, Texas.
Hardison, Walter M., to AGF Pacific, Ft. Shafter, TH. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Hartley, Harold J., to USFET, Frankfurt, Germany. Temp mailing address Casual Officers Det, ORD, Camp Kilmer, N. J.
Hays, Walter L., to Far East Comd., Yokohama, Japan. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Hicks, Kenneth C., Jr., to Philippine-Ryukyus Comd. Manila PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Hodges, Warren Dudley, to transferred to Inf.
Hough, Gerald R., to relieved from active duty.
Howard, Charles Edward, to transferred to FA.
Jackson, Page Spencer, to transferred to FA.
Kemp, Herbert Eugen, to transferred to FA.
Kidd, William T., to First Army Rctg Det No. 11, Ft. Banks, Mass. w/sta at Brockton, Mass.
King, Randolph C., to 1123d ASU Office Sr, State ORC Instr for Conn. 115 Broad St. Hartford, Conn. Detailed as CA Instr ORC State of Conn.
Koenig, August, to 284th AAA AW Bn, Fort Bliss, Texas.
Lawrence, Robert L., to resigned.
LeMaster, Roger H., to Marianas-Bonin Comd. Guam, Marianas. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Loop, Vincent C., to Panama Canal Dept.
Lown, James M., to Marianas-Bonin Comd. Guam, Marianas. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
McCabe, Frank J., to Far East Command, Yokohama, Japan. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
McCartney, Robert W., to Far East Comd. Yokohama, Japan. Temp mailing address Casual Officers Co, Cp Stoneman Ord, Pittsburg, Calif.
McDaniel, Henry Bailey, Jr., to transferred to AC.
McGarry, William F., to USFET. Temp mailing address Casual Army Post Office & PE Staging Area, NYPE, Brooklyn, N. Y.
McGovern, James F., to Philippine-Ryukyus Comd. Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
McKee, Herbert C., to Philippine-Ryukyus Comd, Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Cal.
McKinnon, Edward Francis, to CAC RTC, Ft. Ord, Calif.
MacNeil, Mark K., to First Army 1202d ASU Rctg Det No. 11, Ft. Banks. Mass. w/sta at Warwick, R. I.
Mazzuchi, Reno, to AA & Gm Br, the Arty Sch, Fort Bliss, Texas.
Munroe, Donald A., to Panama Canal Dept.
Nash, James Herschell, to transferred to CE.
Oyen, Alvin O., to the Arty Sch, Fort Sill, Okla.
Perlman, Abraham, to Sixth Army 6901st ASU SFPE, Ft. Mason, Calif w/sta at Cp Stoneman, Calif.
Pallo, John G., to transferred to CE.
Peterson, John Thornton, to transferred to Ord Dept.
Peterson, Theodore W., to First Army Hq & Hq Det HD of NY, Ft. Hancock, N. Y.
Ray, Byron Clinton, to CAC RTC, Ft. Ord, Calif.
Ream, Ellis A., to Far East Comd, Tokyo, Japan. Temp mailing address Casual Officers Co., Cp Stoneman ORD, Pittsburg, Calif
Reid, Samuel L., to Stu WD Language Sch, Peiping, China.
Ride, Walter T., to Wash ORC Instr Gp, 755 Central Bldg., 810 3d Ave, Seattle, Wash.
Robideau, Robert J., to AGF Pacific, Ft. Shafter, TH. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Robinson, Michel Andre George, to transferred to AC.
Roe, Walter L., to AA & GM Br, the Arty Sch, Fort Bliss, Texas.
Schmader, William P., to Office Sr. ORC Instr State of Del. w/sta at Georgetown, Delaware.
Scott, Russell Faux, to transferred to Ord Dept.
Seabrokk, George W., to Philippine-Ryukyus Comd. Manila PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Simon, Shadie, to Far East Comd, Yokohama, Japan. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Snyder, Marvin H., to Arty Center, Fort Sill, Okla.
Staffieri, Leonard D. F., to Fourth Army 4202d ASU El Paso USA Rctg Dist, El Paso, Texas w/sta at Main Sta, Santa Fe, N. Mex.
Stark, Marshall W., to the Armored Sch, Fort Knox, Ky.
Sterken, Edward J., Jr., to Philippine-Ryukyus Comd. Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Swartz, Alva William, to transferred to QMC.
Thedos, Jack V., to HD of Puget Sound, Fort Worden, Wash.
Thompson, Albert Nicholas, to transferred to FA.
Tringali, Joseph A., to the Arty Sch, Fort Sill, Okla.
Turner, Aaron B., to Marianas-Bonin Comd, Guam, Marianas. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Umlauf, Louis Blanton, Jr., to transferred to FA.
Via, Harold F., to Marianas-Bonin Comd. Guam, Marianas. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.

Wade, James Kuykendall, to transferred to Cav.
Wall, William S., to AGF Pacific, Fort Shafter, TH. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Wandel, Hugh E., to ROTC, Houston High Schools, Houston, Texas. 4526th ASU.
Weathers, James Wesley, to transferred to Inf.
Werner, Franklin A., to 5202d ASU Office Sr. Gd. Instr for Ill., Chicago, Ill. w/sta at Bloomington, Ill. Detailed as CAC Instr.
Wicks, Earl N., to Philippine-Ryukyus Comd., Manila, PI. Temp mailing address Casual Officers Co, Cp Stoneman ORD, Pittsburg, Calif.
Wilson, Charles A., to RTC, Fort Dix, N. J.
Wilson, Stanley Livingston, Jr., to transferred to Inf.

FIRST LIEUTENANTS

Adams, Edwin C., to transferred to C.E.
Allen, Joe Lee, to 384th AAA Gun Bn., Ft. Bliss, Tex.
Ambre, Ralph A., to Panama Canal Dept.
Arnold, Ernest J., to RTC, Fort Ord, Calif.
Babcock, Leslie E., Jr., to transferred to FA.
Bacon, James B., to RTC, Fort Ord, Calif.
Barrett, Robert F., Jr., to trfd to Infantry.
Bartholmew, Howard W., to New York Port of Embarkation.
Benford, Frank S., to 284th AAA AW Bn., Ft. Bliss, Texas.
Bennett, Charles C., to Far East Command, Tokyo, Japan.
Bizjak, William J., to Philippine-Ryukyus Command, Manila, P. I. Temp mail add—Casual Officers Co., Cp Stoneman, Calif.
Boechler, Andrew J., to trfd to Inf.
Bowers, William S., to trfd to Inf.
Boyle, Joseph F., to trfd to Inf.
Burr, Wesley H., to trfd to Inf.
Butler, Davis S., to Hq Fifth Army, 5020 S. Sonnell Ave., Chicago, Ill.
Calkin, George R., to the Arty Sch., Ft. Sill, Okla.
Callahan, Walter, to trfd to AC.
Cann, Richard Thompson IV, to trfd to Inf.
Clayton, William V., Jr., to USFFE, Yokohama, Japan—temp address Casual Officers Co., Cp Stoneman, Calif.
Coleman, George J., to AGF Pacific, Ft. Shafter, TH.
Corr, Joseph J., to Far East Command, Yokohama, Japan. Temp address Casual Officers, Company, Cp Stoneman, Calif.
Cowherd, Robert M., to transferred to Inf.
Cox, Eugene C., to Panama Canal Dept.
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