COAST ARTILLERY JOURNAL

JANUARY-FEBRUARY 1948

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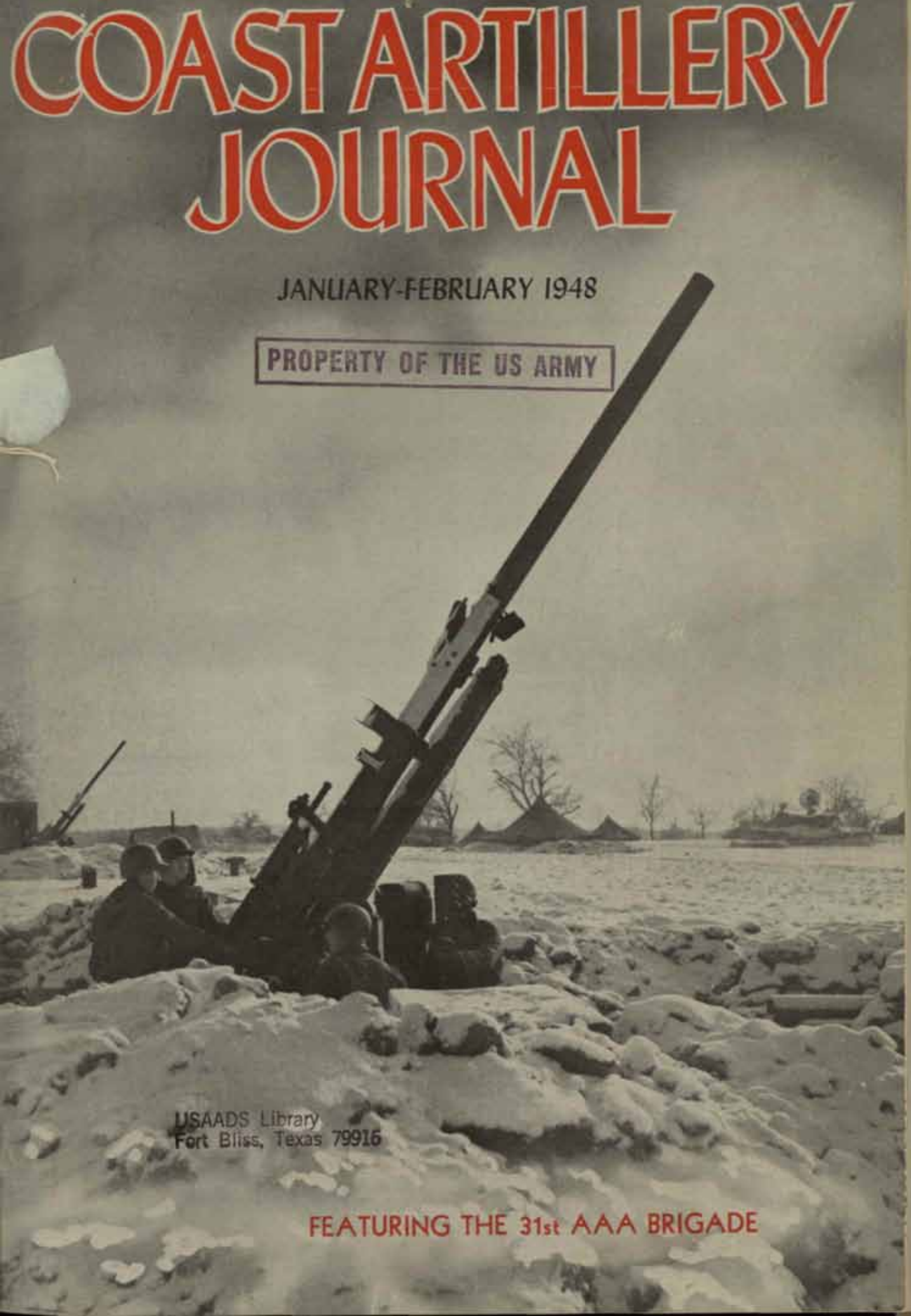

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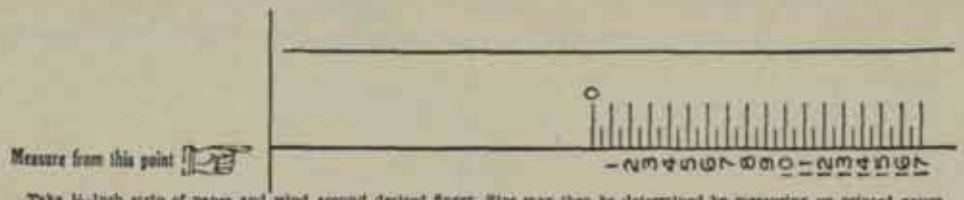

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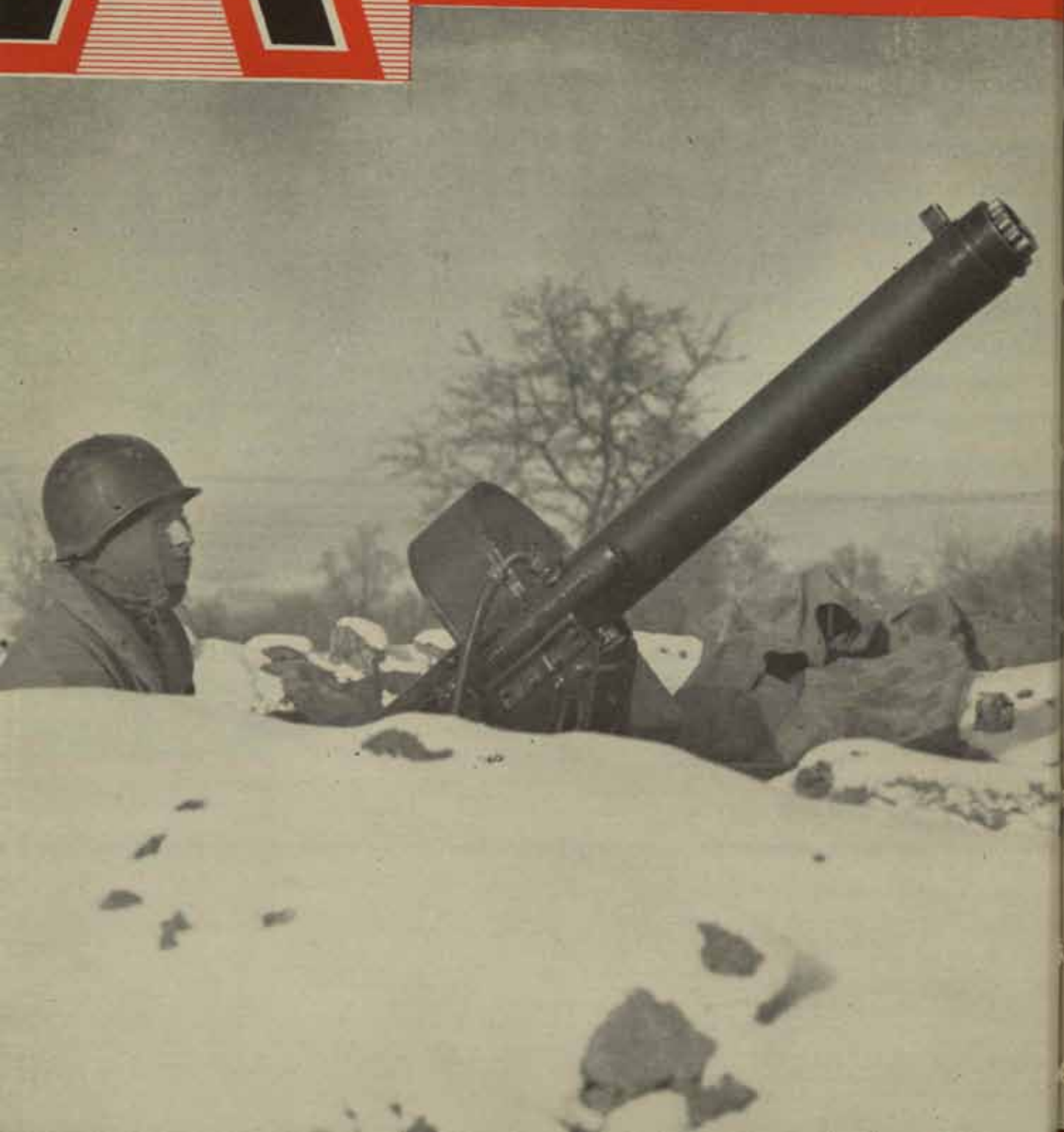
ACTIVITIES OF BRIGADE



THE 31st AAA

By Colonel Daniel C. Nutting, CA Res.

The 31st AAA Brigade was activated at Camp Haan, California, on 20 November, 1942. It left there on 15 March, 1943 under the command of Brigadier General Hobart Hewett, and by a minor miracle of railroading was deposited at Fort Dix on 19 March, only to find no space available on the overseas convoy for which it had been intended. After a period of additional training and physical hardening, it embarked on 27 April aboard the transport *John Ericksson* (nee *Kungsholm*) which sailed shortly after midnight on 28-29 April. The trip was uneventful, and on 13 May, the ship tied up to a pier at Mers-el-Khebir—the ancient seaport for the city of Oran, Algeria.

After some days of outfitting, enlivened by participation as spectators in one of the last air attacks on Oran, it was assigned to Fifth Army, and moved by motor to Constantine, Algeria. There, on 1 June, 1943, it relieved the 34th Brigade in the defense of various airfields, dumps and marshalling yards contained within an area about 70 miles east and west by 35 miles north and south. Troops assigned included antiaircraft artillery regiments, automatic weapons battalions, searchlights, and a number of airborne machine gun batteries. The situation of the latter was uncomfortable in the extreme since their tables of organization made no provision for their proper maintenance when acting independently. After considerable effort, they were placed on a more or less solid footing, only to be detached immediately thereafter.

During the tenure at Constantine no action was experienced, the Germans apparently having more pressing affairs elsewhere. The principal problem was posed by the inadequate communications, which made it a major effort to reach the units by means other than by courier. This problem, incidentally, was to plague the Brigade throughout the remainder of its overseas experience.

In June, a demonstration of the fighter-searchlight team in action was staged by two searchlight battalions, with spectacular results. A number of aircraft were permitted to pass and repass through the "defended" area while a single fighter, controlled from the ground by means of radio and oriented by prearranged handling of the searchlight beams, performed interception. In every case, the "intruder" was technically destroyed long before reaching the hypothetical bomb release line.

Also in June, the Brigade was assigned the additional mission of supervising the advanced training of a French automatic weapons battalion just arrived from Morocco, where it had been organized and equipped according to American tables and with American matériel. This mission, however, was interrupted before it could be developed.

On 9 July, 1943, the 44th Brigade took over at Constantine, and the 31st immediately marched to Hammamet, Tunisia. There, on 14 July, it relieved the 2626th Brigade (later the 71st) in the defense of airfields in the vicinity. Troops involved consisted of two regiments and a number of separate battalions, disposed throughout an area some 130 miles by 75 miles engulfing at that time approximately twenty airfields. Again communications were extremely difficult, and a radio set SCR 299 was secured in order to permit direct contact with the more distant units some 100 miles from Headquarters.

Shortly after arrival at Hammamet, the 31st was instructed to take over from the British 22nd Brigade, the defense of some 15 additional airfields and of the port of Sousse, the British troops already in position being attached for the purpose. This enlarged the area to about 130 by 110 miles. Differences in the customs and terminology of the two nations now posed a very difficult problem, which was aggravated by the fact that from the American standpoint at least, the British were inadequately equipped with communication equipment. A considerable number of field telephones and a few radio sets were immediately procured and issued to the British units on a memorandum receipt basis, but the question of "language" could not be disposed of so simply. After several disconcerting incidents, a liaison officer was assigned to Brigade Headquarters, with the primary duty of insuring that all orders issued were intelligible from the British viewpoint. This left confusion only in the area of contact between the American operations room near Tunis and that manned by the British near Sousse but the individuals involved soon reached an understanding.

About 7 August, 1943, General Hewett was transferred to Allied Force Headquarters, and on 13 August, command of the Brigade was assumed by Colonel Willis McD Chapin.

Within a few days after Colonel Chapin's arrival, a French automatic weapons battalion was attached. This

A Gunner stands ready at his .50 caliber machine gun while scanning the skies for enemy aircraft.

One of the searchlight positions of a Brigade unit in North Africa.

unit, like that at Constantine, was organized and equipped in accordance with American tables and with American matériel, and was comparatively well trained. Colonel Chapin immediately went forth to inspect, and found the French drawn up in perfect order and in perfect uniform with the exception of one small detail: many were barefooted! The Brigade S-4 promptly took action to correct *that* situation.

The advent of the French, of course, further complicated the organizational problem, but the prompt attachment of a French liaison officer resulted in efficient control. It was now found necessary that each order be issued in French as well as in English, and that the English version contain duplicate terms wherever British practice differed from the American system. While somewhat cumbersome, this method functioned perfectly, and no difficulty whatever was experienced.

From the purely operational standpoint at this time, the greatest difficulty was caused by the continual movement of units into and out of the Brigade, coupled with the fact that the Air Force moved from airfield to airfield at frequent but unpredictable intervals. This latter propensity was particularly unfortunate because a high percentage of the American antiaircraft units, and all of the British, were semi-mobile and hence could not move in one operation without outside transport. For this reason it was even necessary on one occasion to send trucks all the way to Oran, a distance of some 600 air-line miles, to help move a newly arrived unit to its station—only to find that the Air Force had decided to occupy a different, though nearby, field. However, intensive liaison with the Air Force, combined with extremely careful planning in connection with the assignment of stations, successfully carried the day.

During the period spent at Hammamet, the northern portion of the "empire" was briefly taken over by the 44th Brigade, but this arrangement lasted only a short while be fore the 44th was withdrawn for another mission, leavin the 31st again in full possession.

No action was sustained in Tunisia during the 31st Br gate's incumbency, with the exception of two occasions o which gun installations near Mateur fired upon hostile ai craft engaged in raids on Bizerte. No results were observe

Toward the end of September, 1943, Brigade Hea quarters was moved to Tunis in order to facilitate liaiso with the Air Force and to place the headquarters in a mor strategic relationship to the communication network. By thi time it had become evident that the latter factor was of par mount importance in selecting the location for a hea quarters charged with a mission of the type in hand, an this principle was closely adhered to in all future situation

By this time, the defense of Sousse had been terminate and the majority of the airfields in the southern and wester portions of the Brigade area had become non-operational the greater portion of the Brigade's troops had been release to the Sicilian operation, and matters had settled down t routine. No sooner had this desirable condition bee reached, however, than on 31 October, the 31st was relieve at Tunis by the British 66th Brigade and sent into stagin for transport to Sardinia.

On 19 November, 1943, the Brigade relieved the 74t CA (Regiment) in the responsibility for the antiaircraft pro tection of "all installations used and useful to the Allie Forces" in Sardinia and in Corsica. The new area comprise two large islands separated by the two-mile-wide Strait o Bonifaccio, and covering an area about 450 miles nort and south by 150 miles east and west. The "installation included three important ports and approximately 25 exist ing or potential airfields. The Italian surrender having oc curred in the meantime, some 3000 Italian antiaircraf

Personnel of Battery B, 406th AAA Gun Battalion, with improvised seacoast fire control instruments constructed for the French at Ajaccio, Corsica.

troops in Sardinia were attached for use in carrying on the mission. These troops were bewildered by the sudden change in their situation, and were poorly fed, poorly equipped, and relatively untrained. A great deal of effort was expended in organizing them and providing them with prediction linkage equipment so that they could use data developed by the American units, but the Germans consistently refused to provide the opportunity for them to prove their worth. Four fixed French antiaircraft batteries in Corsica were also attached at this time. Liaison officers were at once obtained, and orders and instructions were now published in French, Italian, and English.

A few days after the Brigade assumed control, American troops began to pour in from Sicily and from Italy, and the staff was kept abundantly busy in the effort to identify the newcomers and to place them to best advantage in the defense. Within a relatively short time, however, the dispositions were completed and a period of temporary inactivity began. Again communications were the major problem, and it was found necessary to charge the 106th AAA Group, stationed at Bastia (Corsica) with the supervision of the Corsican defenses. An additional SCR 299 radio was secured to permit direct contact between the 106th Group's headquarters in Bastia and the Brigade headquarters in Cagliari, Sardinia.

The next period of confusion was now initiated when, on 1 January, 1944, the CA regiments were reorganized into Group Headquarters and separate battalions, many of which underwent drastic changes in numerical designation.

Shortly after the first of the year, Colonel Chapin received his promotion to Brigadier General which, among other desirable features, placed him in a much improved position when dealing with the Generals commanding the Allied and Cooperating troops in the Brigade.

Beginning in March, 1944, Corsica began to assume increasing importance relative to Sardinia, and on Easter Sunday, the Brigade headquarters was moved to Bastia in order to be more efficiently located with regard to communications and to facilitate liaison with the Air Force. Supervision of the installations in Sardinia was now delegated to the 74th AAA Group (nee 74th CA Regiment (AA)), located in Cagliari.

At about this time a number of French automatic weapons battalions were assigned and were at once placed in the defense in Corsica, since their training was entirely adequate. Shortly thereafter a French 90mm battalion was also assigned, but it was in need of considerable training and was given a minor role for the time being. This battalion was soon detached for use in the French invasion of Elba.

The assignment of two battalions of American searchlights now brought the command to a grand total of four Groups, twenty-one American battalions, four French battalions, and about three thousand Italian troops; about 22,000 men in all. Defenses were being provided for the ports of Cagliari, Ajaccio, Bastia and Porto Vecchio, the British submarine base at La Maddalena Island in the Strait of Bonifaccio, and about twenty airfields. Five operations rooms were in action, one supervised by each of the four Group headquarters and one by the 406th Gun Battalion at Ajaccio, and the entire organization was functioning smoothly and efficiently. Long-range warning was provided by two Air Force information centers, one near Bastia (Corsica) and the other near Alghero, Sardinia.

Due to the great distance between Brigade Headquarters and Allied Force Headquarters at this time, much administrative detail was required, for which no provision was made in the headquarters T/O. This entailed a great deal of additional work, but was successfully handled without increasing the administrative section.

During the spring of 1944, a unit of OQ2A target planes was received, and firing was conducted against them by such automatic weapons as could be spared from their combat positions. Results were excellent, although a bit hard on the target planes. Attempts to obtain tow-target missions for the 90mm units, unfortunately, were unsuccessful.

In May, 1944, in preparation for the French invasion of the island of Elba, the Brigade was assigned the task of training the previously attached French 90mm battalion in the technique of firing against seaborne targets. Battery B of the 406th AAA Gun Battalion, after scouring the island of Corsica for materials, constructed and presented to the French a complete set of plotting room instruments, including percentage corrector, range board, wind component indicator and deflection board. Since no sights were available, it was necessary to lay the guns in both azimuth and elevation by use of the director, with all possible corrections stripped out. The deflection board was arranged to compensate for the constant drift allowance built into the mechanism, and adjustment in both elevation and deflection was performed by operation of the spot dials on the director. Basic data were taken from the self-contained range finder and smoothed by a graphical plot in range and azimuth separately. After a remarkably short period of training, the battalion fired a practice at some 15000 yards against a ten-knot pyramidal target with excellent results. Whether the enemy was actually engaged by these methods is not known.

At about this time, smoke personnel were provided, and smoke coverage was arranged for the ports of Bastia, Cagliari, Ajaccio, and Porto Vecchio. Experiments were also

conducted with a view to determining the effectiveness of a smoke screen for the protection of an airfield against low-level strafing attacks, but the results were somewhat unconclusive.

While in general the Germans pointedly ignored the installations in Sardinia and in Corsica, frequent raids were mounted against the submarine base at La Maddalena. On one such occasion the 167th Gun Battalion was credited with the destruction of seven of an attacking force estimated at 25 aircraft. Damage was minor and future attacks were conducted by smaller forces which operated at much greater altitudes and showed no disposition to slug it out with the defenses.

The ports of Ajaccio and Cagliari were occasionally visited by high-flying reconnaissance aircraft which were engaged by the 90mm defenses. Results were questionable owing to the great altitude and high speed of the intruders.

The various airfields in Corsica were frequently reconnoitered, sometimes to the accompaniment of flares, but only twice were serious attacks experienced. The first of these began at 2152 hours on 12 May, 1944. On this occasion some twenty-five aircraft were plotted heading in toward Bastia, but sheered off when fired upon by the 90mm defenses there. They then attacked the airfield at Poretta, some miles to the south. Flares were dropped and the field was strafed and showered with anti-personnel bombs. Several British aircraft were destroyed on the ground, and a number of British personnel killed or wounded. Damage to antiaircraft personnel and installations was minor. One of the attacking aircraft was claimed destroyed. Prearranged barrages were fired by the defenses, since the attackers could not be seen in the darkness.

Four hours later, at 0202 hours on 13 May, some twenty aircraft again approached Bastia and were driven off by radar-controlled fire. They then proceeded south a mounted a determined attack against the airfield at Ales only a few miles from Poretta. Again barrage fire, ma necessary by the darkness, failed to turn the attackers, w dived under their own flares to bomb and strafe installatio on the field. Light from the gasoline dump, which was afire by one of the first bombs, greatly aided the attack while handicapping the defense, and heavy damage w caused to aircraft on the ground and to personnel and stallations of the Air Force. The antiaircraft suffered o man killed, about 18 wounded, and minor damage to m tériel. One aircraft was claimed destroyed.

The port of Bastia was twice fired upon from the sea b craft mounting guns of approximately eight-inch calibe Both raids were accompanied by diversionary air actio including the dropping of flares which were promptly fire upon by the caliber .50 machine guns with some succes Damage was negligible in both cases, and the attackers we soon driven off by the combined fire of the 90mm antiai craft guns and the French fixed batteries.

As preparations for the invasion of Southern Franc progressed, Corsica bulged with troops and matériel, an the AAA defenses lived in momentary expection of actio But, although reconnaissance photos obtained by the Ge mans must have shown clearly the concentrations at hand no attempt was made to interfere.

At this time the 31st was selected as the rear area brigad for the invasion, and a great deal of planning was don (behind locked doors) in preparation for the efficient de velopment of the defenses after the beachhead should hav been gained, and to determine the best method of releasin from their operational positions in Corsica those AAA troop which were also to participate.

On 17 July, 1944 the 44th Brigade took over the defense

A Battery commander pays his men while they remain at their M-51.

of Sardinia, and shortly before D day it also assumed command of the defenses of Corsica.

On D plus 4 the 31st went into staging at Ajaccio. Embarkation was accomplished on the afternoon of D plus 5 and the operational portions of the headquarters, now assigned to Seventh Army, landed at St. Tropez on the morning of D plus 7 and relieved the 105th AAA Group in the control of the AAA defense of the beaches. A red alert was sounded the same evening, but no action followed, nor was any sign seen of the enemy air force during the entire period of beach operations thereafter.

The invasion having progressed much faster than was anticipated, the carefully prepared plans were discarded, and a period of high-speed turmoil began, during which the Brigade, having been assigned the additional mission of acting as expediter for incoming AAA troops, found it necessary to conduct continuous liaison along the beaches in order to care for the units as they debarked. This phase was of short duration, and with the capture of Marseilles, the Brigade established its headquarters at that point and proceeded to build up defenses for Marseilles, Toulon, and Port de Bouc, in addition to the beaches. An important railway bridge some forty miles distant was soon added, and again communications became a serious problem which was not made less difficult by the fact that the Air Force information center was located in Aix-en-Provence, some twenty miles north of Marseilles. However, with the gradual abandonment of the beaches as the port of Marseilles was placed in operation, the situation took a decided turn for the better.

During the Brigade's stay of some six months at Marseilles, the port was developed to the point where all matériel and supplies for the southern front passed through it, and the defense included smoke and barrage balloons as well as 90mm and 40mm guns. The Germans staged no attacks, but they sent over very frequent reconnaissance missions consisting of single aircraft flying very high and very fast. Although the odds against them were tremendous, the 90mm defenses doggedly engaged each mission, but with little success. Early warning was excellent, plots were consistently good and the engagements soon developed into routine. All concerned were therefore greatly astonished when on one occasion the aircraft, after approaching from the east, turned back before reaching Marseilles. As he turned, two other tracks were observed to branch off from his. One proceeded in a straight line to the west, losing altitude slowly and steadily, until it apparently struck the water southwest of the city. The other, after starting off in the same manner, went into a wide, slowly descending spiral and apparently crashed in the hills to the east of the city. On the chance that some type of glide bomb was being tried out, the Brigade S-2 personally supervised an intensive search of the area, but nothing was found with the exception of a badly battered belly tank of the type used by Allied fighters. The company of engineer troops which conducted the search, however, succeeded in wearing out one pair of shoes per man, some 400 in all, on the sharp rocks.

The only other unusual event occurring during the Marseilles period took place just before Christmas, 1944, when the Counter Intelligence Corps received information that a concerted break was planned by German prisoners, of whom some thousands were confined in lightly constructed stockades near the city. The Base Section Commander, as part of his general plan for countermeasures, requested the antiaircraft to prepare data which could be used to deliver fire against points likely to be seized or attacked by the Germans, and which could be covered from tactical positions. This was immediately done, and a complete plan for the co-ordination of countermeasures was prepared. In this plan the communication net formed by the radio equipment of the various AAA units, figured very prominently. The prisoners, however, apparently thought better of the enterprise, and nothing developed.

While at Marseilles, an attempt was made to use the OQ2A target planes, but the strength and turbulence of the air currents at the only suitable firing point made this impossible. A squadron of tow-target planes was assigned at about the same time, and a firing range for both heavy and light guns was established at Sausset-les-Pins, on the seashore, some twenty miles west of Marseilles. A records section was organized and trained and a number of practices were fired.

While at Marseilles also, the Brigade radar officer supervised experiments which led to the successful use of the SCR 584 radar for spotting range to the burst in trial fire.

As the European situation moved toward a satisfactory conclusion, even the enemy reconnaissance forces ignored the 31st Brigade area, and the defenses were reduced practically to the vanishing point. Eventually the Brigade was assigned to the Ninth Air Defense Command, and in April, 1945, moved by motor convoy to Namur, Belgium, where it assumed responsibility for the defense of airfields, bridges, dumps, and marshalling yards over an area some 75 by 50 miles. Again the Germans pointedly ignored the installations, and the principal difficulty, as always, was the necessity for handling a constantly shifting troop and objective assignment in the face of totally inadequate communications.

The Brigade was still at Namur when the German surrender took place on 8 May, 1945. The antiaircraft defenses in the area were maintained in readiness for a few days following the great event, and then were declared non-operational, and the Brigade operations sections folded up.

Then followed a short period of uncertainty until the 31st Brigade was ordered to assume administrative control of a number of antiaircraft battalions engaged in rounding up enemy matériel in Germany. Accordingly, on 2 June, 1945, the headquarters was moved to Langenselbold, some fifteen miles east of Frankfurt-am-Main, Germany. Technical control of the units was vested in other headquarters, and the majority of the Brigade headquarters personnel were therefore in a strictly idle condition. A school was immediately set up, using texts furnished by the Armed Forces Institute, and featuring subjects only slightly connected with military affairs. No sooner had the school begun to function smoothly, however, than all high-point enlisted men were removed for re-deployment to the United States and the high-point officers soon followed. General Chapin joined the homeward march on 24 August, 1945, and command was subsequently assumed by Colonel Parry W. Lewis.

After experiencing the effects of redeployment and redistribution of troops so characteristic of the period, deactivation took place at Esslingen, Germany on 30 June 1946.

Thus was brought to a close the experiences of an Antiaircraft Brigade which are probably unique in regard to the vast areas over which it operated in three languages and in the number and variety of troops included.

Unfortunately complete records are not available, but the following is a partial list of units attached to the Brigade during its operations:

REGIMENTS

62nd Coast Artillery (2nd Battalion)
67th Coast Artillery (AA) (Less 3rd Battalion)
68th Coast Artillery (AA) (2nd Battalion)
74th Coast Artillery (AA) (Partial)
209th Coast Artillery (Headquarters & Headquarters Battery & 2nd Battalion)
213th Coast Artillery

GROUPS

1st Antiaircraft Artillery Group
1st Coast Artillery (AA) Group
4th Coast Artillery (AA) Group
5th Coast Artillery (AA) Group
106th Antiaircraft Artillery Group

BATTALIONS

167th Coast Artillery Gun Battalion
201st AAA Automatic Weapons Battalion
215th AAA Gun Battalion
216th Coast Artillery (AA) Battalion (Separate)
351st Coast Artillery Searchlight Battalion
353rd Coast Artillery Searchlight Battalion
354th Coast Artillery Searchlight Battalion
355th Antiaircraft Artillery Searchlight Battalion
403rd Coast Artillery (AA) Battalion (Separate)
406th AAA Gun Battalion
410th Coast Artillery (AA) Battalion (Separate)
431st AAA Automatic Weapons Battalion
432nd Coast Artillery (AA) Battalion
434th AAA Automatic Weapons Battalion (Separate)
435th Coast Artillery (AA) Automatic Weapons Battalion
437th Coast Artillery (AA) Battalion
439th Coast Artillery (AA) Battalion
454th AAA Automatic Weapons Battalion (Separate)
532nd Coast Artillery (AA) Battalion (Separate)
533rd AAA Automatic Weapons Battalion
637th Coast Artillery (AA) Battalion
638th Coast Artillery (AA) Automatic Weapons Battalion (Separate)

BATTERIES

688th AAA Machine Gun Battery
689th AAA Machine Gun Battery
694th AAA Machine Gun Battery
695th AAA Machine Gun Battery
696th AAA Machine Gun Battery
697th AAA Machine Gun Battery

PLATOONS

6675th Gun Operations Room Platoon
6705th Gun Operations Room Platoon

BRITISH UNITS

19th Antiaircraft Artillery Operations Room
34th LAA Regiment
71st HAA Regiment
88th HAA Regiment
105th LAA Regiment
106th HAA Regiment
142/45 LAA Battery
209/70 LAA Battery
263rd Pioneer Company

FRENCH UNITS

34/411 Regiment
157/411 Regiment
211/411 Regiment (1st Platoon)
413th Regiment

36th Demi Group
50th AA Group
54th Demi Group
55th Demi Group

I question whether any civilian agency of government can match the earnest devotion that men in the armed forces have applied to their duty. And I question whether any civilian agency has offered more faithful stewardship to the American people with sparser remuneration and scantier thanks.—GENERAL OMAR BRADLEY.

THE PULSE JET

By Eugene J. Manganiello

In the Spring of 1944 Great Britain experienced the bloody dawn of the flying bomb era heralded by the warning buzz and subsequent detonation of the German buzz-bombs. The flying buzz-bombs, also called doodle-bugs and robot bombs and, more formally, V-1 for Vergeltungswaffe (reprisal weapon), caused tremendous loss of life and property during the few months of their use. The effectiveness of the buzz-bomb was not only measured in terms of actual physical damage and destruction, but also in terms of the intense nervous strain and apprehension of the inhabitants of the target areas resulting from exposure to that new and mystifying weapon.

Shortly after the first few raids sufficient parts and complete units were recovered to solve the mystery of the buzz-bomb and to understand its operation and performance.

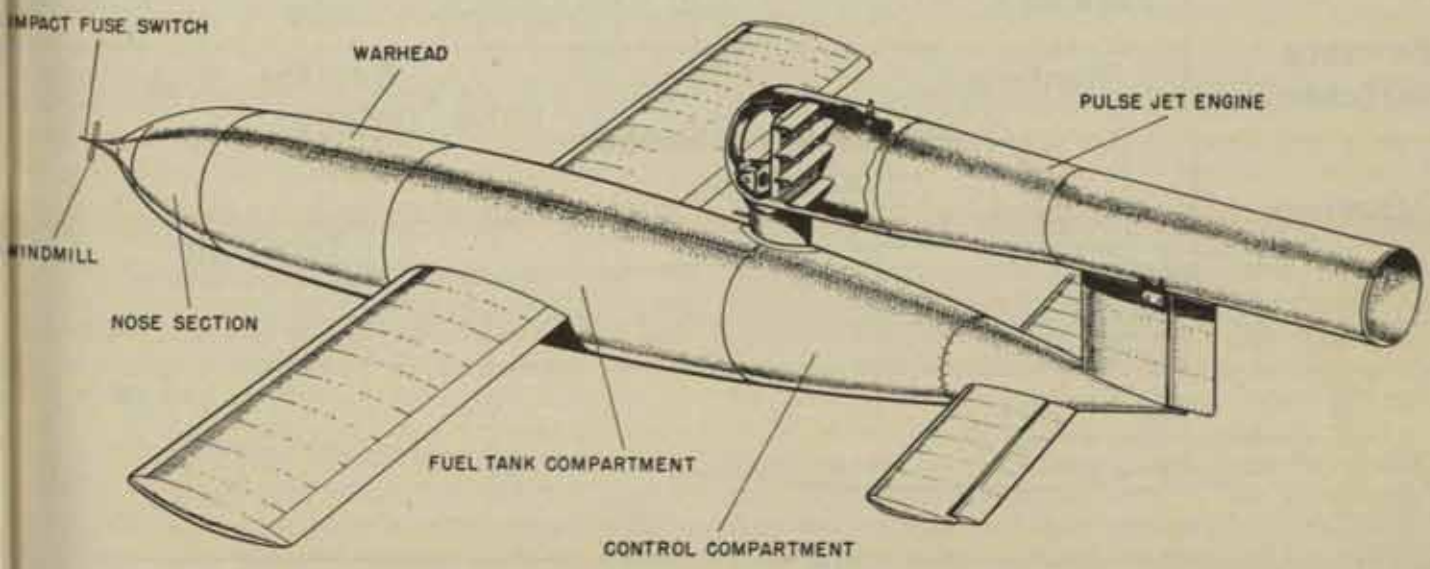
The German buzz-bomb which has a speed of 360 mph and a range of about 150 miles is diagrammatically shown in figure 1. It is a simple but extremely ingenious aircraft built almost entirely of welded mild steel plate. The whole construction is of the simplest and cheapest kind ideally suited to mass production. It has an over-all length of 25.4 feet, a gross weight of 4750 pounds and an empty weight of 1800 pounds. The fuselage is 21.5 feet in length and has a maximum diameter of 2.7 feet. The wing is rectangular with a span of 17.7 feet, a chord of 3.4 feet and a maximum thickness of 15 per cent of the chord. The total wing area is 51 square feet, giving a wing loading of 93 pounds per square foot which is greater than the maximum value used by any conventional aircraft. The high-take-off speed required for this wing loading was achieved with catapults which launched the V-1 at a speed of about 150 mph.

The nose of the fuselage is detachable and contains impact fuses, a magnetic compass, a master gyro and a tiny air-log windmill. Directly behind the nose is the 2000-pound warhead followed by the gasoline tank which is a plain cylinder with domed ends having a capacity of about 150 gallons. The tank is pressurized to 100 pounds per square inch which is sufficient to provide injection of fuel in the power unit. Behind the gasoline tank is a compartment containing two metal spheres for air compressed to 150 atmospheres (2200 pounds per square inch) pressure. This air pressurizes the gasoline tank and operates control gyroscopes through pressure reducing valves. The unusually high pressure is used because no greater weight of metal is required to contain it than would be required in a sphere of twice the diameter, or eight times the bulk, for a pressure one-eighth as great.

The tail portion of the fuselage carries an automatic pilot, three air-driven gyroscopes and height and range setting controls. Attached to it are, of course, the horizontal and vertical control surfaces.

The propulsive unit, or engine, for the V-1 is mounted above and along the rear of the fuselage. This power plant, which is the principal topic of this article, is the pulse jet. Other names commonly associated with it are intermittent ram jet, aeropulse, resojet and other modifications and

Figure 1—The German V-1 Robot Bomb.



combinations of these, all of which serve to describe, in some measure, the mode of operation of the engine. In the German literature the engine is sometimes referred to as the Schmidt-Rohr (Schmidt tube) after its inventor Paul Schmidt. This engine is probably the simplest and most ingenious part of the entire buzz-bomb, and its development is largely responsible for the advent of the pilotless aircraft era. It is a welded steel tube or "stovepipe" about 12 feet long with a maximum diameter of 21½ inches. As illustrated in figure 2 it has a short entrance cowl section that incorporates an internal diffuser followed by a flapper-valve assembly and three horizontal venturi passages formed by airfoil shaped vanes. The valves and venturis are at the entrance of the cylindrical combustion chamber which tapers down to the 15½-inch diameter tail pipe.

The flapper-valve assembly consists of sets of small spring-steel sheets 0.010 inch thick, which are preformed and installed to seat tightly against the ribs of the aluminum grid sections (see detailed sketch in figure 2). The spaces between the ribs form the air passages across the grid sections; the air flow through these passages is controlled by the opening and closing action of the flapper valves. Nine fuel injection nozzles of the centrifugal spray type are distributed over the downstream face of the valve grid and inject finely atomized fuel through the three venturi channels and into the combustion chamber. These channels improve mixing of the fuel and air. Although the engine will operate without them, thrust output, fuel economy and smoothness of operation are depreciated by their omission. A spark plug and compressed-air jets are also provided for engine starting, as will be described later.

Figure 3 is a photograph of the downstream face of the flapper-valve assembly and shows the nine fuel-injection nozzles and three compressed air jets.

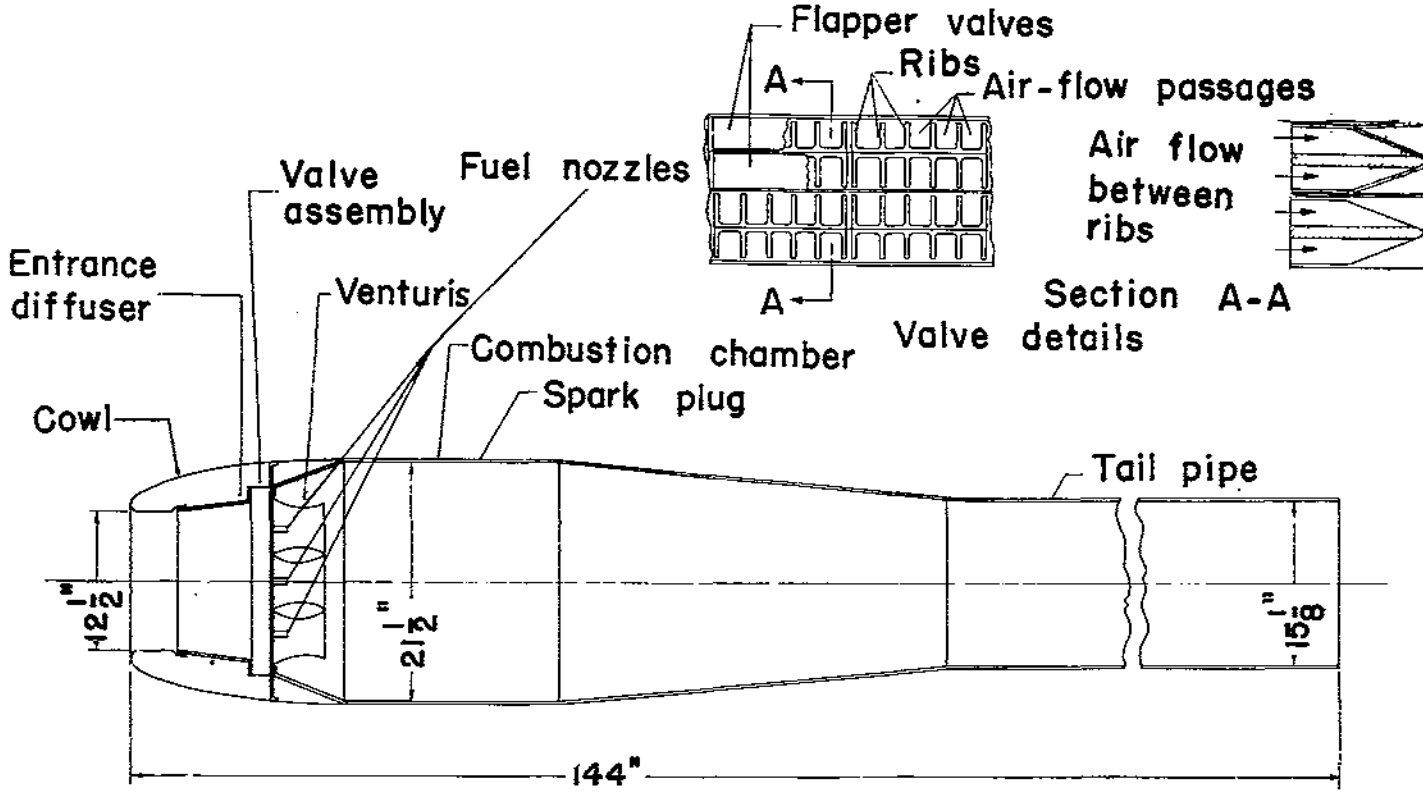
The pulse jet, like the ram jet,* is a compressorless thermal duct engine. It differs in having the barrier of flapper valves to prevent the back pressure during compression from overcoming the ram pressure and blowing the flame out the inlet. The intermittent action of these valves emphasized by reasonance in the tail pipe causes the characteristic buzz and pulsating flame instead of the steady flame of the ram jet.

The propulsive thrust for jet or thermal duct engines is equal to the product of the mass flow of gases through the engine and the difference between the jet and flight velocity. In the case of the ram jet the velocity or momentum of the mass of combustion gas has been increased, producing a force which in turn produces a reaction or propulsive thrust on the ram jet.

One of the principal factors affecting the performance of the ram jet is flight velocity. Increase in flight velocity increases the weight flow of air through the ram jet and increases the pressure in the combustion chamber. The increase in pressure results in increase in jet velocity which in combination with the increased air flow gives rise to increased thrust. Increase in flight velocity also increases the efficiency (i.e. reduces the specific fuel consumption) of the ram jet because of the higher thermodynamic cycle efficiency resulting from the higher pressure or expansion ratio. When the ram jet is stationary no air passes through it and it cannot develop any starting or static thrust. Hence take-off must be accomplished by some auxiliary means such as launching by catapult or with rockets. When the ram jet attains flight velocity it can develop its own thrust; however, it must reach a speed of about 500 mph before it produces sufficient thrust to overcome its own drag.

*See article, "The Flying Stovepipe—How It Works" in January-February 1947 issue of the COAST ARTILLERY JOURNAL.

Figure 2—Details of the V-1 pulse-jet engine.



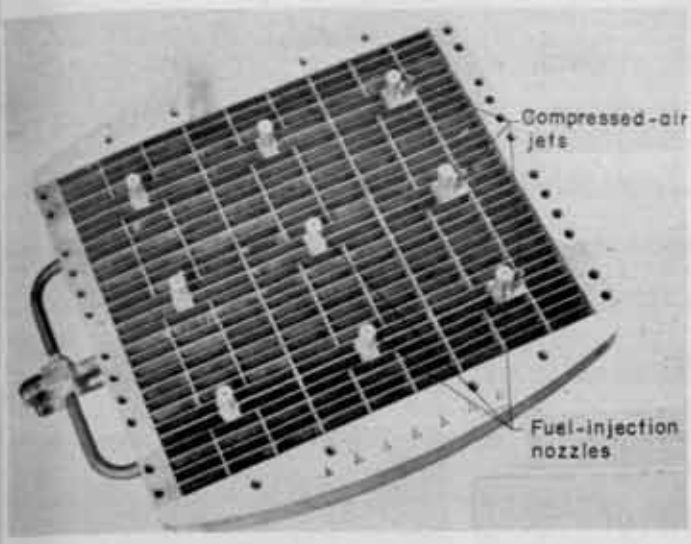


Figure 3—Downstream face of flapper-valve grid assembly.

With this background, let us now examine the operation of the pulse jet, which we will assume is in flight. As with the ram jet the kinetic energy of the air entering the engine inlet is converted to pressure in the diffuser section. The pressure acting on the spring flapper valves opens them and admits air to the combustion chamber. The atomized fuel from the injection nozzles mixes with the air and forms a combustible mixture which is ignited and burned. The increase in temperature of the burning gases raises the pressure in the combustion chamber and shuts the flapper valves preventing further admission of air. Combustion then proceeds at almost constant volume conditions resulting in further increase in pressure. The pressure expands and propels the gases rearwardly through the tail pipe. Once the combustion gases have been put into a state of motion, their inertia tends to keep them moving out of the combustion chamber and causes a depression in pressure.

The reduced combustion chamber pressure assisted by the ram pressure on the upstream side of the valves opens the flappers and admits a new charge of air. At the same time the reduced combustion chamber pressure causes a reversal of flow in the tail pipe such that some of the exhaust gases and air move upstream towards the valves. This reversed flow serves to compress the new incoming charge and, following ignition tends to produce constant volume combustion. The cycle then repeats itself again and again, resulting in a rapid succession of impulses which give rise to the characteristic intense buzzing or pulsating sound associated with the pulse-jet engine. Although the flow of air through the engine and the ensuing jet is pulsating in nature, thrust is produced because the average jet velocity is higher than the average inlet or flight velocity.

When the pulse jet is operating, ignition of the combustible mixture during each cycle occurs through contact of the fresh charge with the high temperature residual gases that remain in the engine from the previous explosion. A spark plug is used to ignite the first charge, but is not required for the subsequent explosions and is usually deenergized as soon as the pulse jet starts operating.

Unlike the steady flow ram jet, the pulse jet may be started statically, that is, when in a stationary condition. In starting, compressed air is introduced into the combustion chamber through the air jets. At the same time fuel is injected through the spray nozzles and the fuel-air mixture is ignited by means of the spark plug. The resulting combustion and pressure rise forces the gases out the tail pipe, and, as in normal operation, inertia keeps the gases moving rearwardly and causes a pressure depression in the combustion chamber. The pressure depression is sufficient to open the flapper valves (even in the absence of ram pressure at the upstream face of the valves) and induce a fresh charge of air. The fresh charge is then ignited by the hot residual gases of the first explosion and operation continues in the manner previously described. The thrust developed by the V-1 pulse jet under such static conditions is not as great as that developed when in flight because the absence of ram pressure causes a reduction in the amount of air flowing through the engine. The thrust produced at rest, which is about 60 per cent of the maximum value developed in flight, could provide for take-off; however, catapults are generally used in order to decrease the take-off distance.

The pulse jet used on the V-1 operates at a frequency of about 40 cycles or explosions per second. This frequency is established by the resonant frequency of the engine tube which, similar to an organ pipe, varies inversely with the tube length, that is, the shorter the tube the higher the frequency. Such being the case, it would appear desirable to cut off part of the tail pipe and obtain a greater frequency of pulsation and perhaps more thrust output. Unfortunately the situation is not quite that simple. Shortening the tail pipe will increase the frequency, but the air induced per cycle will decrease with a resultant decrease in thrust. If on the other hand the tail pipe were increased, the frequency would decrease but so also would the thrust. In other words there is an optimum length for a given diameter engine which results in the maximum performance. The smaller the diameter of the engine the shorter the value of this optimum length and the higher the frequency of operation.

Having obtained a general understanding of the construction and operation of the pulse-jet engine let us now consider its performance. For purposes of illustration we will present a brief summary of the results of an investigation conducted at the Cleveland laboratory of the National Advisory Committee for Aeronautics. The investigation was conducted with a Ford-built replica of the German V-1 pulse jet (figure 2) and the results obtained are representative of the normal performance of this type of engine. For the investigation the engine was mounted on a thrust stand and air was supplied by means of blowers which simulated ram pressures corresponding to flight speeds ranging from 0 to 340 miles per hour at sea-level conditions. Measurements were made of engine thrust, airflow, fuel flow and various temperatures and pressures throughout the engine.

As a supplement to the investigation with the full scale pulse jet, a photographic study was made of the combustion process in the pulse jet. For this study a glass-sided apparatus which permitted duplication of the operating cycle of the pulse jet was constructed and high speed motion pictures of the combustion process were taken. A typical sequence of photographs that illustrates the combustion during one cycle of operation is shown in figure 4. The photographs show the rectangular (34- by 6-inch) combustion chamber window. The vertical black lines are rods used to reinforce

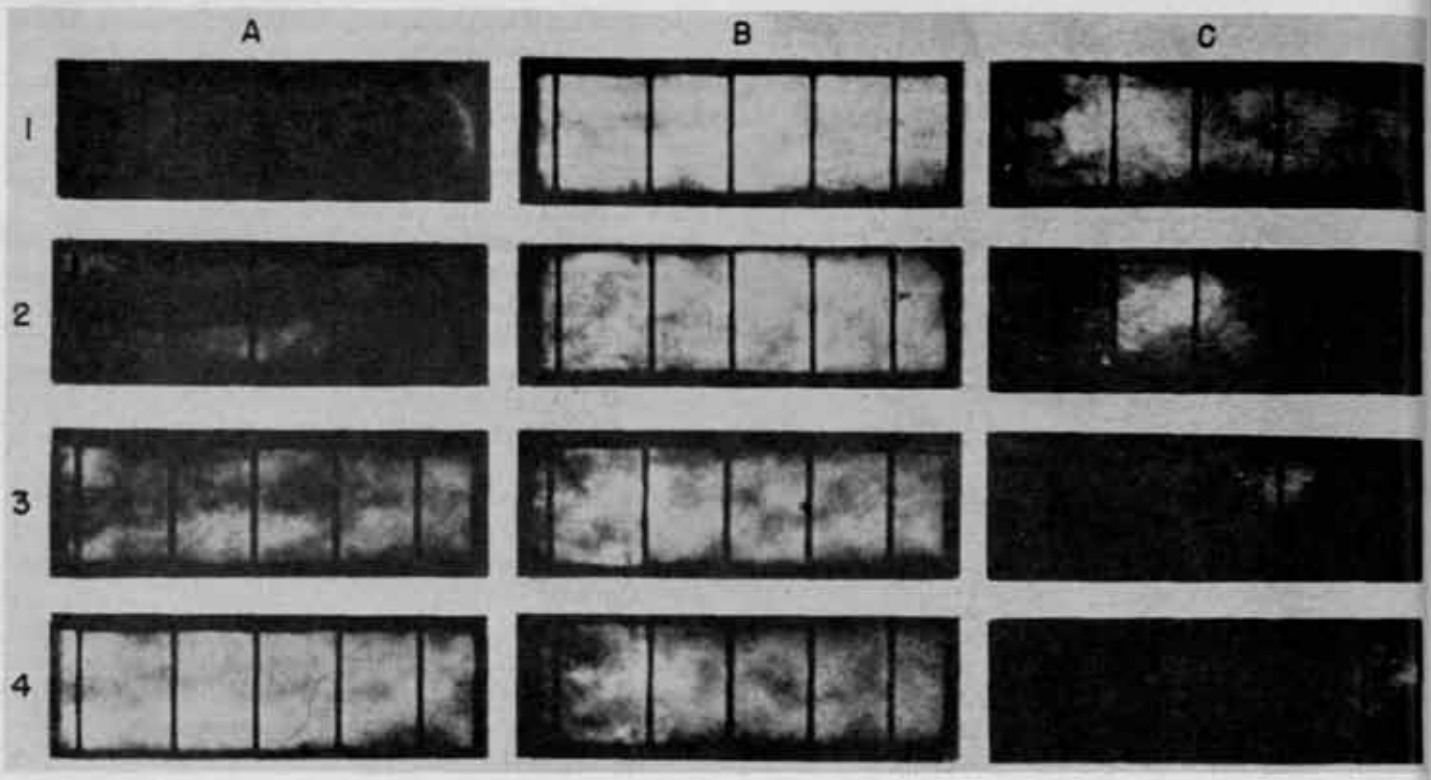


Figure 4—Photographs of a typical combustion cycle.

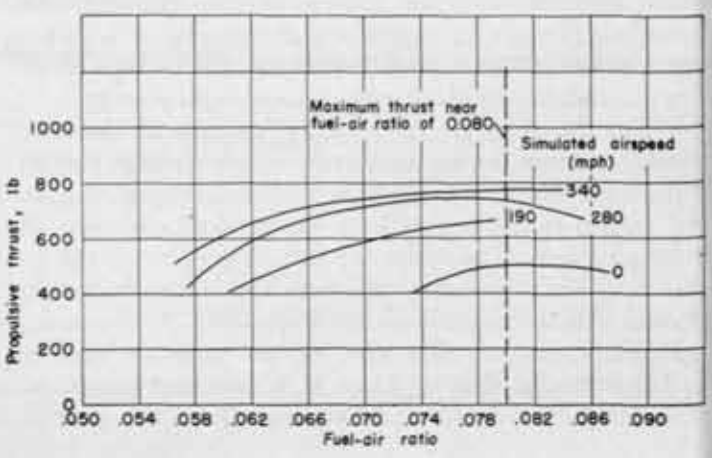
the window. The flapper valves are to the left of the window and the gases flow to the right. The combustion process is illustrated in the frames of column A, a part of the expansion process in column B, and the induction process in column C.

In the first frame of column A combustion has just started in a fresh charge. A small amount of residual flame from the previous cycle which is present in a thin layer at the upper and lower walls of the chamber provides the ignition; combustion then proceeds progressively in towards the center of the chamber in frames 1 to 4. In column B the expansion progresses from the right to the left and in the fourth frame has started a barely noticeable movement toward the right in the gas at the extreme left end of the combustion chamber. In other words the gas at the right which is closest to the tail pipe exit begins to expand and move out first, followed by progressive expansion and movement of the gases at the left or upstream end of the chamber. Once the gas is set in motion, it acts like a mass on a spring and "stretches" or rarefies the gas near the valves, thus reducing its pressure which causes the valves to open and admit a fresh charge of air. The motion of the hot gases ahead of the new charge is shown in the frames of column C wherein the darkening area represents the fresh unburned charge. In the fourth frame of column C, the cycle has reached the same condition as in the first frame of column A and the charge is ready to repeat the cycle.

In figure 5 the net propulsive thrust (neglecting external aerodynamic drag) is plotted against fuel-air ratio for several simulated sea-level flight speeds. Thrust increases with initial increase in fuel-air ratio, levels off and then decreases with further enrichment of the mixture. Maximum thrust occurs at a fuel-air ratio in the neighborhood of 0.08 which is the value at which reciprocating piston-type engines develop maximum power. Thrust also increases with increase in flight speed; at zero speed (static condition) the maximum thrust is 500 pounds whereas at 340 mph the thrust is 780 pounds.

It should be noted that these values of thrust pertain to an engine of the size (21½-inch maximum diameter) and design of that shown in figure 2. It has been found that the thrust is proportional to the cross-sectional or frontal area of the engine, that is, to the square of the diameter. Thus, an engine having twice the diameter of the one under discussion would develop four times as much thrust. It can be seen from a study of the curves that the rate of increase in thrust with increase in flight speed is greater at lower speeds than at higher. Indeed other investigations of similar pulse jets have shown that thrust reaches a maximum value at air speeds in the neighborhood of 350 to 400 mph and then decreases with further increase in speed with eventual nonoperation of the engine occurring at speeds above about 450 mph. The initial increase in thrust with increase in

Figure 5—Variation of propulsive thrust with fuel-air ratio. (Sea-level operation 21½″ diam. pulse jet.)



flight speed is due to the attendant increasing quantity of air flowing through the engine. The subsequent decrease in thrust and eventual nonoperation of the engine at the higher values of flight speed is a result of interference with the resonant operation of the engine.

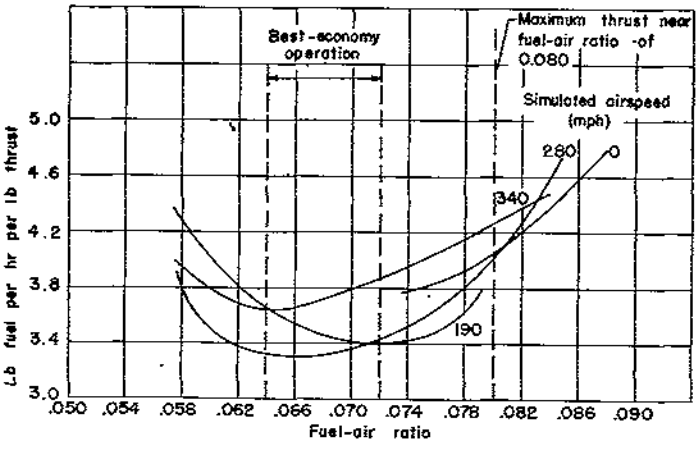
The variation of thrust specific fuel consumption (pounds of fuel per hour per pound of thrust) with fuel-air ratio and flight speed is shown in figure 6. Thrust specific fuel consumption decreases with initial increase in fuel-air ratio, reaches a minimum value and then increases with further mixture enrichment. Best economy, that is, minimum specific fuel consumption, occurs in the region of fuel-air ratios between about 0.064 and 0.072 which is leaner than the mixture for maximum thrust. Comparison of figures 5 and 6 shows, however, that when the pulse jet is operated at the best economy fuel-air ratio, the thrust developed is only slightly decreased from its maximum value. Thrust fuel consumption decreases with initial increase in flight speed but increases at the higher values of air speed. The minimum fuel consumption value shown, 3.3 pounds per hour per pound of thrust, is about three times the values obtained with current turbojet engines. Though the pulse-jet can hardly be considered a particularly efficient propulsion system it does have a much lower fuel consumption than the steady flow ram jet at these relatively low flight speeds and than the rocket at any flight speed.

The thrust horsepower developed by an aircraft propulsion system is equal to the thrust in pounds multiplied by the flight speed in miles per hour divided by 375. Thus our pulse jet engine producing a thrust of 780 pounds at a flight speed of 340 miles per hour develops $780 \times \frac{340}{375} = 710$ horsepower. The thrust specific fuel consumption, in pounds of fuel per hour per pound of thrust, can similarly be converted to power specific fuel consumption in pounds of fuel per hour per thrust horsepower by dividing by flight velocity in miles per hour and multiplying by 375.

The corresponding minimum value of 3.8 pounds of fuel per thrust horsepower is about seven times as high as values attained by conventional reciprocating engine-propeller systems under cruise operation.

As was stated, the foregoing results were obtained at sea-level conditions. Some flight investigations to determine the altitude performance of the pulse jet have been conducted by the Army, and Navy, and several of their contractors. The results of these investigations indicate that the thrust of the pulse jet decreases with altitude up to approximately 15,000 feet in about the same proportion as air density decreases with altitude. Above 15,000 feet the thrust decreases even more rapidly and at altitudes of 20,000 feet and higher the pulse jet ceases to operate. On the other hand the specific fuel consumption does not appear to change appreciably with altitude.

Figure 6—Variation of thrust specific fuel consumption with full-air ratio. (Sea-level operation 21½″ diam. pulse jet.)



The performance values presented above are representative of the pulse jet engine used by the Germans for propelling the V-1 robot bomb and of American units built to approximately the same design specifications. During the past few years, considerable research has been conducted with the pulse-jet engine by the Army, Navy, and NACA, and by private industry under contract to the Army and Navy. As a result of this research effort the thrust developed by a given size pulse jet and the fuel economy have been improved and it is expected that further improvements will be made in the future. One of the phases of pulse-jet research currently being pursued is directed towards extending to higher values the flight velocity range over which the pulse jet will operate. Preliminary results give promise of not only extending the velocity range through the speed of sound (about 760 mph at sea level) but also of increasing the thrust at the higher speeds.

The operating life of the German units was limited to a half hour or less, after which time the flapper valves and attendant engine performance would deteriorate rapidly and eventually fail. The failure of the valves was due to the repeated impact stresses resulting from the rapid striking of the valves against their aluminum seats. This condition has been considerably alleviated by two methods developed in this country. One method consists of coating the valve seats with a thin layer of neoprene and the other method consists of constructing the flapper valves of a sandwich of two layers of thin steel sheets separated by a layer of fabric. Both these methods, which reduce the impact stresses by cushioning the shock, have increased valve life to three hours and more.

The general characteristics of the pulse jet may be summarized as follows: It is extremely simple and inexpensive to construct and does not require the use of scarce material or difficult machining processes. Operations, including static starting, acceleration, throttling and shutdown, are readily effected and control is obtained by simple regulation of fuel flow. The engine will operate on practically any of the common liquid fuels and develops a relatively high thrust per unit engine weight and frontal area compared to other engine types that utilize atmospheric air. On the other side of the ledger we have a relatively short life and high specific fuel consumption, and an extremely serious noise and vibration problem.

These characteristics admirably suit the pulse jet for application to the propulsion of guided missiles, target drones and other pilotless aircraft. At present these applications are restricted to flight velocities below 500 miles per hour and to useful ranges of several hundred miles, however, future development will undoubtedly raise these limits, and provide other applications for the pulse jet.

Guided Missiles And The National Defense

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

Introduction

One thing is certain—the United States will not strike the first blow in World War III! ! ! Of course, you may feel that World War III is a warmonger's dream and will never come to pass. Truly, our efforts should be directed to the end that there will be no more war in this hectic, uncertain world of today. Nevertheless, we dare not allow ourselves to slip back into a position of serene complacency. WE MUST BE PREPARED! ! ! Why? ? The answer to this question was effectively phrased by now retired General Ira C. Eaker while he was Deputy Chief of the Air Force. General Eaker said:

> "Due to the valor of our Allies, we had two years to prepare our defense and to gear our industries in World War II. I doubt if we will have two days next time."

In any plan for the National Defense, each department —the Army, the Navy, and the Air Force—will have its own particular mission outlined. Within the Department of the Army, the Coast Artillery Corps will have its mission defined; and, in the accomplishment of this mission, the Coast Artillery Corps may, conceivably, employ a new type of weapon—the Guided Missile.

Estimate of the Situation

At this point, let us pause and take stock of the defense problem which confonts us. An estimate of the situation lends itself to division into two parts—a more realistic, immediate situation and a more speculative, future situation. We may, for the purpose of discussion, consider these two cases as follows:

Case I—Immediate Situation

Visualize a large bombing raid on the city of New York, or Washington, or Chicago, or Los Angeles—or perhaps all four simultaneously—by conventional bombers similar to our own B-29 Superfortresses. Such an attack is within the realms of possibility when we consider the long-distance feats already accomplished by the B-29 airplane. For instance, on the 13th of November 1947, a combat equipped B-29 set a long-distance flight record of 4,410 miles—and with 670 gallons of gas to spare. Considering this fact, and the fact that larger and longer range aircraft, such as the B-36, are being developed; and also considering the fact that what weapons we have, or will have, we must assume any potential enemy has, or will have, we can readily appreciate that we are not immune from air attack in the United States. If we add to this picture the element of the atom bomb, the possible results of such an air raid render themselves even more appalling and fearsome.

Case II—Speculative Situation

Now visualize, if you can, a long range guided missile similar to the German V-2 missiles which were launched against London during the latter stages of World War II. However, this newer and more advanced missile may have a range of at least ten times that of the V-2 (the range of the V-2 was 150-300 miles) and perhaps even greater. Of course, such a missile may be ten to fifteen years off. Nevertheless, if such a missile of the future were to have the same accuracy as the V-2, and, furthermore, if such a guided missile were to carry an atomic warhead, no part of the United States would be safe from a destructive attack.

Having visualized the manner in which we may, conceivably, be attacked by an enemy, we can appreciate the fact that we must have an adequate program of national defense. The major phases of this defense may include the following:

1. An accurate and detailed intelligence of the military and scientific activity of potential enemies in order that their hostile actions may be anticipated—the time, the method, and the weapons of attack.
2. A warning system to detect the approach of enemy aircraft or missiles and to activate our defensive forces.
3. The development of weapons capable of intercepting and either destroying or repulsing the enemy force before it reaches its objective.

The last phase, the development of defense weapons, includes the development of guided missiles. Therefore, it behooves officers of the Coast Artillery Corps to be aware of the potentialities of the guided missile as a defense weapon.

Possible Solution of the Defense Problem

Let us go back to Case I—a raid, or raids, by long range bombers of the conventional type. Let us assume that the bomber formation has been detected by long range radar and is being tracked, or followed, in its progress toward its target—thus the position of the enemy is known and the defense team can go into operation. First, our Air Force may dispatch piloted interceptor type jet-propelled planes to attack the enemy formation. These interceptors might use the

conventional type of armament, such as the 50 caliber machine gun which proved so effective in World War II; however, these interceptors might, instead, utilize air to air missiles (AAM) which can be guided at high speeds toward their target and may furthermore, be launched at a range beyond that of certain types of defensive armament of the enemy. An example of this type of missile is the German "X-4" missile (*Fig. 1*) which is a fin-stabilized guided missile with a proximity fuze warhead weighing approximately 45 pounds. This missile is propelled by a liquid rocket engine and can attain a maximum speed of approximately 550 mph. The guidance of this particular missile is accomplished by wire control by an operator in the launching aircraft who can relay azimuth and elevation control signals up to a range of approximately 1.5 miles. Actually, this missile will probably prove to be a crude forerunner of the air to air guided missiles of the future which will travel faster, farther, and more accurately to their targets.

Experience during World War II indicated that, in the face of a determined enemy, no bombing raid could be stopped completely by an aerial defense and that some aircraft would get through to the target area. Therefore, we must assume that such will be the case in future operations of this type. And so, as the enemy aircraft approach the target area, the ground defenses must necessarily take over the defense problem. What types of weapons will the ground defenses (CAC) employ? They may use the present and, perhaps, improved type of antiaircraft artillery such as were used in the past war; but, also, they may employ a surface to air guided missile type of antiaircraft weapon. The Germans had developed this type of weapon also, although not to the point of operational use, before the end of World War II. This German missile is the Wasserfall (*Fig. 2*), which is a wing-borne, fin-stabilized, rudder controlled, flak rocket. The Wasserfall resembles a half-size V-2 missile, except for wings, and was to be launched vertically from the ground, reaching a maximum speed of 1565 mph in approximately 45 seconds. The missile was to be radio-controlled from the ground until it approached the enemy bomber formation, at which time a self-contained homing system was to assume control and direct the missile into the enemy formation. A warhead of 670 pounds was to be detonated by a proximity fuse. The guiding control problem delayed the scheduling for operational use of this missile to about May 1946, just one year too late. However, the future will, in all probability, contain the solution to the guidance problem, and, in addition, will probably bring forth missiles which are even more uncanny and destructive in performance.

Now let us go back to Case II—an enemy attack by guided missiles. First, we have the problem of detecting any such enemy missiles as soon as possible since they will be traveling at supersonic speeds. If we are to use the German V-2 as a criterion, the speed of these missiles may be in the magnitude of 3600-5000 mph. However, assuming that we can detect the enemy missiles shortly after they are launched, we must ourselves launch surface to air missiles (SAM) to intercept the enemy missiles before they can come within a destructive range. This problem is complicated further by the fact that these enemy missiles need not be launched from surface bases, but can be carried by aircraft to within shorter ranges—perhaps 1000 miles or less—and then launched as air to surface missiles (ASM). In this latter case, the aircraft formation carrying the missiles can approach as near the target area as possible and yet remain beyond the reach of our defensive interceptor aircraft and ground defenses before launching their missiles. The problem of interception is, therefore, rendered even more difficult because of the shorter time interval in which to accomplish the launching of our counter-missiles for interception. Thus, you can readily appreciate the magnitude of the defense problem posed by the threat of an enemy attack by guided missiles.

Problems To Be Solved

Having established the type of defense required to repulse the hypothetical attacks described, let us now look at the problems which are associated with the development and the employment of guided missiles as weapons of defense.

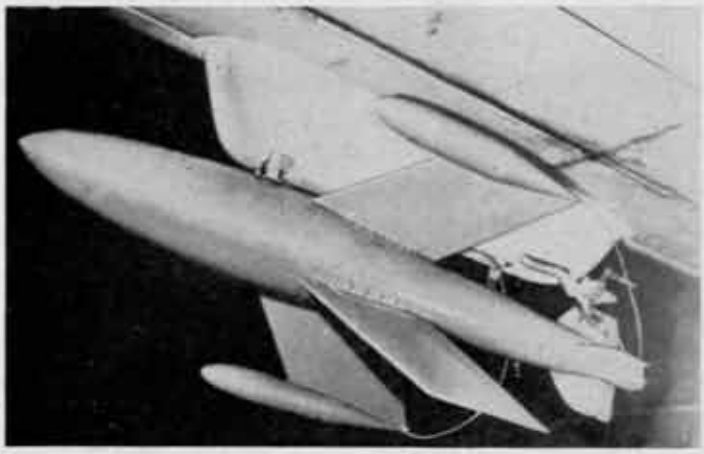
Propulsion

Propulsion is one of the major problems encountered in the development of guided missiles. The fact that guided missiles will be jet propelled may be assumed to be a certainty. However, the avenues of investigation leading to the development of satisfactory propulsion systems branch out in several directions—the ram-jet, pulse-jet, turbo-jet and rocket engine developments. From this assortment of engines, one, or several, may be developed with a sufficiently high specific impulse to provide the power, acceleration, speed, and range performance characteristics desired.

What is specific impulse? Simply, it may be described as the "oomph" factor or the "kick" produced by the engine. It is defined as the pound-seconds of thrust per pound of fuel consumed, and it is proportional to the square root of the ratio of the absolute temperature of the gases in the combustion chamber to the molecular weight of the gases. Obviously, the ideal condition would be to have a fuel which, upon combustion, would produce the highest absolute temperature possible and, at the same time, have a low molecular weight.

Present day combustion temperatures are roughly 4000°-5000° absolute. However, the problem of raising the combustion temperature is limited not only by the characteristics of the fuel itself but also by the material and structural limitations encountered in the construction of engine com-

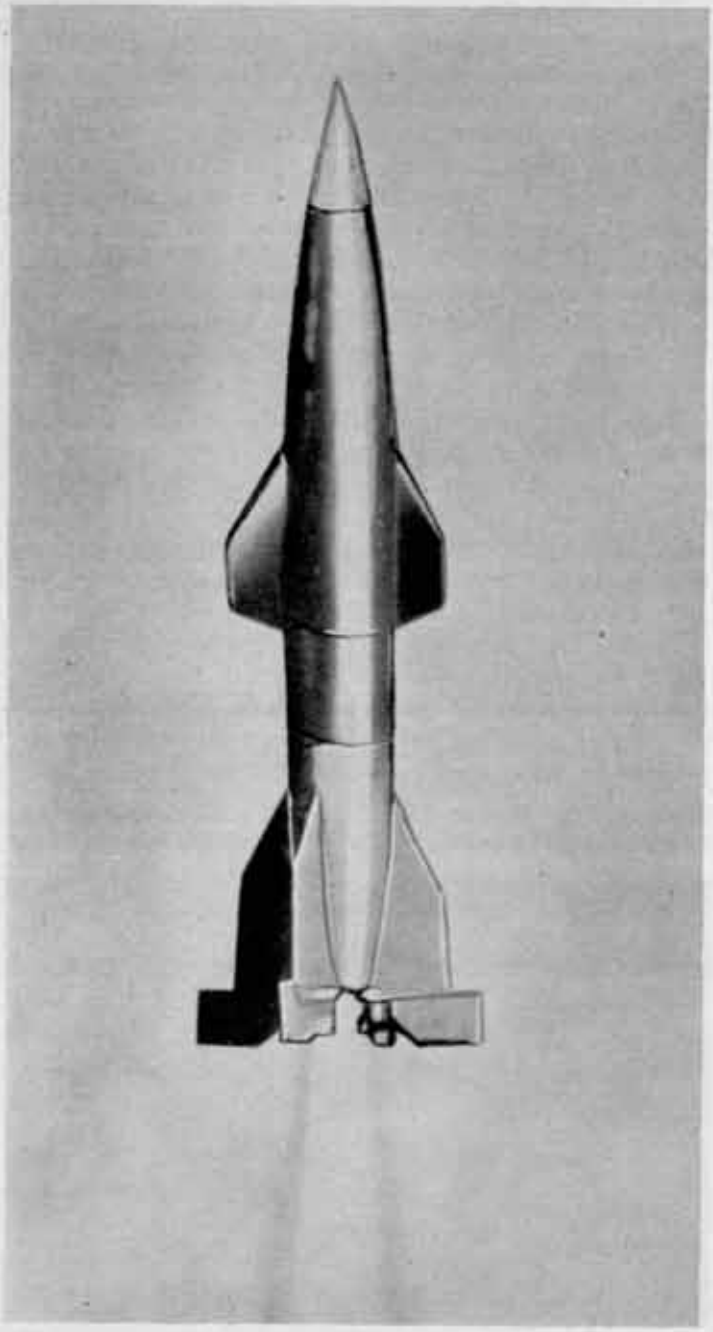
Figure 1—The German "X-4," a liquid rocket, fin-stabilized, air to air guided missile armed with a proximity fuze warhead.



bustion chambers and exhaust nozzles capable of withstanding higher temperatures. Therefore, corollary problems of engine design to withstand higher temperatures must be solved. Possibilities along this line include the following:

1. *Regenerative Cooling* of the combustion chamber and the exhaust nozzle—This may be accomplished by circulating the fuel through a jacket around the combustion chamber and nozzle prior to its injection into the combustion chamber. This method of cooling is limited inasmuch as the maximum amount of heat which may be absorbed by the fuel depends on its heating capacity and the maximum temperature to which it may be heated before it becomes chemically unstable.
2. *Sweat Cooling*, as the name implies, is a method of cooling by injecting a propellant through the porou material of the inner surfaces of the combustion cham ber and exhaust nozzle. In this method, the fuel in injected through the porous material forms a liqui film on the inner surface. The heat of the fuel com bustion causes this film to evaporate thereby produc ing a cooling effect and reducing the heat transfer t the combustion chamber and the exhaust nozzle Thus, this principle of cooling is the same as that em ployed by Nature in cooling the human body.
3. *Ceramic Coating of Metals*—Since certain liquid pro pellant fuels become chemically unstable at high tem peratures and cannot be used in the process of regen erative liquid cooling, the possibility of developing metals and materials to withstand higher temperature must be investigated. One method of protecting the metals from the high temperatures is by reducing th amount of heat transmission to these metals. This ma possibly be accomplished by the application of ceramic coatings to the surfaces of metal parts exposed to the high temperatures.

Figure 2—The German "Wasserfall," a wing-borne, fin-stabilized, rudder controlled, surface to air guided missile.



Assuming that we have conquered the material and structural limitations discussed, we are then confronted by a fuel limitation. Present day "know how" in the field of combustion indicates that the maximum absolute temperature obtainable by the combustion reaction of known propellants is about 6000° absolute. Therefore, the next logical step in improving the specific impulse of potential power plants would be to investigate the possibility of using the various known propellants either singly or in pairs in order to arrive at a propellant which will provide exhaust gases with a lower molecular weight.

Present day propellants for certain power plant applications have a specific impulse in the neighborhood of 150-225 lb. secs. of thrust per lb. of fuel. However, in the years to come, the promotion of the various sciences and the solution of the propulsion problem just discussed may provide us with propellants of a much higher specific impulse. This possibility seems even less remote when we consider the fact that the vast field of atomic energy for propulsion has yet to be explored.

Guidance

Without guidance there can be no guided missile! ! ! A guided missile is effective only if it can reach its target. To reach its target, the missile must have a guidance system which works. The problem of guidance, as previously mentioned, prevented the Germans from putting their antiaircraft missile, the Wasserfall, into operational use. Today, guidance still looms as the foremost single problem to be solved in the development of guided missiles.

The requirements of an effective guidance system are that the missile can be controlled accurately in its course to the target over a long range, and that the guidance system cannot be jammed and rendered ineffective by enemy countermeasures. The development of guidance systems lends itself to division into three parts:

1. Initial Guidance.
2. Midcourse Guidance.
3. Terminal Guidance.

This division of guidance into three phases is a logical one when we consider the distinctive functions of each particular phase. The first phase, initial guidance, is required from the instant that the missile is launched to the time that the second phase, or midcourse guidance, assumes control. The initial guidance system has an important task to perform in that it must get the missile off to a good start—that is, it must insure that the missile is directed to the area in which the midcourse guidance beam can pick the missile up for the second phase of guidance. The initial guidance will probably employ automatic steering techniques much like those utilized in the operation of the autopilot on conventional aircraft. The initial guidance system must not only orient the missile in the proper direction of flight, but also it must provide stability of the missile with respect to roll and spin so that the technicians controlling the missile's flight from the ground station will know which control surfaces will produce an up or down motion and which will produce a left or right motion of the missile. However, if the missile is allowed to spin like an artillery shell, in order to achieve spin stabilization of the missile, some means must be provided for switching the control signals to the proper control surfaces. You can see that even initial guidance, although the simplest of the three phases, is no cinch.

The initial guidance system having successfully guided the missile in its first phase of flight, the midcourse guidance system will then pick up the missile and direct it over the major portion of its trajectory to the target area. Such midcourse guidance will probably rely on electronic means such as radio or radar. There are several ways in which this control may be achieved. Some general types of systems which offer possibilities for use are the following:

1. *Command System*—Commands are transmitted to the missile by electronic means from operators on the ground. The missile receives the command signals and executes them.
2. *Direction Along a Beam System*—The missile once placed on a radar beam follows that beam to the target.
3. *Direction By a Navigational Net*—Loran, Shoran, or other types of electronic navigational systems which may be available, transmit data to a computer in the missile which automatically interprets the information received and makes corrections to maintain the prescribed direction of flight.
4. *Celestial Navigation System*—A computer automatically interprets celestial fixes by electronic means and makes corrections to maintain flight of the missile in the desired direction. In other words, this system continuously and uncannily performs the job of the captain of a sailing vessel. It "shoots the stars" and then makes adjustments to maintain its course.

After the midcourse guidance system brings the missile into close proximity with the target, the third phase, or terminal guidance system, goes into action. The terminal guidance, or homing system, is self-contained within the missile and may be actuated by some characteristic property of the target such as heat, light, sound, radar reflections, or perhaps electromagnetic waves emanating from the target. The purpose of such a homing system is to direct the missile into the target. If the target is a moving one, such as an aircraft or a missile, the homing system will cause the missile to follow the target even though it may be engaged in evasive actions. You can appreciate the difficulty of the problem of developing a homing system operating on only one of the characteristics such as heat, light, sound, etc. This difficult problem is aggravated by the fact that several types of homing devices will have to be utilized in a single operation since the enemy will probably develop countermeasures against homing control systems. Also, no single type of homing is effective against all types of targets. Thus, future development will have to be spread among several systems in order to insure the availability of a homing system which will do the job required and will not be rendered ineffective by enemy countermeasures.

It is simple for us to state what initial guidance is, what midcourse guidance is, and what terminal guidance is. However, the matter of designing and developing the equipment to perform the essential task of guidance is staggering in its complexity. Some of the problems which present themselves are:

1. Automatic Control Problems—Components such as gyros, servo motors, power supplies and computers must be designed for special characteristics such as small size, light weight, high accuracy and incentivity to acceleration.
2. Techniques of Electronics Guidance—In order that missiles may be guided at long ranges, radio and radar with greater range, higher accuracy and greater response speed are required. Among the sub-problems involved are the development of electronic tubes of higher power and the development of improved antennas and scanning methods. Undoubtedly, new radical concepts of electronic guidance are required to achieve the ultimate goal desired.
3. Terminal Guidance System—Two major problems in the development of homing systems are the attainment of sufficient range and the attainment of discrimination of the target from the target background. Furthermore, these two requirements must be achieved with lightweight, sensitive, and accurate mechanisms.
4. Computing Mechanisms—Computing mechanisms will be used for calculations in many types of guided missile systems. At present, the design of computers has reached a fairly high state of development. However, additional research is required to reduce the weight of such equipment and to increase its accuracy.

We have treated the many and varied problems of guidance only in a general way since the subject has numerous technical ramifications. Figure 3 is intended to give you a schematic idea of one possible method of missile guidance.

Countermeasures

By definition, a countermeasure is an action taken to prevent the enemy from completing a program of attack that he has already set in motion—or vice versa, of course. Thus, to design a countermeasure we must be aware of the principles of operation and the capabilities of the system which is to be neutralized. Various types of countermeasures may be used. For instance, in the case of conventional aircraft and low speed missiles such as the German V-1 "buzz

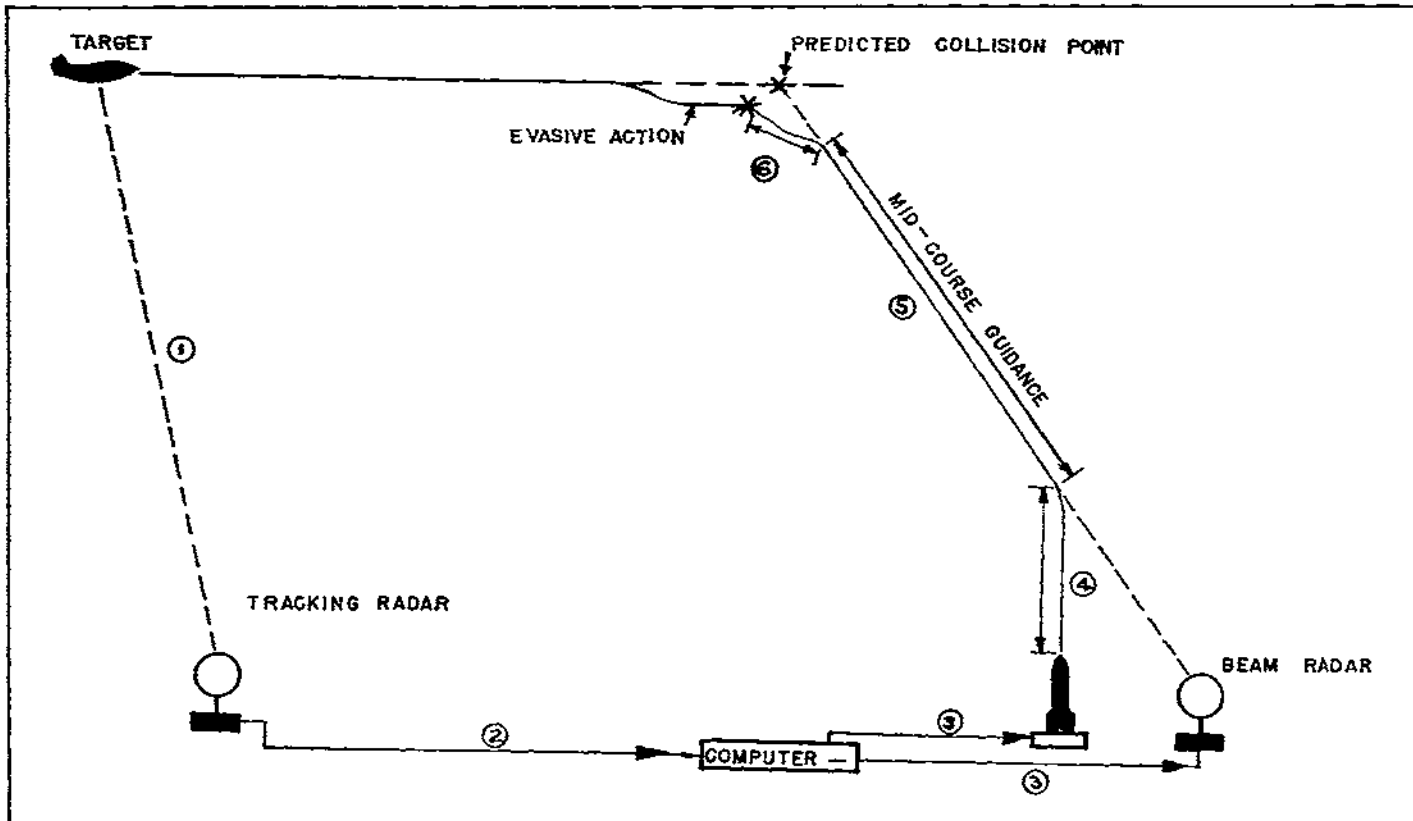


Figure 3—Schematic diagram of one possible method of missile guidance.

bomb," we may effectively employ fighter interception, anti-aircraft fire, and barricades such as cables strung up by barrage balloons as countermeasures. In the case of high speed electronically controlled missiles, electronics jamming techniques might prove effective. This type of jamming may be accomplished by transmitting radio or radar wave energy of the same frequency as that being utilized by the enemy.

If the missile is one which employs a homing system utilizing radar reflections, heat, light, or sound characteristics of the target, then false heat, light, sound, and radar reflections sources may confuse the homing device and may succeed in attracting the missile to the false target.

Not only are we confronted with the problem of developing countermeasures against enemy aircraft and missiles, but also we are confronted with the problem of neutralizing the countermeasures which the enemy may apply to our own missiles—in other words, countermeasures for countermeasures. Nor will we, necessarily, stop at this point, for it is possible that the enemy may devise a countermeasure to our countermeasure to their countermeasure to our system. Confusing isn't it? You can imagine, then, how complex the technical problems involved in the development of countermeasures can be.

Early Warning System

As the speed of aircraft and missiles increases, the time-space factor between any two points on the surface of the earth will shrink. For instance, at a speed of 250 mph, an aircraft or missile would require twenty hours to travel 5000 miles. Comparatively speaking, this would provide our defenses with ample time to initiate countermeasures. However, at a speed of 3600 mph (speed of the V-2) a missile would require only about an hour and a half to travel the same 5000 miles. Thus, from the standpoint of defense, every minute will count since each minute will bring the enemy missile sixty miles closer to our cities and homes. Obviously, supersonic enemy aircraft and missiles must be detected as soon as possible. It is apparent that early warning radar equipment must be maintained in continuous operation to insure maximum safety from a sudden and unexpected attack.

Radar detection equipment such as that used in World War II is inadequate to perform the mission of early warning since it is too short in range and too complicated to operate and to maintain. Considerable impetus must be given to the development of newer and better detection systems. An ideal situation might be to have the defense perimeter of our nation surrounded by a ring of automatic and semi-automatic early warning stations which would be simple to maintain and which would not require the constant attention of humans in their operation.

Obviously, much research and development will be required to provide defense network which will knit together all of the units of defense and put them into action at the

earliest possible moment. With the threat of an atomic attack imminent we must have a system which will provide 100 per cent effective interception of enemy aircraft or missiles.

Conclusion

We have attempted to provide you with an insight into the problem of national defense in the coming age of the guided missile. Because of the secret nature of the details of the national research and development program we cannot cite the specific action being taken to fulfill the requirements of national defense. We have attempted merely to summarize our own personal theories with the hope of stimulating your own thought on this subject.

Before closing, we must point out one of the biggest problems of all—money! It is going to take money—and plenty of it—to develop electronic guidance and early warning systems; to build extensive test facilities, such as test ranges and supersonic wind tunnels; and to design and test experimental guided missiles. The total cost of this program will probably reach figures which appear astronomical. Under a peacetime economy, it probably will be difficult to obtain such huge allocations. Even you may ask, "Is such a costly program really necessary?"

If we are to have guided missiles and a defense system which will insure our national safety, it is necessary. Each of the remaining major powers of our world—Russia, Great Britain, and the United States—is active in this field of development. Perhaps, you recently read the following excerpt in your local newspapers:

> "Munich, Germany, Dec. 10—German scientists employed by the Soviet have shot a V-2 type missile 3600 miles in a little less than an hour. At a shorter range of 1740 miles, repeated experiments have established that the weapon can be dropped within a bull's-eye with a diameter of six-tenths of a mile. . . ."

Do you think that we can afford to neglect our own guided missile research and development program?

Automatic Ionosphere Recorder

A new instrument for automatic recording of ionospheric phenomena, which are of great practical importance in radio propagation, has been developed by the Central Radio Propagation Laboratory of the National Bureau of Standards. Now in operation at the Bureau's ionospheric research station at Sterling, Virginia, the prototype Model C2 Recorder was completed in time to participate in the recent Army Air Forces-National Geographic Society Eclipse Expedition in Brazil, where, in addition to special records during the May 20 eclipse of the sun, valuable data were obtained on general ionosphere conditions. An analysis of this information will add to the fundamental knowledge of the ionosphere, a series of ionized layers in the atmosphere 50 to 250 miles above the earth.

Long-distance radio transmission would be impossible if it were not for this outer envelope of the earth, the ionosphere, which reflects radio waves back to earth. The wide fluctuation in ionosphere characteristics, that is, changes in its degree of ionization due to varying amounts of ultraviolet light from the sun, causes radio propagation to vary daily, seasonally, and over the sunspot cycle. By systematic analysis of these changes over the entire surface of the earth, the National Bureau of Standards predicts ionospheric conditions three months in advance. Such predictions permit accurate calculation of the best radio frequency to use at any given time between any two points on the earth, information which is important to the Federal Government, the Army and Navy, and the communications industry as a whole. The new recorder will aid in this prediction service as well as in basic research by providing data on ionosphere characteristics through automatic and continuous measurements of critical frequency, and the heights of the various layers. Plans are now being made to install recorders in all the ionosphere stations operated by the Bureau.

The Model C2 recorder was designed to utilize the so-called multi-frequency technique of investigating the layers of the ionosphere beginning at sixty and extending to more than one hundred miles above the earth's surface. Pulse transmissions are used similar to those employed in radar, except with varying probing frequency. The frequency is plotted against the time delay of the echoes from the ionosphere, an interval corresponding to twice the height of reflection. One sweep in frequency from the lower to upper limits produces each ionosphere record in a time interval of as little as 7½ seconds.

Location Of Mortars By Radar

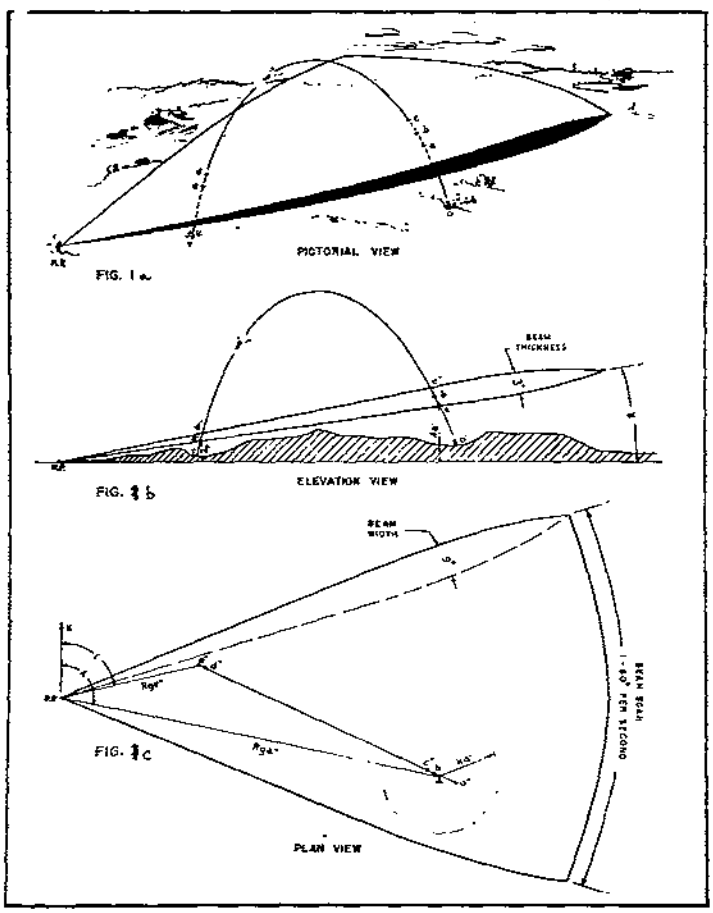
By J. T. Evers and W. P. Goldberg

INTRODUCTION

The mortar, a small and unspectacular weapon, has never received any great attention by newspapers or magazines, although it was perhaps one of the deadliest weapons of World War II. The Allies became aware of the tactical efficiency of this weapon early in the war and by the end of 1943 they had assembled sufficient statistical information to show that enemy mortar fire was extremely effective; so effective that in practically every battle area, well over 50% of Allied casualties were directly attributed to enemy mortar action. These statistics were sufficient to place the development of counter-mortar devices in a top priority category.

The originator of the idea that radar might be of use in the location of mortars is unknown; certainly echoes from shells had been observed by the operators of the earliest types of fire control radars and it is known that experiments were carried on in England, in the latter part of 1943, with the specific objective of determining the strength of the echo from a British 3″ mortar bomb.

Figure 1—Principle of mortar location used by AN/TPQ-3.



High priority radar mortar locator research in the United States was well under way by August 1944. The Signal Corps Engineering Laboratories, Fort Monmouth, N. J., were assigned the task of providing radar mortar locators for the Army Ground Forces, with Radiation Laboratories, Massachusetts Institute of Technology, serving in an advisory capacity. The efforts of the Signal Corps Engineering Laboratories were divided into two main categories:

(a) *Interim measures,* which involved an investigation of the capabilities of existing radar equipments.

(b) *New developments,* which included the design of specialized equipment for mortar location.

The Signal Corps mortar location program, which was personally led by Lieutenant Colonel John H. DeWitt, Jr., then Director of Evans Signal Laboratory, Signal Corps Engineering Laboratories, resulted in the production of the Radar Sets AN/TPQ-3, AN/TPQ-4, and the modified SCR-584 as interim measure sets, and the development of a new and specialized mortar location radar. The work involved in selecting, modifying, and testing these sets was prodigious; included the assembling and operating at Island Beach, N. J., of all available radar equipment having possibilities as mortar locators, the firing and observation of thousands of rounds of mortar ammunition, and the correlation of a tremendous volume of data, all necessarily accomplished under the pressure of high priority field needs.

Characteristics of The Weapon

Investigation into the problem of mortar location first centered on the characteristics of the weapon. It was found that the types of mortar shells ranged from the small Japanese knee-mortar, approximately 50mm, through the 60-mm, 81mm, and 4.2 inch, and included the big Berthas discovered on islands hastily turned over to the Marines by the Japanese. However, the majority of the mortar fire involved the use of 60mm, and 81mm ammunition. Except for minor changes in fin shape and fuze characteristics, the 60mm and 81mm ammunition of the enemy was similar in physical appearance to that of the Allies.

An investigation into the flight characteristics of the missile revealed a number of interesting details, i.e., initial angle of fire variable from 45° to 85°, time of flight as great as 30 seconds, subsonic velocities, maximum range approximately 4,000 yards, and parabolic character of flight path.

It was learned that an expert mortar crew could put as many as ten shells in the air at one time, placing them with remarkable accuracy, and then be on the move to a new location. The need was emphasized for absolute and speedy location based on the first observed round of fire.

PRINCIPLES OF OPERATION

The techniques devised for mortar location were divided into two general categories:

(a) one-point, relative location,
(b) multiple point, absolute location.

The principle of mortar location by the one-point system, category (a), was extremely simple. No absolute map location of the enemy mortar was obtained; instead, radar observation established one point on the trajectory of the enemy missile during its upward flight. This point was marked on the radar oscilloscope. Counter-mortar fire was then observed by the same radar, and fire corrections were made until the echo from the counter missile appeared at the marked spot on the oscilloscope screen. When this condition was established, the counter missile was following, to a first approximation, the reverse path of the enemy shell. A surprising accuracy in the laying of counter-mortar fire has been achieved by this method. Radar Set AN/TPQ-4 (modified AN/APS-3) which was one of the first pieces of equipment considered in England, utilized the one-point principle of location.

The category (b) principle of mortar location had many variations, including continuous tracking systems, such as the modified SCR-584; the multiple point systems, represented by the AN/TPQ-3, and the two-point systems, represented by the new Specialized Mortar Locator. The basic principle used with all these sets was the same, i.e., if enough accurate points were obtained on the trajectory of a missile, a space curve could be drawn which, when extrapolated back to an intersection with the ground plane, would determine the position of the enemy mortar.

AN/TPQ-3

The AN/TPQ-3, one of the first sets to be used for locating mortars, was the only mortar locator classified as standard by Army Ground Forces. It consisted of an AN/TPS-3, modified to improve its accuracy. As this set had no means for positioning its antenna in elevation, its locating technique depended entirely on azimuth and range data. In operation as a mortar locator, the set was usually sited behind a low hill in such a way as to screen out as much ground clutter as possible and yet allow the mortar shell to be picked up fairly close to the ground. A sector was scanned until a mortar shell echo was noted by the operator. The azimuth and range where the mortar echo first appeared and the azimuth and range of the point where it was last visible were recorded and plotted to scale. The line joining these points represented the ground projection of the trajectory. To find the position of the mortar it was necessary to extend this line backward from the first plotted point. The amount by which it was extended was determined by solving the geometric problem shown in figure 1.

RP represents the position of the radar and points a and e in figure 1a are the points where the echoes from the mortar shell were first and last seen. The azimuth and range of a and e were obtained from the radar and plotted as a″ and e″ in figure 1c. The height ha′ in figure 1b, was determined from the equation

$$ha' = Rga'' \sin \propto$$

where Rga″ was the range to point a and $\propto$ was the vertical angle of the beam. The angle $\propto$ could be approximately determined from the height of the antenna and the slope of the ground in front of it. However, it was usually found experimentally by shooting a friendly mortar straight up at some distance in front of the antenna, and timing flight to the point where the echo first appeared on the PPI screen. Having found the height ha′, the simplest method of finding the distance a″o″ was to assume that the angle of fire of the mortar was 65°, which represented a good average, and that the trajectory was a straight line between the point of origin and a. This gave

$$a''o'' = \frac{ha'}{\tan 65^\circ} = \frac{Rga'' \sin \propto}{\tan 65^\circ}$$

Since tan 65° was a constant and the angle $\propto$ was a constant, for any particular site, this calculation could be made very rapidly. It was then only necessary to extend the projection of the trajectory a distance a″o″ back from point a″ to locate the mortar positions. Of course any difference in altitude between the radar and the mortar position would affect the value of h and had to be taken into account. This difference of altitude was usually taken from a contour map of the region.

SCR-584 (Modified)

When the SCR-584 was first used as a mortar locator, all plotting was performed manually. A sector was scanned until an echo appeared that was identified as being from a mortar shell, at which time the operator positioned the antenna directly over the spot where the echo first appeared and set the range gate to the proper range and waited. When the echo from a second shot appeared, the set was placed in automatic track status and the range, azimuth and elevation dials were read and recorded periodically on a given signal as the radar tracked the shell. The range and azimuth data were plotted to scale and a line drawn through the points produced a straight line which was considered

Figure 2—Mechanical plotting board RC-308 for use with SCR-584.

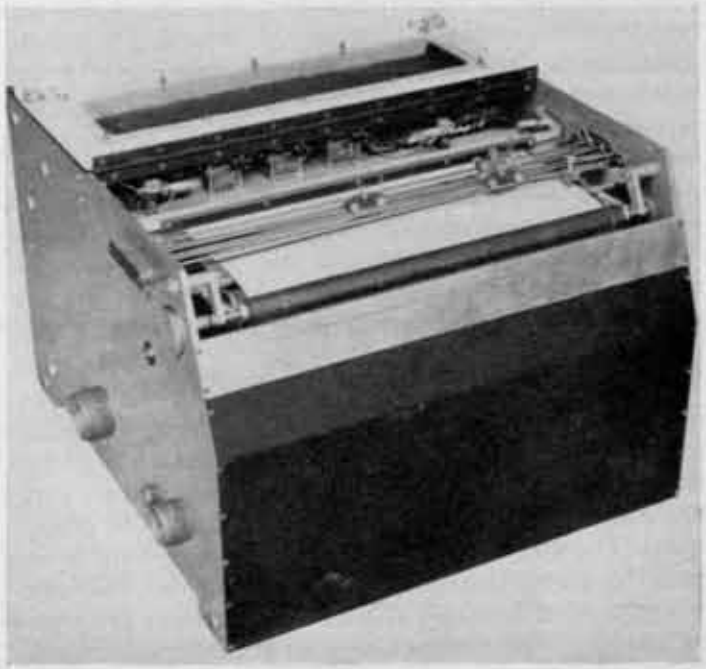


Figure 3—Antenna system of production model of a new mortar locator.

as the ground projection of the trajectory. The range and elevation readings were used to compute the height and this information was plotted to an arbitrary scale perpendicular to the range-azimuth line. A parabola curve was then fitted to pass through the height plots and was extended back from the first point until it intersected the range-azimuth line. This was the position of the mortar. Any difference of altitude between the radar and the mortar position had to be accounted for either by adjusting the values of the height plots or by extrapolating below the range-azimuth line if the mortar position was below the radar plane and above the range-azimuth line if the mortar position was above the radar plane. This difference of altitude could be found from a contour map.

Another method of plotting was later developed which eliminated the uncertainty involved in extrapolating the range-height parabola. This system depended primarily upon the fact that the height versus time curve of any free falling missile was a parabola of constant shape, independent of its angle of fire or propelling charge. Use of this method required careful timing of the interval between two points as well as very accurate determination of their coordinates and in addition called for a quite complicated calculation. The complications in the calculation were finally eliminated by constructing a nomogram, but this method remained considerably more time-consuming than the first method.

Things were speeded up considerably and hand plotting eliminated entirely by the development of two types of automatic plotters. The first was a two-pen electronic plotter and computer which used one pen to plot x and y coordinates, and the other to plot height versus integrated ground speed. The plot of height versus integrated ground speed could be extrapolated back to zero height, thus determining the mortar location. The extrapolation was performed by using an overlay containing a set of predrawn parabolas of various shapes, and fitting one of these to the trajectory. Timing was provided by a mechanism which periodically lifted both pens from the paper for short intervals, leaving blank spots in the curve.

The second plotter, the RC-308, was a considerably more simple device. Three selsyn driven pens recorded azimuth, height and range on a sheet of paper. The paper was pulled at a constant speed in a direction perpendicular to the pen movement, thus plotting all three quantities against time. The height-time plot was then a parabola of constant shape and could be extrapolated back to its starting point at zero time—the time the mortar was fired—by means of an overlay with only a single curve. The point of zero time having been established, the azimuth and range could also be extrapolated back and the mortar position located. In both of these plotters, it was again necessary to take into account any difference in altitude between the radar and the mortar position.

The New Specialized Mortar Locator

The technique for this locator was based on utilization of an operating wavelength of 1.25 cm to obtain a narrow beam width while at the same time retaining rather compact equipment. By using a very narrow beam and providing a relatively small shift in beam positions, two spaced points on the initial part of the trajectory can be established, hence a straight line extrapolation through these points should provide accurate locations of the enemy mortar.

DESCRIPTION OF EQUIPMENT

AN/TPQ-3

The AN/TPQ-3 consisted of a modified AN/TPS-3 plus certain additions to provide more accurate range and azimuth data.

When the AN/TPS-3 was converted to the AN/TPQ-3, several minor modifications were made; the 20-mile range on the PPI scope was converted to a 10,000-yard range, and the sweeping mechanism converted to produce OFF-center PPI operation. No changes were made to the A scope since it was not used in mortar locating. The sweep selsyn in the antenna pedestal was replaced with a small data transmission selsyn.

In addition to these simple changes, a completely new piece of equipment called a control unit, was developed. This unit contained an accurate range unit and an accurate azimuth indicating device with a built-in sector scan switch. Each of these units was mounted on a separate chassis which could be easily removed for servicing.

SCR-584

In the unmodified SCR-584, the azimuth and elevation indicating dials at the operator's position gave only coarse readings. That is, they were connected 1:1 with the antenna. These were reconnected to the 16:1 selsyns on the antenna and new scales were provided so that they read 400 mils per revolution. The remote indicating dials were also reconnected and provided with new scales to give coarse readings. The only other modifications were the addition of an automatic sector scan kit and the revision of the PPI to produce a 10,000-yard sweep.

Later on, automatic plotting boards were added for

greater accuracy. The first of these boards was an almost purely electronic device; a very bulky, heavy piece of equipment which required the facilities of a separate truck. The size somewhat cancelled the advantages resulting from the increased accuracy, so steps were taken to develop another plotter that would be much smaller and lighter. The second plotting board to be developed was a simpler device which plotted mortar height, range and azimuth against time. Mortar location could be determined in less than a minute after the shell had been tracked.

AN/TPQ-4

The AN/TPQ-4 was, basically, an AN/APS-3 modified for ground operation with auxiliary precision ranging and azimuth marking circuits added.

New Specialized Mortar Locator

The development model was designed and constructed by Bell Telephone Laboratories in conjunction with Signal Corps Engineering Laboratories in six months; an outstanding performance even in wartime. (Figure 3.) Azimuth scanning was accomplished by means of a Lewis scanner. The Lewis type of scanner was considered to be mechanically superior to the Foster scanner and therefore more desirable for field use. Vertical directivity was accomplished by the use of another Bell Telephone Laboratory development, the metal lens. The pencil beam produced by the complete antenna system was approximately 0.6° in the vertical plane and 1.0° in the horizontal plane; extreme directivity in the vertical plane was desirable in order to permit the positioning of the beam at a low angle, (the accuracy of the two point system was predicted on the ability of the radar equipment to detect the mortar shell at low elevations). Azimuth, elevation, and range data were supplied by inter-connection and servo mechanisms so that when the operator set the azimuth and range cursors on the mortar shell echoes, as seen on the oscilloscope, mortar location was automatically computed. Provisions were also available by means of which the mortar location could be recomputed if map references indicated that the mortar was higher or lower than the radar set. As a protection to the personnel, suitable cabling was provided to permit operation at a distance of 300′ from the antenna system.

MAXIMUM RANGE

The maximum range of detection for the various radars was determined by observation of a large number of mortar firings. This range varied somewhat depending upon the aspect and size of the shell. The following figures are presented as being representative:

Equipment	*Maximum Range*
New Specialized Mortar Locator	4,000- 5,000 yards
AN/TPQ-3	10,000-12,000 yards
AN/TPQ-4	3,000- 4,000 yards
SCR-584	7,000- 9,000 yards

ACCURACY

Having determined the range at which each of the sets could be used most effectively, the next step was to determine the accuracy with which they could locate mortars. To do this, operation under simulated tactical conditions was necessary. The radar operators were told to search a sector which represented the front lines and mortars were fired from several positions that were accurately surveyed, but unknown to the operators. A great many rounds of ammunition were expended and the location data from each set were compiled by statistical methods. These tests were repeated at many different sites since it was known that the accuracy of both the AN/TPQ-3 and the SCR-584 was affected by the screening angle and therefore depended on the terrain.

The results of these tests indicated that under average conditions, the AN/TPQ-3 could locate a mortar with an accuracy of ± 50 yards, i.e., the data would place the mortar as being in a circle with a radius of 50 yards, centered on the actual mortar position. The SCR-584, on the average, could cut the radius of error in half, i.e., to a circle of 25-yard radius. The New Specialized Mortar Locator was capable of cutting this error approximately in half again. It could locate mortars as being within a circle of 15-yard radius. The AN/TPQ-4 could not be compared with the other three sets because it was used exclusively for correcting the fire of a counter mortar or counter battery, and did not actually give the coordinates of the enemy mortar; it was sufficiently accurate, however, to be useful under certain conditions.

TACTICAL CAPABILITIES

After the range and accuracy tests had been completed, the next step was to evaluate each set tactically and determine the conditions under which it could be used most effectively. To do this, many other things besides range and accuracy had to be taken into account. Some of these were, weight and size, transportability, ease of camouflage, susceptibility to jamming, and operation under confusion fire conditions. All but the last of these considerations had already been determined from the physical characteristics of the sets or from previous tests, so that it was only necessary to test the sets under confusion fire conditions. These tests included rapid fire from a single mortar, with as many as eight shells in the air at the same time; simultaneous fire from a battery of four mortars in various configurations and spacings; other types of artillery firing into the sector being searched; and aircraft flying into the area being searched. It was found that all four sets when operated by trained personnel were not too greatly affected by any of these conditions. The worst confusion resulted from simultaneous fire from a battery of mortars. Even then, all sets could locate the complete battery with accuracy and a good operator would often succeed in locating individual mortars.

PROBLEMS ENCOUNTERED

During the field tests of the four sets, many new problems cropped up. The worst of these, at least for the AN/TPQ-3 and the SCR-584, was ground clutter. At the short ranges that were employed in mortar location, reflections from objects on the ground sometimes completely covered the PPI screen. Tilting the antenna upward did not help very much because these reflections were usually so strong that they could even be seen with the antenna pointed straight up. Of course hilly or mountainous country aggra-

vated the condition greatly. It was found that the only effective means for eliminating at least some of this clutter, was to site the sets behind a low hill. This had the effect of screening out most of the clutter without affecting the mortar shell echo, because the mortar, having a high firing angle, projected the shell high above the surroundings. Of course the accuracy was adversely affected to some extent since the echo would first become visible, when the shell entered the beam, at a point high above the ground. However, the sets were calibrated in terms of accuracy versus screening angle, so that the operator knew what accuracy to expect at any given site.

Bad interference was obtained at S as well as X and K bands during rain; and at K band and to a lesser extent at X band, troubles were encountered due to echoes from birds and insects.

SHELL ASPECT

In conclusion, the fact should be mentioned that the echoing characteristics of mortar shells proved to be by far the greatest limitation associated with mortar location. Experimental radar observations, later corroborated by laboratory measurements, showed that the mortar shells had an echoing characteristic which was both frequency sensitive and aspect sensitive. The shells behaved very much in the same manner as would a wire several wavelengths long; a few degrees change in the aspect of the shell could, under certain circumstances, change the effective echoing area by a factor of 100 or greater.

Noteworthy contributions have been made to the development of mortar location by personnel of Radiation Laboratory, Bell Telephone Laboratories, Ohio State University Research Foundation, and Signal Corps Engineering Laboratories among others. Special mention should be made of the work of Mr. M. J. Test, formerly 1st Lieutenant, Signal Corps, for his efforts in organizing and running the Field Trials at Island Beach, and compiling and analyzing the enormous quantity of statistical data.

EXTRACTS FROM A LECTURE*

By General Sir William Slim

I have enumerated a formidable list of the basic qualities our higher commander should possess—strength of will, soundness of judgment, flexibility of mind, integrity of character. You will not have failed to observe that none of these is the sort of thing that it is easy to teach. Indeed, there is a great deal of doubt whether they can be taught at all. It is, at any rate, certain that the later in life their inculcation is begun the more difficult it becomes. I believe myself that the seeds of all these qualities are planted, if they are planted at all, in the child, long before he grows up, by his parents, his home influence, his schooling and his early religion. Later in adolescence and manhood, given the opportunity, they can be developed, but it is no use watering the ground if the seed is not there.

Our first problem, therefore, in the production of higher commanders is not one of training, but of selection—how to get hold of the youth who is a potential leader. Can we spot him while he is still at school? We might make a guess in a boarding school, perhaps, but school values, with their scales weighted on one side towards academic distinction and on the other towards athletic prowess, too often do not correspond to achievement in later life. Top boys are not always top men, and it is astonishing how often the fellow who was undistinguished at school rises high in the world.

As long as Conscription is in force, the problem of getting the potential leaders into the Services is simplified because, automatically, we get a cross section of the youth of the country—good, bad and indifferent. All come. This, although I have never heard it mentioned as such, is from the Services' point of view one of the greatest benefits of Conscription because, somewhere in the herd, under our hands, are the future champions. It is for us to recognize them, persuade them to adopt the profession of arms, and give them the opportunities to develop.

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Rockets And Their Fuels

Part Two: The Liquid Fuels

By Willy Ley

General Considerations

Prior to 1940 the main argument advanced in favor of liquid fuels for rocket propulsion was that any liquid which burned at all was superior in energy content to black rocket powder. The use of liquids would automatically lead to much higher exhaust velocities and thrusts.

Because of the introduction of double-base powders in very large thickwebbed grains and the development of fuels like GALCIT 53, this argument is no longer as forceful as it was before the war. It is still true that liquid fuels have a higher energy content than even modern rocket powders, but the gap has narrowed considerably and it may be closed completely as a result of future research on solid rocket propellants.

But even an "ideal" solid rocket fuel can do no more than increase the force with which a rocket propels itself. It cannot change the inherent characteristics of a solid fuel rocket and it cannot overcome its essential drawbacks. These drawbacks do not count too heavily if the rocket is used like artillery, but they become apparent if the rocket is to be large, and especially when it is contemplated to use it for the transportation of humans.

One of the main drawbacks of a solid powder charge of any kind is that nothing can be done once the propelling charge has been ignited. There is no way of turning off a solid fuel rocket nor can the rate of burning be controlled, except by initial design. And since "combustion chamber" and "fuel tank" are one and the same thing, any explosion which may take place will always affect the total of the still unburned fuel supply.

In a liquid fuel rocket, the problem of turning it off after ignition is reduced to the problem of closing a valve in the fuel line. Likewise the adjustment of the rate of combustion can be handled by properly designed orifices through which the fuel has to pass, by control valves and other means. If there should be an explosion in the rocket motor it can affect only the amount of fuel which happens to be present in the combustion chamber at that particular instant. Even if the flame could go back through the fuel line, which it can't, nothing spectacular would happen since fuel and oxidizer are in separate tanks and cannot burn until they are brought together.

Liquid fuel rockets also have the advantage that they have no size limit while such a limitation exists for solid fuel rockets, especially for the unrestricted burning type. During wartime experimentation, it was found that in long rockets of this type, the gases generated at the rear end (near the exhaust nozzle) had a tendency to choke off the flow of the gases generated farther forward. While it would be rash to say that solid fuel rockets have already reached their size limit, there can be little doubt that they are close to it.

Most important, however, is that solid fuel rockets cannot have a high mass-ratio (ratio of total weight to weight less fuel). The take-off mass of a rocket (M_O) is composed of the mass of the rocket itself (M_R), the mass of the payload carried (M_P), for example a warhead or instruments, and the mass of the fuel (M_F). For good performance, with a given M_P, it is essential that M_F be as large as possible and M_R as small as possible.

As we have seen in the first part of this article the burning pressure of a JATO unit charged with GALCIT 53 is on the order of 1800 lbs. per square inch. The burning pressure of ballistite is usually still higher; naturally the whole rocket, except for its warhead, must be able to withstand the highest likely burning pressure plus a reasonable safety margin. This calls for thickwalled and heavy combustion chambers.

In a liquid fuel rocket, the pressure in the combustion chamber is on the order of 300 lbs. per square inch. In small liquid fuel rockets, say up to a take-off weight of two tons or thereabouts, the fuel tanks have to be pressurized to an internal pressure somewhat higher than that prevailing in the combustion chamber. But a tank wall which has to withstand an internal pressure of, say, 350 lbs. per square inch can obviously be much lighter per square foot of surface or cubic foot of volume than one which has to withstand 1800 lbs. plus per square inch. And this straight comparison does not even consider the fact that the tanks of the liquid fuel rocket stay at a reasonable temperature, while the walls of the solid fuel rocket have to withstand heat as well as internal pressure.

If the rocket is large enough, it may carry a turbine driven fuel pump for forcing the fuels from the tanks into the combustion chamber. Then the tanks can be still lighter, because they do not have to be pressurized.[1] The switch from pressurized tanks to non-pressurized tanks with fuel pump is not desirable, of course, unless the tank weight thus saved is greater than the weight of the fuel pump, its driving turbine and whatever auxiliary mechanisms might be needed.

[1]The tanks of the V-2 rocket are pressurized to a small extent, partly in order to assist the fuel pumps, but mainly to prevent the collapse of the tanks themselves at a time when they are nearly empty and the acceleration is highest.

With the aid of such fuel pumps the mass-ratio

$$\frac{\text{Rocket plus Payload plus Fuel}}{\text{Rocket plus Payload}} = \frac{M_0}{M_1}$$

of about 3.5:1 could be achieved in the V-2 rocket. Liquid fuel rockets with pressurized fuel tanks can have at least a mass-ratio of 2: 1.

Principles of Fuel Selection

Since the velocity which a rocket will attain at the moment its fuel is exhausted (neglecting air resistance) is equal to the product of the exhaust velocity and the natural logarithm of the mass-ratio, it is quite obvious that the fuel with the highest exhaust velocity is the logical choice if high performance is required.

Actually a very large number of gas-generating reactions of liquid chemicals can be used for rocket propulsion. Some are straight oxidations with oxygen in the pure state, others are somewhat more complicated reactions with chemicals rich in oxygen, as for example hydrogen peroxide (H_2O_2), or nitric acid (HNO_3). The best starting point for a discussion on fuel choice is a table of theoretical exhaust velocities which has been published by Dr. Sänger.

Table of Theoretical Exhaust Velocities of Liquid Fuels

Fuel	Theoretical exhaust velocity "c" in feet per second	
Oxygen supplied in the form of O_2		
Methane	14730 ft/sec.	(16420)
Benzene	14010 "	(15770)
Gasoline	14620 "	(16280)
Alcohol	13730 "	(15220)
Carbon	14190 "	(15770)
Hydrogen	16970 "	(18600)
(The exhaust velocities in brackets are theoretically valid if the oxygen is supplied in the form of $Ozone_3$)		
Oxygen supplied in the form of N_2O_5		
Methane	13040 ft/sec.	
Benzene	12020 "	
Gasoline	12950 "	
Alcohol	12310 "	
Carbon	12640 "	
Hydrogen	14790 "	

The various fuels listed on the table require greatly varying amounts of oxidizers per unit weight of fuel. It can be seen that the theoretical exhaust velocities of the various fuels (with the same oxidizer) are all of about the same order of magnitude except for pure hydrogen which would present great practical difficulties at the present moment. In comparing these theoretical exhaust velocities, it must be remembered too that the best existing liquid fuel motors of today actually produce only about half of the values listed. This, of course, further reduces the differences. Therefore it may be said that for the more likely fuels, the actually obtainable exhaust velocities do not differ sufficiently at the present moment to influence the choice of a specific fuel appreciably. The choice will be dictated by other factors.

The following list of desirable characteristics applies both to the oxidizer and the fuel proper:

(1) Low Price.

(2) Abundance of raw materials.

(3) Availability. This is not quite the same as point (2). One may imagine a fuel which would be cheap if mass-produced and which may be derived from abundant raw materials or by-products of other industries. But there may simply have been no need for this particular substance eleswhere, hence neither facilities nor techniques for manufacturing exist.

(4) Stability in Storage. This requirement is, of course, purely relative since any substance which can be used as a fuel or as an oxidizer must be inherently unstable.

(5) High density. This facilitates handling and keeps the size of the rocket tanks smaller, thereby improving both mass-ratio and air resistance.

(6) Non-toxicity. While a toxic substance might be chosen if it has superior qualities in other respects, non-toxic fuels will prove less expensive in storage and handling.

(7) Low density exhaust. The lighter the average weight of the gas molecules composing the exhaust, the higher the exhaust velocity.

(8) Non-toxic exhaust. This is an important and often overlooked consideration since a toxic or corrosive exhaust blast would impede the health of operating personnel, ruin other equipment and require expensive countermeasures.

(9) Convenient freezing and boiling points. The liquids should be in that state within the operational temperature range that may be encountered, i.e. they should not boil at temperatures below 110° F. and not become solids at temperatures above —40°F.

(10) High specific heat. The temperatures generated within the combustion chamber by these high energy fuel combinations is far above the melting point of metals which can be used for the chamber walls. The heat must be dissipated by a liquid coolant. Obviously, this should be one of the propellant liquids and should have reasonably good thermal conductivity.

Of the various combinations tested and actually used not one has shown itself to conform to all ten of these requirements but several have proven their practical usefulness. Since the same oxidizer may be used with various fuels, the following is arranged by oxidizers rather than by fuels.

The Oxygen-Fuel Combinations

From the point of view of combustion, the best oxidizer is of course, oxygen itself which also happens to fulfill most of the foregoing requirements. It is relatively cheap, more than abundant, available, non-toxic and of reasonably high density (1.15 when liquid). That it does not have a high specific heat is unimportant since the job of cooling the motor can fall to the fuel. It is transparent, like water, but slightly bluish. Because its boiling point is extremely low, about —190°C. its vapor pressure at ordinary temperatures is high. The same precautions and the same amount of experience needed for handling water safely at temperatures

more than 200°C. above its boiling point are also required in handling liquid oxygen. If kept in vented containers, it is absolutely harmless without the slightest danger of explosion. If the quantity is large and the container is heat insulated, loss through the vent is relatively small. Small or poorly insulated quantities are likely to "boil dry"—without damage to the container, however. Small spatterings on clothing or even on bare skin can be disregarded.

Liquid oxygen can be used with a wide variety of fuels; historically the combination of liquid oxygen and gasoline was the first to be tested. Professor Robert H. Goddard operated a rocket motor on a test stand with that combination on 1 November 1923. The first ascent of such a rocket took place on 16 March 1926 in Auburn, Mass.

The first experiments of the German Rocket Society used the same combination in Spring and early Summer of 1930 without any knowledge of Professor Goddard's work which was not published until six years later. The reasoning then was that the fuel for the rockets should be something that was available anywhere even though a widespread availability of liquid oxygen appeared doubtful at that time. Liquid oxygen and gasoline rocket motors performed satisfactorily on the test stand, where the motor could be cooled by running water. However as experimentation progressed, it was found out that a closed cooling jacket with water was insufficient for rockets that rose from the ground. Professor Goddard seems to have experienced similar difficulties and apparently tried to overcome them by a great excess of gasoline.

The engineers of the German Rocket Society considered injecting water into the combustion chamber through a separate injection nozzle since it was known that neither the oxygen nor the gasoline could serve as a coolant.[2] It was hoped that the water and gasoline could be mixed well enough to be injected through the same nozzle. This was a vain hope. Moreover, one weight unit of gasoline requires 3.5 weight units of oxygen for complete combustion while alcohol requires only two—and the mixture stays mixed. Alcohol was chosen as the rocket fuel. At first, the mixture was made quite watery, about 50% by volume, since much of the cooling was to be accomplished from the inside by injection. But because such watery mixtures were hard to ignite, the older idea of placing the motor inside the fuel tank was revived in a modified form in which the fuel, with an admixture of water, was led into the cooling jacket and injected into the combustion chamber from the cooling jacket.

The German experimenters who continued to work under Hitler then found out that the water admixture not only improved the cooling characteristics but actually improved performance. The exhaust consists of carbon dioxide (CO_2) and water (H_2O). By adding water to the fuel the relative number of H_2O molecules was increased, the average molecular weight of the exhaust gases decreased and the exhaust velocity thereby increased. The optimum mixture was found to be around 75% alcohol to 25% water as beyond that the exhaust velocity fell off again because of an excess cooling effect. This mixture in the V-2 produced an exhaust velocity of about 7000 feet per second.

[2]Attempts to put the motor directly inside one of the tanks led to explosions.

The combination of liquid oxygen and methane was tried successfully only once to the author's knowledge and that was by Johannes Winkler in March 1931. It is questionable whether the somewhat higher energy content of methane outweighs the difficulties caused by having to handle two liquefied and cold gases.

Dr. Eugen Sänger, then of the University of Vienna, ran a long series of rocket motor tests in 1932-33, using oxygen and light fuel oils. The results were good but very high injection pressures were required which can be produced conveniently only in ground tests.

The most powerful chemical fuel of all is the combination of oxygen and hydrogen which could be boosted some more by supplying the oxygen in the form of ozone but the practical difficulties are as unpleasant as the combustion equation is attractive. Liquid hydrogen has a boiling point still far lower than that of liquid oxygen (about −252°C.) and its specific gravity is low even in the liquid state, being near 0.7. A liquid hydrogen, liquid oxygen rocket therefore would need rather bulky and well insulated tanks and would be a proposition of "fuel and fire" without any delay. In addition to that, the cooling problem looks almost insurmountable, since neither of the two components is suitable as a coolant.

Because of the practical difficulties presented by liquid hydrogen, some attention has been paid to compounds which are very rich in hydrogen. *Ammonia* (NH_3) has the advantage of being well known and readily available. It should also produce a high exhaust velocity, but it is toxic and must be confined under pressure to remain liquid at ordinary temperatures. In addition, it cannot be used as a coolant for the motor. *Hydrazine* (N_2H_4) is a liquid at room temperature, but cannot be used as a coolant. *Hydrazine hydrate* ($N_2H_4.H_2O$) looks promising in many respects, with a density about the same as water, a melting point below −40°C. and a boiling point of 118.5°C. It can probably be used as a coolant and can be mixed with water, but its performance when pure is not likely to be much superior to the far cheaper and more readily available ethyl alcohol. The latter remark also applies to fuels such as *ethyl ether* ($(C_2H_5)_2O$), *methyl alcohol* (CH_3OH), *propargyl* (C_3H_4O), etc. They are all usable substances, with generally good characteristics, but fail to surpass ethyl alcohol to an extent which merits attention.

Some hydrides of metals, however, are worth detailed investigation, for example *boron hydride* ($B_{10}H_{14}$) and *lithium hydride* ($(LiH)_2$) which might produce exhaust velocities not far below that of hydrogen itself. Whether these high-hydrogen compounds are suitable otherwise could only be determined by experimentation.

The Hydrogen-Peroxide Fuel Combinations

Because of the difficulties presented by liquid oxygen and liquid gases in general, an intensive search to replace oxygen has taken place. One of the obvious substitutes for oxygen was hydrogen peroxide (H_2O_2) on which the Germans did a very large amount of research. Originally the main difficulty was that peroxide could be obtained only in rather weak watery solutions as more concentrated solutions were considered very dangerous since they often seemed to explode without apparent cause.

It was found, however, that detonations of strong solutions of H_2O_2 were caused either by impurities or by inadvertent contact with substances acting as catalysts, for example copper and copper alloys. By keeping strong solutions pure within a few parts per million (not counting the 10-15% water, of course) and by using containers of pure aluminum, copper-free nickel alloys, etc., the Germans succeeded in making it reasonably safe.

The decomposition of H_2O_2 takes place according to the formula.

$$H_2O_2 \rightarrow H_2O + \frac{1}{2} O_2$$

which releases enough heat to heat the products of the decomposition to about 950°C. For this reason, H_2O_2 can be used as a rocket fuel by itself if it is sprayed into the combustion chamber simultaneously with a catalyst which causes the decomposition to take place. Such catalysts are sodium or potassium permanganate, used in strong watery solutions. (This system is utilized in the V-2 rocket for driving the turbine of the fuel pumps.) The exhaust consists of steam and free oxygen.

Considered solely as an oxygen carrier, H_2O_2 is not too enticing; even a hundred per cent solution would release only 47 per cent of free oxygen for combustion. The Germans used their "T-Stoff" as an oxygen carrier in the Walter rocket motor which powered the Me-163b interceptor fighter. The same motor was contemplated for the project *Natter*, a piloted interceptor missile. The fuel used was alcohol with an admixture of about 20 per cent of hydrazine hydrate which, being a fuel itself, acts as a catalyst for the decomposition of hydrogen peroxide. The rocket motor could be designed without provision for ignition devices because of this catalytic fuel. Although Hellmuch Walter would have preferred a smaller admixture of hydrazine hydrate, 20 per cent was the smallest percentage which would prove reliable ignition. However, this poor result is fully compensated for by the decomposition heat of H_2O_2 itself. Hydrogen peroxide has been used as an oxygen carrier for burning gasoline, but in spite of Walter's glowing descriptions of its safe characteristics (*N.A.C.A. Techn. Memo No. 1170*) the feeling seems to prevail among most rocket experts that it still cannot be trusted completely.

The Nitric Acid Fuel Combinations

Another substitute for liquid oxygen is nitric acid (HNO_3) which will release 63.5 per cent of free oxygen for combustion. It is not a generally known fact that the use of nitric acid for rocket propulsion is historically about as old as the use of liquid oxygen and alcohol. The first to use nitric acid was the German solid fuel expert, Friedrich Wilhelm Sander of Wesermünde, who was willing to admit the superiority of liquid fuels but insisted (apparently without even trying) that liquid oxygen could not be handled.

During the second World War, the use of nitric acid was energetically pursued by the Jet Propulsion Laboratory of California Institute of Technology. While so-called "white acid" (relatively pure HNO_3) was used at first, the experimenters found that performance could be improved by dissolving from 6-14 per cent of nitrogen dioxide (NO_2) in the "white acid," thus changing it into "red fuming." At first gasoline seems to have been used as a fuel, but the California experimenters experienced much trouble with this combination. Then one of them, Dr. Malina, discovered that another group of experimenters at Annapolis had the same difficulty and after prolonged discussion with these people, wired to California regarding the use of aniline as a fuel. In Annapolis they had been thinking of aniline as an addition to gasoline; Dr. Malina proposed to use aniline only. This turned out to be an excellent suggestion. Not only could the aniline be used as a coolant, for which gasoline is useless, it also turned out to ignite spontaneously with nitric acid. Later some 20 per cent of furfural alcohol was added to the aniline to depress its freezing point.

Unfortunately, the aniline is toxic and the other component is corrosive, highly toxic and gives off toxic vapors. While nitric acid is not untrustworthy in the same sense as hydrogen peroxide, it simply is not a pleasant substance to have around. For this reason, the designers of the XS-1 rocket airplane decided in favor of the V-2 fuels and they were strengthened in their decision by consideration of the fact that the nitric acid-aniline combination is spontaneously combustible. They decided that this was permissible for a missile but would not do for a piloted craft where any dual leak in the pipelines would cause a violent fire.

The exhaust velocity of the nitric acid combinations is on the order of 5780 feet per second; some 500-600 feet per second less than that of oxygen and alcohol-water. The main advantage is improved storability.

The Monopropellants

Liquids, such as hydrogen peroxide, which burn or decompose into gases in the presence of a suitable catalyst, can be considered monopropellants. It might look at first glance as if a liquid monopropellant could combine the design advantages of the liquid fuel rocket with the simplicity of the solid fuel rocket. The difficulty with monopropellants is that they are not likely to be good coolants. Furthermore a monopropellant is not as safe as a bipropellant which cannot burn until and unless the other component is also present. While the reasoning of the designers of the XS-1 against the nitric acid-aniline combination for piloted craft applies to monopropellants too, the latter might be useful for pilotless aircraft.

So far only one seems to have been investigated, namely nitromethane (CH_3NO_2) which is liquid at ordinary temperatures, nontoxic, noncorrosive and insensitive to contamination. It will burn smoothly with a catalyst, produce a combustion pressure of not quite 600 lbs. per sq. inch and an exhaust velocity of not quite 5780 feet per second. Unfortunately mechanical shock will detonate it and it will decompose explosively at around 550°F. While it appears to be reasonably safe otherwise, it would not be safe as a coolant. However, for relatively short burning times, say between 15 and 20 seconds, it might be possible to design a rocket motor which will stand up without cooling, especially in expendable units where the need for re-use of the same motor does not arise.

The monopropellants are still a largely unexplored field and may yield some pleasant surprises in the propulsion of expendable units.

Nuclear Energy for Propulsion

Ever since nuclear energy has been released successfully in five large scale demonstrations, many hopeful glances have been cast in the direction of the uranium atom. Since rocket experimenters are looking for powerful fuels, an energy release of the intensity of an atomic explosion is naturally intriguing to them. But it is almost impossible to say much about nuclear energy for rocket propulsion. In order to make a statement many details of nuclear fission would have to be considered. It is possible that of those details some simply are not yet known, but it is certain that those details which are known bear classifications of such a kind that it will take a generation before they are relaxed to an "unrestricted" category.

One thing, however, is certain. Nuclear energy can provide only the energy for the rocket exhaust, not the mass of the exhaust. A rocket propelled by nuclear energy would have to carry the "energy generator" based on uranium fission and a "filler mass" for the exhaust. This filler mass would have to comply with the usual requirements, of high-density in the tank but low molecular weight in the exhaust nozzle. It also should (and probably would) be an inert substance in itself. Since the system would probably operate about equally well whether large or small quantities of filler mass are exhausted, one might assume that there can be wide limits of exhaust velocity, possibly as little as 6100 feet per second or as much as 164,000 feet per second.

If we assume then that there might be a rocket motor which can so-to-speak be "set" for any exhaust velocity within these wide limits it might be interesting to see for what exhaust velocity it would be "set" in practice.

From the formula giving the velocity of a rocket, as equal to the product of the exhaust velocity and the natural logarithm of the mass ratio, we can quickly establish required mass ratios for varying exhaust velocities. Supposing that it is required to fire a V-2 type of missile over a distance of about 600 miles. For this the rocket velocity has to be about 10,000 feet per second plus whatever additional energy might be required to overcome air resistance. We can then draw up the following table:

Assumed exhaust velocity (ft/sec.)	Mass ratio
3050 ft/sec.	20.5 : 1
6100 "	4.5 : 1
9150 "	2.72 : 1
12200 "	2.11 : 1
15240 "	1.82 : 1
30480 "	1.36 : 1
60960 "	1.15 : 1
152400 "	1.07 : 1

It can be seen that the savings in mass-ratio become quite small beginning at a certain point. Of course the same result can be found in any other example; generally speaking the savings in mass ratio may be termed unimportant once the exhaust velocity has reached a value twice as high as the rocket velocity required. For a rocket velocity greater than twice the exhaust velocity no important savings are possible, the corresponding mass-ratio being $\sqrt{e} = 1.64$. It also has to be remembered that the efficiency of a rocket motor depends on the velocity with which it moves, hence the values for v (rocket velocity) and c (exhaust velocity) should not differ too greatly.

It becomes apparent, therefore, that nuclear energy offers hardly any special advantages for comparatively short ranges. The case used above as an example constitutes about the limit. For lesser ranges chemical fuels seem simpler, unless the uranium "engine" turns out to be a marvel of economy and simplicity.

One point must not be overlooked. Whichever shape the uranium "engine" takes, it certainly will not comply with point (8) of the list of desirable characteristics. The exhaust will certainly be highly "toxic," namely radio-active, and the ground splash at take-off will contaminate the take-off site with radio-activity. This drawback may be overcome by using a chemical fuel booster rocket so that the nuclear energy rocket will not begin to work until an altitude of several miles has been reached.

There will be times when, as taxpayers, the cost of maintaining national security through preparedness will seem burdensome, and many of us will be tempted to skimp it. To businessmen, proper expenditures of this sort make sense. They are quite parallel to the expenditures we make in our own affairs for insurance against fire, theft, or any form of disaster.

K. T. Keller, *President,* Chrysler Corporation.

EMPLOYMENT OF AAA GUNS IN THE DUAL ROLE*

By Major H. F. Rolph, Coast Artillery Corps

General

For some years it has been doctrine in the United States Army that artillery is never held in reserve. In view of this axiom, it logically follows that antiaircraft artillery, when not actively engaged in repelling enemy aircraft, should be used in a ground support role.

During World War II, commanders in all Theaters realized and appreciated the possibilities of the 90mm antiaircraft gun as a powerful ground support weapon. It has lent itself particularly to the role of medium artillery in general support and reinforcing missions. It has demonstrated remarkable ability as a direct fire weapon, particularly against caves and pillboxes where its high muzzle velocity and flat trajectory may be exploited. It has also been proven that the 90mm AA gun, using the antiaircraft fuze M43A3, can obtain an extremely well-adjusted time setting where an air burst is required.

In short, the 90mm antiaircraft gun, with no modifications to the gun or mount, can easily be used as a ground support weapon. It may be employed in a dual role of primary antiaircraft and secondary ground support missions, or it may be employed in a primary ground support role. In either case, it is a hard-hitting, dangerous, and versatile weapon.

Capabilities and Limitations

Attention is invited to the fact that the following capabilities and limitations of the 90mm antiaircraft gun apply *only* when the gun is employed as field artillery and in no way affect its employment in the primary antiaircraft role.

Capabilities

The 90mm antiaircraft gun when employed in the ground support role is characterized by the following capabilities:

(1) High rate of fire—The ability to deliver a great volume of fire within a short period of time. With a well trained crew serving the piece and for short periods, the 90mm AA gun M-2 will deliver from 20 to 24 rounds per minute. However, the normal rate of sustained fire is about 15 rounds per minute. This rate of fire is far in excess of the rate of any of the field artillery weapons, which vary from 4 rounds per minute for the 105mm howitzer to 1 round every two minutes for the larger caliber howitzers and guns. This characteristic lends itself particularly to surprise fire where large masses of fire are placed on the target within the least possible time.

(2) Unlimited traverse—The ability of the 90mm AA gun to traverse through 360 degrees without having to shift trails makes it an excellent weapon with which to protect the flanks of the sector to which assigned. This feature is also of great value in protecting the sector from mechanized attack.

(3) Relatively long range—The relatively long range of the 90mm antiaircraft gun (19,560 yds) makes it extremely valuable as a general support weapon with either corps or division artillery. In the general support mission, its range may be exploited by use in long range neutralization, interdiction, and harassing fires.

(4) High muzzle velocity—This characteristic of the 90mm gun makes it an excellent weapon in direct fire against caves, pillboxes, emplacements, and targets of like nature. The high muzzle velocity also gives the projectile great striking power and causes the projectile to arrive at the target prior to arrival of the sound of approach.

Limitations

The 90mm antiaircraft gun in the ground support role is limited by the following characteristics:

(1) Limited flexibility of ammunition—The fixed type ammunition used by the 90mm antiaircraft gun does not allow the flexibility which characterizes the multi-charge ammunition in use by the field artillery. This makes it impossible to vary the charge to make it commensurate with the mission. By the use of the field artillery fuze M-48 with the standard antiaircraft ammunition M-71, it is possible to obtain either impact, delay, or ricochet bursts; and with the fuze M-67, we may obtain air bursts to the limit of the trajectory. The standard antiaircraft mechanical time fuze M43A3 may be used to obtain air bursts to a maximum of 13,000 yards; or when set to safe, will give approximately 75% impact detonations, while the remaining 25% will be duds. It is felt, however, that the fact that the charge cannot be varied is of little or no inconvenience to the artilleryman while firing guns. The variance of charge is more applicable to howitzers.

(2) Lack of tactical mobility—Although the 90mm antiaircraft gun is considered highly mobile, its mobility is limited due to the time required for emplacement and leveling and the fact that it cannot be manhandled by the crew. This should be considered in assigning direct fire missions close to the front lines. Its mobility is such, however, that it can keep pace with division general support artillery in most situations.

(3) Lack of destructive power—Since the destructive power of a projectile is directly proportional to its weight, the 90mm antiaircraft gun is not considered as a suitable weapon for destructive missions except by direct laying at short ranges where the high muzzle velocity will make

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up for the lack of weight. Guns and howitzers of larger caliber are generally used for this mission. The 90mm projectile is much better suited for use as a neutralizing or harassing agent.

(4) Flat trajectory—This feature of the 90mm antiaircraft gun, while good for direct fire, limits the use of the weapon where defilade is necessary. Due to the extremely flat trajectory, a 90mm gun cannot take defilade and still fire at short ranges. At an elevation of 100 mils, the range is 8,000 yards (see Firing Tables 90AA-B-3).

(5) High silhouette—The high silhouette of the 90mm antiaircraft gun, together with its inability to take defilade, make the gun extremely difficult to revet and camouflage. For this reason, it is best used some distance behind the front lines except when engaged in direct fire missions.

Employment

Antiaircraft artillery guns may be assigned the following missions:

(1) Primary mission of antiaircraft defense with a secondary mission of antimechanized or anti-boat fire for local protection.

(2) Primary mission of antiaircraft defense with a secondary mission of ground support fire. (The Dual Role.)

(3) Primary ground support mission.

When antiaircraft guns are employed in the dual role, it is presupposed that their *primary* mission is antiaircraft fire and that their *secondary* mission is field artillery fire. Since antiaircraft artillery may not be assigned two primary missions, the secondary mission *must* be subordinated to the primary mission. Antiaircraft guns may not be assigned primary field artillery and secondary antiaircraft artillery missions.

When employed in the dual role, antiaircraft artillery gun units will be sited by batteries around the defended area with the antiaircraft mission receiving priority in the selection and occupation of positions. Field artillery missons will be fired from the antiaircraft positions.

When assigned secondary missions of ground support (the dual role), the antiaircraft artillery gun battery will be the fire unit and will generally be assigned general support missions with possibly an additional mission of reinforcing the fires of a direct support battalion.

When antiaircraft artillery guns are employed primarily in the ground support role, their tactical mission becomes the same as that of a medium or heavy field artillery battalion. In this role they are relieved of all responsibility for the engagement of aerial targets except for local defense.

In the primary field artillery role, antiaircraft artillery gun units will be sited by battalion with the pieces emplaced according to current field artillery doctrine. The organic caliber .50 machine guns (4 per battery) will be sited so as to provide for local defense against low-flying aircraft. In this mission, antiaircraft artillery gun units will not engage aircraft except those directly attacking the position and which are within the range of the .50 caliber machine guns.

In some instances, antiaircraft gun batteries will be detached from battalion control and moved forward and assigned direct fire missions. In this type mission, control will be decentralized to the batteries or fire units engaged in direct fire. Under certain circumstances "sniping batteries" may be formed for use in direct fire missions against targets of opportunity. Sniping batteries have sometimes been composite units consisting of two 90mm and two 40mm antiaircraft guns, or they may consist of only two or more 90mm guns.

Control

Antiaircraft artillery guns in their primary (antiaircraft) role will generally be under brigade or group control. This control will be exercised through the Antiaircraft Operations Room (AAOR).

In the ground support role, control will be by corps or division artillery, through the appropriate fire direction center (FDC). In this situation, control of the terrestrial fires of the antiaircraft artillery gun battalion is identical to that exercised over the corps or division artillery.

Antiaircraft artillery gun units employed in the primary ground support role will store their antiaircraft fire control equipment (radar, director, generators, etc.) in the rear area prior to occupying positions. This will preclude their employment as antiaircraft artillery while assigned primary field artillery missions. Antiaircraft artillery gun units so employed will normally use their BC telescope (Instrument, Observation, AA, BC, M-1) for spotting fire and the aiming circle (Circle, Aiming, M-1) for laying the battery. Other than these instruments, no fire control equipment is necessary other than Command Post and Fire Direction Set No. 1.

Antiaircraft artillery guns in the dual role, *i.e.*, primary antiaircraft and secondary ground support, will be under the control of the antiaircraft artillery brigade or group for antiaircraft fire (through the AAOR), and corps or division artillery for ground support fire (through the appropriate FDC). In the dual role, AA gun batteries will normally be tied in to the closest field artillery battalion for fire direction.

In the dual role, priority of fire will habitually be given to the primary (AA) mission unless the firing unit is specifically relieved of its primary mission by competent authority (division or higher commander). (See par 86a, FM 44-4.) When antiaircraft artillery gun units are delivering terrestrial fire and an air attack is imminent, ground fire will be suspended and the aerial target engaged. If the responsible commander desires that a terrestrial fire mission be executed regardless of aerial attack, he must specifically relieve the AA unit of its primary responsibility during that period. If this is not done, the antiaircraft unit will cease fire on the ground mission and engage the aerial target.

Survey

Antiaircraft artillery guns in a dual role will generally be emplaced by batteries. Survey control will be established from the nearest field artillery battalion. The survey will normally be accomplished by the field artillery battalion survey section and will be tied in to the fire direction center. In some instances, it may be necessary for the AA battalion to run the survey from the individual batteries to the field artillery battalion FDC. In any case, the antiaircraft gun battery will not be responsible for any survey other than the position area survey.

Antiaircraft artillery gun units in a primary ground

support role will normally be emplaced by battalion. Survey control will be established from corps or division place mark. The complete survey, including horizontal and vertical control will be run by the AA gun battalion (this will include the target area, position area, and connection surveys).

Fire Control

Each antiaircraft artillery gun battalion and battery must be capable of establishing and maintaining its own fire direction center. (See Part Six, Chapter 2, par 355 to 358, FM 6-40, 1 June 45.) When engaged in a primary role of ground support and emplaced as a battalion, the battalion should establish a fire direction center capable of computing firing data for either the battalion as a whole or for any of the individual batteries. When engaged in a dual role, each antiaircraft artillery gun battery must be able to compute its own firing data with information received from the field artillery fire direction center. Each battalion and battery should be equipped with Command Post and Fire Direction Set No. 1. (See Engineer Catalog No. 6, 370-01, June 1945, and Change 1, December 1946.)

Reconnaissance

In the reconnaissance, selection, and occupation of position, the requirements of the position will be dictated by the primary mission of the unit. Reconnaissance will always be influenced highly by the primary mission while the secondary mission is subordinated thereto.

The battalion commander's reconnaissance party will consist of those staff officers whose services will be required; however, the size and composition of the commander's party will be dictated by the local situation.

The following is a typical battalion commander's reconnaissance party for an AA gun battalion in a primary ground support role:

Battalion Commander
Battalion S-2
Battalion S-3
Reconnaissance Officer
Communications Sergeant
Master Gunner

Observation

In order to hit the enemy we must be able to see him. Adequate observation is the primary requisite of the artilleryman. Reconnaissance by the battalion commander and the battalion S-2 should be continuous for observation posts as well as battery positions.

Each battery and battalion should establish and maintain its own observation post. Each OP must have a clear and unobstructed view of the field of fire, the zone of observation, and the base point. Personnel on duty at the OP must be alert and well trained as observers. Each man should know how to adjust artillery fire and should be able to bring accurate fire on any part of the target area with the least practicable delay.

Observation posts are used both for surveillance of fire and for intelligence. Each OP should be tied in to the higher headquarters intelligence system so that reports may reach their destination with a minimum of delay. Personnel must be trained to report any activity in their zone of observation quickly and accurately.

Liaison

Antiaircraft artillery battalions assigned either a primary or secondary mission of ground support will be required to establish liaison with higher and adjacent headquarters. This liaison will normally be command liaison established personally by the commander. Once the liaison has been established, the commander may be replaced later by one of his staff. This staff officer should be capable of and authorized to make decisions for the commander during his absence in accordance with previously established policy. He must have a thorough knowledge of the capabilities and limitations of his weapons and of the artillery problem as a whole. He must be well informed as to the problems and tactics of the supported unit and the situation confronting the reinforced unit.

Communications

Communications between the antiaircraft artillery unit and the corps or division artillery agencies will normally be by wire, which will be laid by the corps or division artillery units. Communication with the reinforced field artillery battalion will also be by wire which will be laid by the *field artillery unit.* In all cases involving wire communications between antiaircraft and field artillery units, the wire will be laid *by the field artillery unit to the antiaircraft artillery unit.*

Radio communication will not be considered as a normal means of intercommunication between reinforcing antiaircraft artillery gun battalions and the reinforced units. There are an insufficient number of radio sets in the field artillery battalion to provide one for the specific purpose of establishing a net with the reinforcing antiaircraft artillery unit. Also, by superimposing transmissions of a reinforcing unit on an existing field artillery battalion net, the nets would become so crowded as to render normal communications unsatisfactory.

Ammunition

When antiaircraft artillery guns are employed in the dual role, the ammunition allocated for the antiaircraft mission will not be used for the secondary (field artillery) mission. Ammunition for use in the ground firing role will be allotted in excess of the basic AA load. Antiaircraft artillery gun unit commanders may decline to fire a terrestrial mission when the firing of that mission will deplete the basic antiaircraft allocation of ammunition.

If the responsible commander desires that a terrestrial mission be fired regardless of the fact that the basic antiaircraft load of ammunition may be violated, he must specifically state that the mission will be fired in spite of the ammunition supply on hand. The antiaircraft artillery unit commander should keep the higher commander (division or above) informed as to the status of ammunition on hand within the unit.

When antiaircraft artillery units are to be employed in a secondary ground support mission, arrangements will be made for their organic vehicles to transport sufficient ammunition to perform the secondary mission provided the plan can be foreseen sufficiently in advance to permit such action. Organic battalion ammunition train loads will be

dumped in position areas when these vehicles are hauling ammunition for the secondary mission. Organic ammunition loads carried on combat vehicles *will remain intact for primary mission use.*

When the need for employment of units in a secondary role cannot be foreseen in sufficient time for the antiaircraft artillery unit concerned to haul its ammunition, the higher commander must allot sufficient transportation.

When the mission of the antiaircraft artillery gun battalion employed in either a primary or secondary role of ground support indicates the use of fuze M-48 and/or M-67, or any other special fuze, it will be the responsibility of the higher commander to assure that these fuzes are available in sufficient quantity for the mission.

Antiaircraft artillery gun battalions in general support of Corps or Divisions will normally draw their ammunition from the dumps of the Corps or Divisions concerned. It is possible, however, that ammunition will have to be drawn from Army dumps some distance to the rear. In any case, it will be the responsibility of the higher commander to arrange where the ammunition will be drawn. The establishment of ammunition credits with Corps or Army dumps will be the responsibility of the Corps or Division commander or his authorized representative. It will be the responsibility of the antiaircraft artillery gun unit commander to insure that the ammunition is actually drawn as needed and that it is on hand in sufficient amounts at all times.

The problem of ammunition supply is of vital importance to the artillery commander and must be given his personal attention. The ammunition problem of the antiaircraft artillery unit commander when employed in the dual role will be virtually double that encountered when the unit is concerned only with the AA role, and hence will require even more attention. In this case, the commander and his S-4 will be required to keep themselves and the higher commander constantly informed as to the status of ammunition within the unit.

Conclusion

Having taken into account the characteristics, capabilities, limitations, and appropriate missions of the 90mm antiaircraft gun when employed as a ground support weapon, it is possible to draw the following conclusions regarding its employment:

The 90mm AA gun, when employed as a ground support weapon, is best used either as corps or division general support artillery.

The 90 is best suited for long range missions and for neutralization, harassing, or interdiction fire. The 90mm AA gun is not considered suitable for destruction fire due to the light weight of the projectile, except as indicated below.

Because of its high muzzle velocity and flat trajectory, the 90mm AA gun is considered an excellent weapon for direct fire missions. When employed for direct fire, it will normally be used against caves, pillboxes, emplacements, armored vehicles, and targets of like nature. In direct fire, the effect sought will usually be either destruction or neutralization.

When the 90mm AA gun is employed in direct fire missions, the batteries or fire units will be detached from battalion control and moved forward for fire against targets of opportunity. In this type mission, control will be decentralized to the batteries or fire units engaged in direct fire missions.

Manual of Instructions for Radio Predictions

Instructions for the use of "Basic Radio Propagation Predictions—Three Months in Advance" (CRPL Series D), issued monthly by the National Bureau of Standards, have been prepared in the form of a separate manual which is now available as NBS Circular C465.

The purpose of this manual is to explain how the monthly predictions may be used in calculations of usable and working frequencies for radio sky-wave transmission. Maximum usable frequencies and optimum working frequencies may be computed over any path for any time of day during the month in question. Prediction charts are included for two recent months, and sample problems are given for four paths, with a discussion of differences in results because of length of path, the ionosphere layer con trolling reflection, season of the year, and degree of sola activity. An attempt is made to emphasize that the mos important case of all, namely, transmission by the F2 laye over a transmission path more than 4000 km in length, ca: be calculated in a very simple manner. The pamphlet als contains other useful data, including tables, charts, an specimen work sheets.

Circular C465 may be obtained from the Superintender of Documents, Washington 25, D. C., at 25 cents a copy The subscription rate to Basic Radio Propagation Predi tions, also available from the Superintendent of Document is $1.00 a year (foreign, $1.25), single copies, 10 cents eacl

BUILDING THE NEW BRITISH ARMY

By Lieutenant Colonel William R. Kintner, Inf.

Postwar adjustment problems are not the exclusive plague of the American Army. The War Office of Great Britain has had to wrestle with most of the nightmares that have made our military planners lose sleep. The magnitude of the task confronting British military men is, in many respects, greater than our own; yet the means available to meet the endless demands of Empire Defense are incomparably slender. For this reason, a survey of current difficulties confronting the British Army should be profitable to us.

Just as in our own case, the British are devoting themselves to the Herculean task of building a new army. The most crucial obstacle with which the British must contend is the wise allocation of scarce men between industry and the Services. Up to the present, they have tried to maintain an army greater than our own, based on one-third of our population. This army is composed in part of volunteers but in the main consists of conscripted soldiers. In order to rebuild the volunteer element of the postwar regular army, an effort is being made to overcome the traditional reluctance of British young men to volunteer for military service.

So far the British have not been too happy over the results of their recruiting program. Labor shortages, conditions under which many British troops must serve abroad, and the postwar reaction to military life have hampered efforts. But a definite campaign has been launched to break down resistance to recruiting through making the soldier's life more attractive not only in appearance but in reality.

Ambitious plans have been announced to make the soldier's barracks a more attractive place in which to live. Discomfort and soldiering, in some minds, have been synonymous but the Army leaders hope to end this dismal marriage in time of peace. It has been seen how the RAF has managed to maintain a good fighting reputation while living in surroundings much superior to the Army's. Eventually it is hoped to achieve the RAF's pattern for living in the Army.

Admittedly, the British Army has a long way to go in improving the soldier's way of life. But a new goal has been set, and, in spite of facetious criticism, the rank and file would like to see Montgomery' plans for humanizing soldiering achieved. The British recognize that Army service can never be made as comfortable as civilian life but believe that the gap between the two standards can be narrowed. Harassed Britain, however, is in no position at this moment to effect any radical change in the condition of barracks life. Bedside lamps, additional married quarters, and other desirable amenities must hurdle the domestic priorities, labor shortage, and the export program. Plans to redesign barracks to give them a more homelike atmosphere and to furnish them with less Spartan equipment cannot be executed with thin air. Nothwithstanding, the British program recognizes that barracks can be made more pleasing without detracting from military efficiency and discipline.

While schemes to improve barracks conditions will take some time to work out, the new regulations which have been issued, affecting the individual soldier, can be implemented immediately. These regulations are calculated to make the soldier feel more like an ordinary human being and less like some serial number on the company roster. The British Tommy is to receive a new "walking-out" uniform, complete with shirt, to overcome the social limitations of the battle jacket. Another reform is the free issue of blankets and pajamas. The introduction of comfortable reception rooms, in which the soldier can entertain his girl and family is another welcome innovation.

Good chow and good morale go together in any army. The British have established the Army Catering Corps to insure the preparation of good food by a professional cooking staff.

No change has been made in the long-established system of maintaining three separate messes, a mess for officers, a mess for sergeants, and one for the other ranks.

Endless, irksome military formations have been common in armies the world over. The British have eliminated falling in line for every military chore from chow call to sick call. As they put it, unnecessary parades will be abolished. No longer will Tommy fall in for sick parades, parades for drawing clothes, or for going to meals. In fact, parades will be held only when absolutely necessary.

Both at home and abroad, soldiers will be allowed to wear "mufti" when off duty. This will not cut down on the good conduct expected of British troops. This particular order grants a privilege which can be withdrawn if this additional freedom is violated.

Unlike us, the British have not tampered with their saluting regulations, which always call for less wear and tear

on the right arm than our own. For with the British, only the senior of a group of juniors need salute a superior. Similarly, if the superior is a member of a group, only the senior member of his group returns the salute.

As another spur to recruiting, the British have altered the period of enlistment. Formerly a British soldier enlisted for seven years active service, to be followed by five years with the reserve. The ratio has now been reversed but a five years' hitch is still considerably longer than our three-year tour. The British soldier will have six months of basic training at home before going abroad for three and a half years. When his foreign service is completed, he finishes his service with duty at home.

In line with projected improvements of barracks conditions and greater individual liberties is the new British pay bill, which became effective July 1, 1946, the same date on which increases were made in our own Army pay. Actual increases made in the British Army were relatively smaller than our own, especially in the lower ranks. However, considerable simplification was made in the graduation of pay scales and in allowances. Another point of interest is that the pay of all three services, including flying personnel of the RAF, has been put on the same level. British officers receive regular increases for periods of service, but they are also eligible for extra pay if they qualify in certain military specialties.

Pay in the other ranks is awarded on either military or technical qualifications. Technical qualifications are graded by stars and pay raises from recruit, to one star, two stars, three stars, and skilled tradesman—the equivalent of our old specialist first class. The pay of warrant officers and sergeants is raised with grade and length of service.

There is a marriage allowance for all ranks. Any soldier can be married at the age of twenty-one, and is eligible to receive this allowance. There is no separate element in this allowance for the first child, but there is one for any subsequent children.

British service personnel have never been exempted from paying income taxes. Until recently, the pay of enlisted men was too low to make them liable for these taxes, although officers have always paid, even during the war. The new higher pay has resulted in many ranks becoming eligible for income taxes for the first time. So, despite the appearance of higher pay, the actual benefits of this new pay bill are largely theoretical.

Top spots in the British Army were formerly reserved for members of Britain's well-to-do classes. Officers were generally selected from men who had an independent income for few officers were able to live on Army pay. The vast changes that have taken place in the British social structure have forced a drastic revision of this system of leadership procurement. The British Army is now on the open market for talent. The strongest inducement to draw able men into the Army is the new system of career selection, which should permit any qualified man to rise as far as his inherent capabilities will allow.

Every British Army recruit spends six weeks at a primary training center. During the first two weeks at this center, he is given intelligence and aptitude tests which will largely determine the assignment for which he will be trained. His aptitudes are indexed on a card system. When his six weeks are up, he is sent to an initial training center of one of the arms and trained, as nearly as the requirements of the service permit, in duties for which he is best fitted.

When a man demonstrates that he is potential officer material, he is recommended for officer training. A profile report is submitted on the man, which summarizes his military service, education, occupation, social interests, sports interests, hobbies, achievements, and family background. If the candidate's report is suitable, he is examined by a War Office Selection Board, not as an individual but as a member of a squad of eight candidates. The examination comprises many practical tests in which the individual candidate demonstrates his ability to lead men in the solution of actual tasks, and to work in cooperation with others. At the end of the tests, the candidates are rigorously graded, and the best are sent to an officer cadet training unit of the branch for which they are considered most qualified. Upon completion of this additional training, the officers receive temporary commissions similar to the AUS commissions given our OCS graduates.

The selection of Regular Officers from among the officers with Emergency Commissions is carried on along much the same lines. A good percentage of officers granted regular commissions in the expanded Army have been procured from this source. All such vacancies which existed have now been filled.

The bulk of officers given regular commissions in the future will be graduates of Sandhurst—the British counterpart of West Point. Sandhurst now represents a consolidation of the Royal Military College (Sandhurst) and the Royal Military Academy (Woolwich). The new Sandhurst is a thoroughly democratic institution. No longer will the cadet have to pay for the privilege of officer training, but, instead, he will receive a minimum pay of about a dollar a day. Admission to Sandhurst will be open to qualified men from the ranks as well as to men selected from the British schools. Men who qualify from schools by passing a civil service examination must serve six months in the ranks before they will be permitted to enter Sandhurst. Men coming from the ranks must meet the standards set by a Regular Commissions Board.

The course at Sandhurst will last a short eighteen months Less than half of the time will be devoted to military subjects, as basic training will have been given the cadet in the Army. The rest of the curriculum is designed to broaden the cadet's point of view, in order to prepare him for the various roles which modern officers are called upon to play

Admittedly, only a small percentage of the men enlisting in the ranks of the Army will be drawn in by the possibility of making a permanent career of the Service, either as a noncommissioned officer or as an officer. Likewise, the British recognize that plans to transform the soldier's squad room into a private bedroom and to give every man an opportunity to acquire a Field Marshal's baton will not be of primary interest to the ordinary soldier. The average British soldier, like our own, enlists for one tour. He enlists for adventure, foreign service, a chance for technical training etc. But eventually he plans to doff his uniform and seek a civilian job. Consequently, the potential recruit is anxious to know how service in the Army will qualify him for a good civilian job when he gets out.

Field Marshal Montgomery testified concerning the importance placed on post-service employment, when he said that soldiers must have confidence that Army training will fit them for a civilian job. He implied that the Army would do everything in its power to aid soldiers in getting jobs. The ex-soldier already has a legal right to preference in civil service jobs. To carry out this civilian readjustment program, the Royal Army Educational Corps gives specialized vocational training toward the end of a man's enlistment. Organized civil resettlement offices, run by the Ministry of Labor, have been established to act as a bridge between military service and civilian employment. Many barriers have been broken to permit a man's military rating to open up civilian job opportunities. Most employers and trade unions now recognize the Army's technical training, and the military stress on reliance and discipline give the ex-soldier qualifications often higher than those possessed by the average industrial worker. The British Army believes that if it is to lay title to young men in their important, formative years it must, at the same time, prepare them adequately for the civilian life that will follow.

To speed recruiting, the British have taken these forward steps to make a military career as attractive competitively as civilian life. Such measures parallel, to a considerable extent, the actions we have taken in our Army.

Because Britain is experiencing a severe economic crisis, the advances made by the British and the new attractions offered by the British Army to prospective recruits have not approached those presented by our own Army. In fact, because of the differences in relative standards of living, the comfort standard of the British soldier lags behind that provided by our *prewar* Army. These differences are especially notable in terms of pay for the lower ranks, in which the U. S. Private appears as a veritable Midas in contrast to the British Tommy. At the same time, Army pay in Britain is now much nearer to civilian wage scales.

The British have endeavored to civilianize military service. Yet, in spite of a concentrated advertising campaign to sell the good life in uniform, the volunteers have not been stepping up to the recruiting offices in adequate numbers.

The British experience shares in common with our own, the disturbing fact that voluntary recruiting faces tough going. Only partial success has marked these efforts because peacetime military service still rates low on the competitive job scale. The relatively low prestige of peacetime military life in Britain and in the United States stems from the traditional antipathy which many British and American civilians hold toward the military, except in time of war. The tendency to dismiss the soldier with a curt, "Thank you," as soon as the last round is fired is not followed by all democracies, yet it is part of the heritage we share with the British.

This feeling dates back to the British experience of a military dictatorship under Cromwell, during which Cromwell's Army dissolved Parliament and took full power unto itself, thus alienating itself from British opinion. The most popular act of the Restoration, which followed, was the complete dissolution of the standing army. Necessity soon forced the reinstigation of a regular army, but ever since it has been kept in such narrow bounds, and treated with such little consideration that Britain's Army has gone into every conflict ill-prepared for war. The American colonists made this British tradition their own and, since the foundation of our nation, the accord shown the American Army has generally duplicated the British neglect of her land forces.

Parallel with this almost pathological peacetime distaste for things military is the traditional preference that the British have shown for voluntary military forces. Neither the British nor ourselves have resorted to conscription except during time of gravest emergency. The British properly consider today's unsettled world so full of uncertainty that they are planning to continue conscription. Yet they wish to preserve a strong nucleus of volunteer forces to defend their Empire. They want these forces to be actual, not paper, forces—prior to the war a regular Battalion with only 350 out of a T/O of 800 men was a common sight.

The narrow recruiting base of the old Army must be enlarged if the regular ranks are to be kept full. The British have tried to draw into the service, recruits from a wider economic and cultural range than hitherto.

This survey of British postwar military problems reveals that the bulk of the British people must drop their long-seated prejudice toward the peacetime Army, or make conscription their chief source of military manpower. We may face this same choice.

If every one of the 140,000,000 people in America could visit this convincing experiment at Fort Knox, I feel certain that they would endorse universal training.—Dr. Karl T. Compton, *President*, Massachusetts Institute of Technology, Chairman, President's Civilian Advisory Commission on Military Training.

German Underground Installations*

By Major General C. F. Robinson

During World War II, German plans for and utilization of underground installations were much more extensive than those of any other country. While the Germans never succeeded in placing a really substantial part of their war production underground, they did have plans to do so, and were making considerable use of underground installations for manufacture and storage.

It was not until 1944 that comprehensive plans to move underground were drawn up and undertaken. The main factor which caused the Germans finally to adopt a substantial underground program was, of course, the damage caused by Allied bombing and the resulting loss of production. They were unable to protect their factories effectively as the margin of Allied air superiority increased. The situation came to a head with the increased weight and tempo of Allied air attacks in early 1944.

Aircraft Industry

The heavy raids of February 1944 led to the decision, apparently made personally by Hitler, to place the German aircraft industry underground. The general policy was changed from one of dispersal, which had been started in 1942 but not completed, to dispersal and underground protection.

The plan called for the dispersal of twenty-seven aircraft factories into some seven hundred smaller plants. In great part this was merely the completion of the general dispersal plan of 1942. The dispersal program was initially successful. The multiplicity of targets made it difficult to locate the plants and to disrupt production by bombing. The program, however, was very uneconomical. Production schedules were thrown out of gear. Management was spread too thin. Efficiency in terms of pounds per air-frame produced declined.

The plan also called for the construction of eleven *Bunkerwerke*, which were multiple store buildings partially underground with heavy concrete protection above ground. Each *Bunkerwerke* was to have not less than 600,000 square meters of floor space, to be self-sufficient and capable of producing about 1,000 aircraft or the components thereof per month. In addition, about 1,000,000 square meters of cellar space was to be occupied by those aircraft plants which had been most severely damaged in earlier raids.

The complete plan of the special staff of the Ministry of Armament and War Production, as finally drawn in August 1944, contemplated the production of 7,400 aircraft per month, 5,000 fighters, 1,500 bombers, 500 trainers, and 400 other types, by the end of 1945. This would have required some 58,000,000 square feet of floor space, the greater part of which was to be underground, with 13,000,000 square feet for engines, 11,000,000 for fuselages, and 9,000,000 for accessories. The plan was too late and only an insignificant percentage of the aircraft industry had been placed underground by the end of the war.

Oil Industry

The heavy attacks in May 1944 on the German oil industry, convinced the Germans that they could not effectively repair their synthetic plants as fast as Allied bombers wrecked them. A race developed between destruction and reconstruction in which reconstruction could not keep pace. It was apparent that drastic action would have to be taken to save the German oil industry. It soon became apparent that a dispersal and underground program, instead of reconstruction, was necessary and in June 1944 the planning for such a program was started.

The program which was formulated for the oil industry called for the production of 130,000 tons of aviation gasoline per month beginning in the summer of 1945. Seven high pressure catalytic hydrogeneration plants, six underground and one on the surface, were involved. The hydrogeneration plants were very large, contained much heavy equipment, and required a relatively long period for the transfer of production to a new site. Because of the large areas required, much excavation was necessary before any equipment could be moved. The German oil industry had opposed putting hydrogeneration plants underground as being impractical because of their size and complexity. Only two of these plants were under construction when the war ended; work on the others had been dropped before that

*Reprinted, Courtesy of "The Military Engineer."

Aircraft Engine Factory in an Old Quarry, Mosbach, Germany.

Vertical Drill Presses, Blielf, Germany.

time. A larger plant to produce aviation gasoline was also planned along with several small plants and five units to produce blending agents. Only one of them, a blending plant, was in operation before the end of the war.

The motor gasoline program was expected to produce 41,000 tons per month. It involved 40 small distillation units dispersed in the sides of hills, woods, and quarries, with a few underground; two modern thermal cracking units; and 10 small plants to make motor gasoline from carbon monoxide and hydrogen from municipal gas works. These dispersed plants were camouflaged, small, and widely scattered and thus poor targets for bombing. On the other hand, the dispersal increased the transportation problem seriously because all the crude oil was handled by railroad. Thirty-eight of the distillation plants were placed in operation before the end of the war but their capacity was only 40 per cent utilized because of transportation difficulties.

The entire dispersal and underground program for the oil industry involved about one hundred and forty separate plants, twenty-three of which were to be underground and the rest small and concealed. It was expected to supply Germany with 82 per cent as much aviation gasoline as had been produced in January 1944, 25 per cent as much motor gasoline, 50 per cent as much lubricating oil, and 88 per cent as much diesel oil. The program was estimated to cost 1,400,000,000 Reichsmarks and require 200,000 man-years. Because of shortages of explosives, transportation, and labor the construction program kept falling behind schedule. During the course of construction, plans were continually revised because of these shortages and loss of sites to the enemy. In spite of the strenuous efforts that were put into the program, only a million barrels of straight run gasoline and diesel oil and a small amount of bleeding agent were obtained from these plants up to V-E day.

Other Programs

In June 1944, the Germans decided to put part of their rubber industry underground, but it was not until the beginning of 1945 that a definite plan was undertaken. This plan called for a synthetic rubber plant with a capacity of 12,000 tons per year. A tire factory was to be constructed in the same location. An attempt was also made to put a tire fabrication plant underground at another location, but the equipment could not be moved in because of the general tie-up of the railroads from Allied bombing. This illustrates the intimate relationship of the protection of communications to that of production facilities.

In the field of optics and precision instruments, the first movement of production underground was undertaken in the spring of 1944 when a major lens grinding firm was transferred to prepared tunnels in a sandstone quarry. Other optical and instrument manufacturing followed. A major project for optical and electrical components in a bunker-type structure was planned but never carried through.

In spite of the obvious difficulties involved, the Germans made some attempts to put power plants underground. Many small power stations were incorporated in large underground structures designed primarily for other purposes. There was, however, no comprehensive program in this field similar to those for the aircraft and oil industries.

The Table shows the distribution of the planned space, the amount placed under construction and the amount completed. (These figures included only the projects under the jurisdiction of the Ministry of Armament and War Production and the SS but, excluded the large program for the oil industry.)

Types of Installation

German underground installations were of various types. For the most part the Germans adapted existing facilities to underground storage or production. Mines, caves, beer cellars, railroad tunnels, and highway tunnels were remodeled to varying degrees to house manufacturing or storage that had previously been above ground. Remodeled mines were used for the automatic pilots, direction gyroscopes, ammunition, precision instruments, components for aircraft, airplane engines, ball bearings, guns, and the generation of electricity. The floor space in adapted mines

	Planned	*Abandoned*	*Under Construction*	*Completed*
Air-frames	20,766,800	645,600	16,570,400	3,550,800
Aircraft accessories	6,391,400	.....	5,347,700	1,043,720
Aero-engines	20,992,700	1,345,000	15,871,000	3,776,800
Tanks	2,109,000	.....	1,818,400	290,500
Motor vehicles	2,808,360	.....	2,711,500	96,800
V-Weapons	1,538,700	.....	387,400	1,151,300
Shipbuilding	1,775,400	.....	1,248,200	527,200
Weapons	2,173,500	.....	2,119,720	53,800
Machinery	7,101,600	.....	6,079,400	1,022,200
Electrical Equipment	6,746,500	1,463,360	5,283,200	.....
Instruments	1,054,500	193,680	860,800	.....
Foundry Products	204,400	.....	204,400	.....
Technical Glass & Ceramics	53,800	.....	53,800	.....
Welding Equipment & Gases	21,500	.....	21,500	.....
Machine Parts	7,854,800	4,357,800	3,497,000	.....
Machinery	258,200	258,200	.....	.....
Armament Equipment	204,400	.....	204,400	.....
Other	441,200	53,800	387,360	.....
SS Projects	11,298,000	764,000	8,651,000	1,883,000

varied from only a few thousand square feet up to several hundred thousand square feet. Railroad and highway tunnels were used for the manufacture of planes, engine parts, ammunition, electrical equipment. The tunnels were of

Huge Room in which Hand Grenades Were Filled, Salt Mine, Neuhof, Germany.

varying floor space. One tunnel 3 kilometers long was used for the manufacture of ammunition.

The Germans also undertook new construction of underground facilities. These generally consisted of two types; tunnels or galleries excavated into the side of hills and buildings placed wholly or partially underground with a bombproof covering. The so-called *Bunkerwerke* with heavy reinforced concrete arches over the top was of the latter category. New construction was generally confined to the large plants of the major programs for moving critical industries underground. Except in the field of ammunition manufacture and the storage very few of the new projects undertaken were completed by the end of the war.

Construction Features

Generally speaking, structures which were built by the government under central supervision and as part of a major program, were substantial. Design, construction, and camouflage were of high standard. The design methods and standards used were very similar to those used in comparable work in the United States, except that drawings were not well detailed or complete. In the case of certain types of structures, where the government had ordered many similar plants, standardization was evident. This was true in ammunition plants, oil storage, aircraft plants, and synthetic petroleum plants.

On the other hand, most of the underground installations were makeshift arrangements. This was particularly true where they were left to local governmental agencies or private enterprise. Improvisation and expediency caused by the urgency of the situation were controlling factors. Designs varied with the importance of the structure and the abilities of the local engineers, architects, and contractors. Generally speaking, the conversions of existing sites were hasty improvisations that did not begin to compare with American standards for production facilities or in provisions for the comfort and welfare of workers. Many of them were extremely crude and primitive. Much hand labor was used and equipment and construction organization were usually much below American practice.

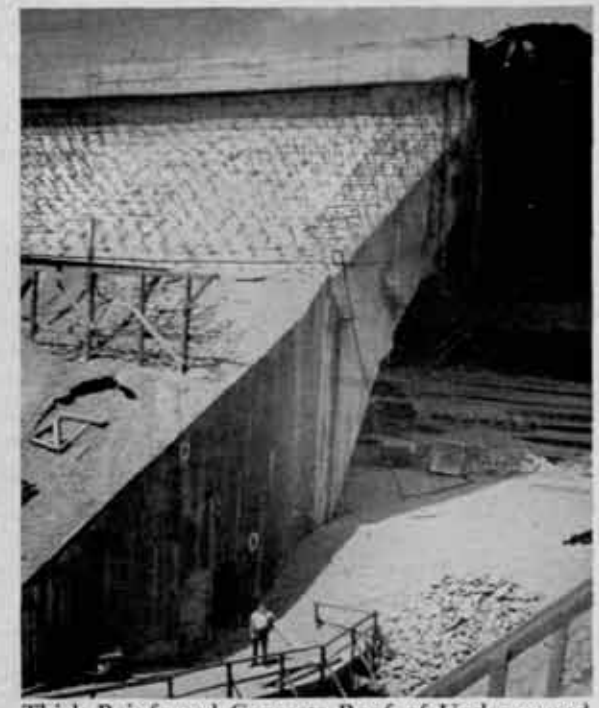
In the selection of existing underground sites for storage or production purposes, consideration was given to size, the possibilities of enlargement, transportation facilities, sources of power and water, and the extent of remodeling that would be required. The selection of new sites was to a considerable extent influenced by the geologic environment. One of the most common types of rock chosen was moderately soft sandstone. This rock was easy to excavate and at some places self-supporting. However, the sandstone varied in hardness and consistency and at several sites it was so weak and unconsolidated that serious rock falls resulted, heavy timbering was required, and the tunnels eventually had to be lined with reinforced concrete. Two other types of rock commonly exploited were massive anhydrite and limestone. Both were excellent because they could support tunnels of good height and width without bracing or lining. Tunnels were also excavated in such soft materials as shale and gypsum because of the shortage of explosives. Careful attention was paid to natural concealment and overhead cover. Access to utilities was also considered as in the case of existing sites. The availability of construction materials was an important factor.

As a guide in the selection of sites and construction of underground facilities the Germans developed the following minimum standards; height 3 to 4 meters, width 6½ meters, and length 50 meters. While these were desirable they were not always followed.

There was a wide range of provisions for utilities. The extent of the utilities layout depended on the importance of

Underground Kitchen for Feeding Workers, Mosbach.

the structure and the time allowed for construction. In the majority of the conversions, the existing sites were poorly lighted and had the bare minimum of other utilities. On the other hand, a few structures had elaborate facilities for



Thick Reinforced Concrete Roof of Underground Factory, Muhldorf, Germany.

water, sewage, heating, light, power, gas-proofing, ventilation, kitchens, and mess halls. These structures usually had standby power and various manually operated devices in case of total power failure.

Floors were normally of concrete. The roofs were almost always arched so that they formed one continuous surface with the walls. Because of the urgency of getting production underground and the general shortage of construction materials, roofs were almost always left unlined, if the rock was self-supporting. In some factories which were sited in sandstone, the walls and ceilings were sprayed with a thin coating of cement in an effort to reduce dust in the factory. This process, while rendering the rooms relatively dust free, was dangerous because it concealed weak spots in the tunnel ceilings. All types and combinations of building materials were used for lining tunnels, such as brick, stone, concrete reinforced with steel arches, and even timber.

Two types of ventilation were used: one in which the tunnel itself was used as an air duct, and the other in which the air was conveyed about the factory in metal ducts and only entered the working areas when it was blown out of holes in a duct on one side of a tunnel and then drawn into another pipe through holes on the opposite side. Fiber board was used as a substitute material for ducts but was generally unsuccessful because they became warped by the hot air. Fans were in very short supply and their lack greatly delayed the installation of ventilating systems. In production rooms it was directed that the relative air humidity should not exceed 60 to 70 per cent and the average air temperature 68 degrees to 78 degrees Fahrenheit. In mess rooms the humidity was not to exceed 50 to 60 per cent and the temperature of the air 68 degrees to 78 degrees Fahrenheit.

In camouflage the Germans excelled. Whether concealing totally underground structures or partially underground structures and entrances, exits, smokestacks, and ventilation ducts, they displayed unquestioned zeal for this activity. Full use was made of natural cover and installations invariably blended into the surrounding countryside. The natural ground surface was disturbed as little as possible. In many cases, immediately after construction, pine trees were planted over disturbed surfaces. Most of the munitions plants and oil depots were buried in dense forest.

The most unique construction was that of the four semi-underground Messerschmitt factories near Munich. These factories were unusual in that the roof was a 10-foot thick reinforced-concrete arch of 280-foot span; the roof arch was poured on a 164,000-cubic yard gravel fill which had to be excavated after the arch concrete had set; the 5- and 8-story buildings constructed underneath these roof arches were made entirely of precast columns, beams and floor slabs; and the heating and ventilating designs were larger and more elaborate than those for any other underground factory.

The Germans apparently did not develop, through experience or experimentation, any conclusive standards of cover for protection against different types and sizes of bombs. At first, concrete 3 meters thick was thought to be sufficient protection. The experience on the Atlantic Wall indicated that 6 meters of concrete was sufficient. As the Allies used larger and larger bombs this was revised upward to the point that 10 to 12 meters was thought necessary for complete protection. The bombing in France indicated that 20 meters of cultivated ground would withstand medium bombing. A top layer of 30 to 40 meters thickness was finally considered the minimum protection against medium bombs. Some German engineers arrived at the conclusion that 60 to 80 meters of rock cover was the only really safe protection.

Costs

The average cost of buildings on the surface in Germany was 80 to 150 Reichsmarks per square meter. In favorable cases involving only the leveling off and concreting of existing underground sites, the cost of underground plants was as low as 30 to 40 Reichsmarks per square meter. The average cost of underground plants, however, was about 300 Reichsmarks per square meter. Some costs in hard rock with extensive ventilation ran as high as 1,000 Reichsmarks per square meter.

In general, the conversion of a mine into a factory was the least expensive type of underground protection. The construction of a factory by excavating new tailor-made tunnels was the most expensive. The costs for the latter type ran as high as ten times that of an aboveground factory of the same floor space. It was estimated that it was three times as costly to build underground plants as surface plants. The installation of the Daimler Benz aircraft engine plant in a gypsum mine at Necksrelz, however, is said to have cost less than the original surface building which was bombed out. Some of the most important factors governing the cost of a new excavation were the selection of a thick bed of self-supporting rock at valley level, the proving of the site by trial borings, and supervision of the excavation by mining engineers.

In optics and precision instrument production the Germans were able to reduce maintenance and operating costs in securing proper temperature and humidity by taking ad-

vantage of the more constant conditions prevailing in underground facilities.

Effects on Workers

The physiological effects on the workers varied, depending on local conditions. In factories that were properly ventilated and where the welfare of the workers was considered, there were no adverse physiological effects at all. In fact, the incidence of colds decreased in some factories because of the uniform controlled humidity and temperature of the air. Ultraviolet ray treatments were available in some factories. Generally, underground work was limited to eight successive hours. Many new workers complained of headaches at first but this condition vanished after one or two weeks work. These headaches were thought to have been caused by the fact that the air pressure was greater than outside due to the forced ventilation systems.

Psychological effects varied in general according to whether or not the individual worker had been employed in an aboveground factory that had been bombed. Those that had survived bombing attacks on aboveground factories were glad to work underground because they felt safer, while workers who had not been bombed generally did not like to work underground because of the lack of sunshine. However, daylight-type strip lighting was not uncommon and the walls were sometimes painted a light green to make the light easy on the eyes.

Effect on Production

Many German engineers claimed that the cost of production in an underground factory properly designed and equipped and built without interference by enemy bombing could and should have been less than an aboveground plant of the same floor space. Production capacity in underground plants should, in general, correspond to normal production in workshops on the surface. The employees generally enjoyed working in the underground shops so long as the management made the necessary arrangements for their welfare including illumination, ventilation, transportation, sanitary, and messing facilities. The greatest difficulty with labor was in providing housing. It was common practice to build dispersed hutted camps near the factories and also house workers in nearby villages. The transportation of workers was by foot, bicycle, bus, and train, depending on the distances involved and facilities available.

Production quality did not drop. The same type of tools were used and the same standardization of working methods was followed as above ground. The work benches were closer together, making supervision simpler. Transportation of supplies inside the better factories was generally by overhead electric cranes or small electric cars. Interruptions of work through disturbances and like incidents (for example, day air raid alarms) ceased. Many sites, such as mines, already had rail-sidings and most newly excavated sites were built near railway lines so that only the construction of short spurs was needed. The biggest bottleneck in production was in getting goods in and out of the vertical shaft mines. This problem was being solved by the excavation of additional shafts both vertical and sloping.

The average loss of production in moving to underground locations was three weeks to two months depending on the industry, the size of the plant and transportation difficulties which became increasingly worse from Allied bombing.

The most serious weakness in the underground and dispersal program was the reliance on the railroads for transportation. Most of the plants depended on railroads both for their raw materials and distribution of their products. This contributed to the overloading of the railroads, which were already severely damaged by aerial attacks. The condition was further aggravated by the general lack of storage space for either materials or finished products at the plants.

Conclusions

The original German mistake was in overestimating the effectiveness of air defense and underestimating the power of Allied air attack. Because of the period required for construction and transferring production to new sites, the Germans should have started moving underground at least three years earlier. By the time the Germans really started to dig on a broad basis, it was too late. This fact was recognized at the time by many German officials who believed that the requisite materials and manpower could be used to better advantage than in the belated attempt to go underground. The German experience shows that the time to prepare underground sites is before, not during, a war.

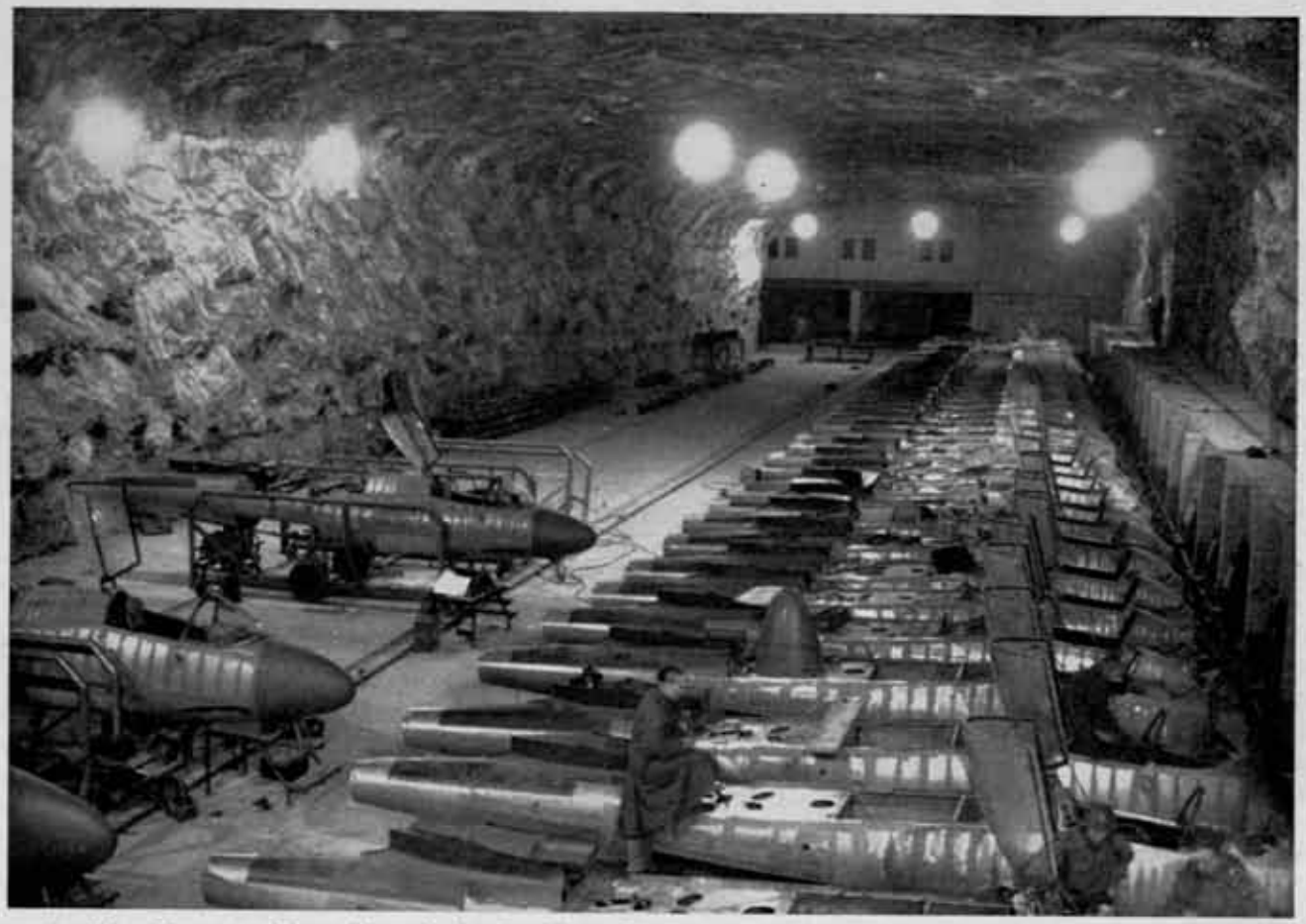
Although the Germans did not get widespread underground production in operation, they had proceeded to the point where most authorities believed that it was practical to place almost any type of industry underground. The greatest difficulties in doing so were in chemicals and power. The major German underground effort was directed to synthetic oil, aircraft, ammunition, and V-bombs. Production underground could generally be maintained at the same standards and costs as above ground. There were no adverse effects on workers. The initial costs of underground plants were, except in rare cases, in excess and often greatly in excess of those for comparable plants on the surface. Maintenance and operating costs were on the other hand favorable and sometimes less than above ground.

The great majority of the German underground plants that did get into operation were in existing mines, caves, cellars, and tunnels. These generally were hasty, crude improvisations. They showed, however, that the complex equipment of modern war can be produced under almost primitive conditions.

Interior of Factory at Muhldorf. Railway carts are filled with gravel and cement.

The German experience indicated that it was better to build a few large centralized underground factories, especially designed for the specific product in question, and as self-contained as possible, than to scatter production in a large number of small dispersed or underground units. To do so minimized maintenance, operation, and production costs; permitted better supervision; and tended to overcome transportation difficulties. The fact that the German practice in those plants which got into operation was generally the opposite was due to the Germans' late start requiring improvisation in hastily remodeled existing sites.

But finally, the German experience indicated that underground plants were not a complete answer to maintaining war production under heavy air attack. While the underground plants themselves were not effectively damaged by bombing, the lines of communications leading to and from the plants were disrupted and in many cases knocked out by persistent and repeated attack thus slowing down or completely stopping production. The vulnerability of the transportation facilities was so great that many responsible Germans admitted that persistent bombing of the railroads could have paralyzed industry even if the dispersal and underground program as it was originally planned had been completed.



German Jet Plane Plant 300 Meters beneath the Earth in a Salt Mine near Engels. Partly completed Heinkel 162's, single jet planes with a speed of 650 miles per hour, are lined up in fuselage and assembly room of this underground plant. The plant, which had been in operation for several months, had a reported output of 40 to 50 planes a month. A large elevator brought completed planes to the surface.

Success is a journey
Not a destination

The Language of Soviet Propaganda

By Colonel Carl F. Tischbein, General Staff Corps

Propaganda, like the air we breathe, is everywhere. Nowhere in America can we safely say that we are immune from its subtle influence. Whether we call it group appeal, advertising, or propaganda; whether it reaches us as a well-argued newspaper editorial, as a noisy, nerve jangling singing commercial, or whether it comes to us as a subtle, seemingly innocuous political harangue—whatever the medium, it all has one common goal; to influence our thinking and, resultantly, our actions. From Bar Harbor to Beverly Hills we are being ceaselessly bombarded by every form of propaganda known to man. Even the hours of silence at a certain radio station have thoughtfully been dedicated to a commercial interest. Appeals to passion, pride, and prejudice are constantly being thrust before us, and the public is whipsawed by so many conflicting interests that it is small wonder the more placid among us are prepared to damn every outward manifestation of what passes for group appeal, advertising, and propaganda.

When you buy soap do you demand "healthgiving properties," or "purity," or "aroma," or just a guarantee against plain B O? Must your cigarette be "easy on the draw," or "kind to your throat," or must it be "milder than the rest"? Do the goblins of pink toothbrush, falling hair, or athlete's foot plague your dreams? If so, you are "in the bag" for the sponsor of that particular brand of propaganda.

History relates that some three hundred years ago, Pope Urban VIII established a special college. It appears that doctrinal thinking had gotten out of hand, and that the teachings of Rome were in danger of distortion. The Pope therefore established a school to educate priests in the management of missions. From this set of circumstances came the development of organizations for spreading particular doctrines or systems, which, Webster now informs us, is the correct meaning of "propaganda."

Doctrines and systems are usually associated with philosophical concepts and creeds. And for the laymen this is where difficulties begin to sprout in great abundance. Philosophies are abstract and difficult of a simple explanation. General principles are usually buried underneath tons of generalities for which legions of apostles are required to unearth the grains of truth and to cast them up before the uninitiated. In addition, the terminology of philosophies is long-handled and difficult for the layman to understand. No wonder, then, that the average American has little patience and small understanding of purely expository presentations of either a philosophy or a creed in its pure form. These must be watered down with quotable passages and understandable terms of reference to be acceptable. And so it is with the language of Communism. The misunderstandings and the confusion as to Soviet aims that befuddle the average American are due, in large measure, to his lack of understanding of the philosophy of Communism and the apparent double talk which accompanies it.

Our failure to appreciate the facts of life concerning Communism may be laid to certain defects in our educational system. Unfortunately, our historians saw fit to place but little emphasis on the convulsing masses of Europe which from 1850 onward have played an even greater part in shaping the destiny of the Old World. Unfortunately, the study of political science has never held a popular appeal; and unfortunately, our geographers have laid but little stress on that vast region which now takes its orders from the Kremlin. As a consequence we lack the appropriate educational background to understand the dialectical rubbish coming out of Moscow. Karl Marx? Dr. Gallup would find a large segment of our population associating him with the famous Hollywood brothers.

Upon his return to Russia, Ilya Ehrenburg wrote, "Americans are inadequately acquainted with the rest of the world. They do not know the history or geography of the Old World. One group of school children was not able to name to me a single city in the Soviet Union." Then he put the finger on our present subject. "Their political level is just as low. People know the intimate side of the lives of senators, but in many states the word 'Socialist' let alone 'Communist' is considered offensive."[1]

It is precisely because as a people we have never schooled ourselves to the nuances of political dialectics that we find ourselves groping for an understanding of this thing called Communism. And because as a people we are not schooled in the fine art of political double talk, we are open to all sorts of foreign propaganda attacks. Were we to have even the merest elementary knowledge of the ways of politicians, we would understand that the words they use to explain their aims should not customarily be taken at their face value. Burnham states the case as follows: "The words used publicly by Communists about themselves and what they do are particularly misleading, because deliberate deception of others, as well as the normal unconscious self deception, are an integral part of Communism . . . The words it (Communism) uses must always be checked in terms of behavior, and may be taken at face value only when they sustain the check. We will find that some of its words, especially those written not for a general audience but by Communists for Communists, are usually revelatory of its inner meaning. But towards all words we must take the attitude: false, unless proved true."[2]

The Kremlin fosters subtle propaganda through misdirection. This has the virtue of resulting in confused thinking and is accomplished by using words which mean one thing to them and another to us. At Yalta President Roosevelt heartily endorsed the principle of "assisting peoples of the former Axis satellites of Europe to solve by democratic

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[1]Izvestia, July 16, 1946.

[2]Burnham, James, *The Struggle for the World*, pp. 56, 57. John Day Co., New York, 1947.

means their pressing political and economic problems." How little did he realize the course that history would take! It must have come as a rude shock to the State Department to learn that the goings-on in Bulgaria are strictly in accord with the "democratic means" envisaged by Yalta—as the Russians understand it. It behooves us, therefore, to learn what these more important terms mean to the Politburo and its communist philosophers. We must be sure to know precisely what the Soviets mean when they employ common words in uncommon ways. Quite obviously when Lenin remarked that the Soviet system was "a million times more democratic than any bourgeois democracy," he was using the term democracy in a sense quite different from that used on Pennsylvania Avenue or on The Hill. Just what do Communists mean by "democracy"? The answer requires an excursion into history.

Our conception of "democracy" has its roots deep in English history. Its origin can be definitely identified: 1215 AD on an island in the Thames. It was here that the detested and despised King John met with a delegation of barons whose supporters watched the proceedings from a marshy river bank still known as Runnymede. It was here that the assembled barons forced an obstinate and wicked King to recognize the dignity of the common man. The Magna Carta, with such provisions as "No freeman shall be seized or imprisoned, or dispossessed, or outlawed, or in any way brought to ruin; we will not go against any man nor send against him save by legal judgment of his peers or by the law of the land," and "To no man will we sell or deny or delay right or justice,"—this is the cornerstone upon which the morality of our understanding of the term is based. It is the mother document to which the Bill of Rights and our Declaration of Independence and Constitution are the rightful heirs. It is the foundation upon which we base our vaunted civil liberties. Professor Carr has stated our conception of "democracy" succinctly. He writes, "The right to dissent—or in other words, the protection of minorities—is the essence of English democracy; and the rule of law means the enforcement of the rights of the individual against the state. Hence the feeling rarely formulated quite explicitly but always latent in America if not in English politics, that democratic government means weak government, and that the less government there is, the more democracy there will be."[3] He echoes the Jeffersonian slogan, "The less government, the better."

The rights of the individual, as we see it, are supreme; and it is only by vigilant protection of these rights that the dignity of the common man may be preserved. We maintain that the system of government by which this may be brought about is termed "democracy." It is a precise denotation of its Greek derivative: strong people—that we use the word.

The communist conception of "democracy" stems from other roots. It is a Latin derivative and has its essence in French political philosophy. "Man is born free and yet is everywhere in chains." Such is the historic opening sentence of *The Social Contract* by Jean Jacques Rousseau in which the author influenced political thought during his time by theorizing that the cause of the world's ills could be traced to the current forms of government. He argued for a republican form of government and preached that the social contract abrogated the rights of the individual in favor of the state. He steadfastly maintained that the individual must conform to the "general will" from which it was high treason to dissent. Coming some twenty-five years before the bloodletting, he was nonetheless the spiritual father of the French Revolution. More important, perhaps, he was also the father of modern totalitarian democracy.

The French Revolution changed the window dressing of French politics. It was simply a victory for those who held certain views as to the authority of the state. This political reorientation did not change the basic tenet of French political philosophy: the state was supreme; the rights of the individual were to continue to be submerged to the rights of the "general will." Such was the political thinking on the Continent at the time of Marx.

At the time of his Manifesto this political concept was not known by the decorous term "democracy." At that time it was still a revolutionary movement with all the adverse connotations which that term implies. Marx called himself a democratic communist.

But after 1850 democracy and communism parted company; democracy was no longer revolutionary. It was now conservative and deemed acceptable in the better drawing rooms. It did not attract the lunatic fringe, the social misfits, those who felt themselves at war with the forces of economics, and those who for better or for worse felt the urge to overturn the natural laws of the social order. Marx thundered against the so-called democratic bourgeoisie and identified democracy with the enemies of the proletariat. He accused the bourgeoisie of selling out the proletariat. He preached the gospel of centralized control, of the supremacy of the "general will" over the rights of the individual. Since his death, the torch for this political concept has been carried by Lenin and Stalin. Centralized control is supposedly but a temporary expedient; it is to continue only long enough to permit the education of the hapless and ignorant masses of the proletariat in the arts of "democratic" government, after which a happy, carefree, classless state is promised. Until that Utopian day arrives, the vanguard of the proletariat will exercise power!

When the initial phase of the Cold War changed from studied and polite disagreements by Soviet diplomats to active, vociferous denunciations of certain ideas which we cherish, Soviet propaganda laid the accent on so-called American "imperialism." Pravda, Izvestia, and the Charlie McCarthy press of Soviet satellites opened all the stops on this new campaign. Vishinsky and Zhdanov gave the official Moscow blessing. In addition, the manifesto issued October 5, 1947 at Warsaw by the newly formed Information Bureau brought the subject up to date. The lusty comrades publicly announced "Two opposite political lines have crystallized: On the one extreme, the USSR and the democratic countries aim at whittling down imperialism and the strengthening of democracy. On the other side, the United States of America and England aim at the strengthening of imperialism and choking democracy."

It must seem a peculiar turn of events to the average American to hear himself denounced as an imperialist. Yet lest it be taken as a newfangled attack by Moscow, we

[3]Carr, Edward Hallett, *The Soviet Impact on the Western World*, p. 7. MacMillan, 1947.

should recall that Communism has always denounced "imperialism." Lenin wrote, ". . . it is inconceivable that the Soviet Republic should continue to exist for a long period side by side with imperialist states." Lesser fry have in the past railed against "the aggressive forces of imperialism," the "feverish preparations of American imperialism," the "struggle of 'American imperialism,'" and "imperialism, the modern stage of capitalism." The last phrase contains the germ of what the Soviets mean when they accuse the United States of "imperialism."

In his Manifesto Marx wrote, "Modern bourgeois society with its relations of production, of exchange, and of property, a society that has conjured up gigantic means of production and of exchange, is like the sorcerer, who is no longer able to control the powers of the nether world whom he has called up by his spells." This is the scarecrow by which Communism points up the evils which are supposed to result from free enterprise in a world of free men. But this is not the end. An increase in production brings an increase in capital. When these two forces are joined they spell "imperialism" to the Soviets. Communists fear the consequences which these forces can bring to bear. They see bank capital merged with industrial capital, and they see, with horror, excess capital exported. For wherever capital is present, they recognize the control which it exercises over industry. Wall Street is thus the harbinger of imperialism by Communist tenets. Advancing a step further in their theorizing, they blame Wall Street for the formation of syndicates, cartels, and international corporations. From this premise they conclude that the object of Wall Street is to secure for the United States the complete domination by monopoly over the economic life of the hapless nations caught in its nefarious schemes. Once economic monopolies have been effected, political domination is supposedly easy. Lenin has written, "Imperialism is capitalism in that stage of development in which the dominance of monopolies and finance capital has established itself; in which the export of capital has acquired pronounced importance; in which the division of the world among the international trusts has begun; in which the division of all territories of the globe among the great capitalist powers has been completed." Judged by these tenets the meaning of imperialism becomes clear.

To the Soviet mind the word freedom does not conjure up the same concepts that the word denotes to the American. It bears little or no resemblance or relationship to an exemption from necessity in choice or action. It has no proper connotation when applied in phrases such as "freedom of worship," "freedom of speech," "freedom of thought or expression." To the Communist these freedoms are purely coincidental, unimportant attributes of life in the Soviet state. The Communist considers them important only in imperialistic countries where the ruthless exploitation of the worker makes it mandatory for him to demand certain minimum safeguards to protect himself against his avenging capitalistic overlord. To the Soviet, freedom implies an absence of discrimination because of sex, color, or nationality, and involves an assurance by the state of economic security.

This freedom so stoutly cherished by the Communists is delineated in the Soviet Constitution of 1936. Therein we find freedom from economic insecurity spelled out in Article 118. Thus all citizens are guaranteed "the right of employment and payment in accordance with its quantity and quality." Article 123 outlines freedom from discrimination by reciting the equality of all citizens "irrespective of their nationality or race in all spheres of economic, cultural, social, and political life." Elsewhere the Constitution sets forth the guarantees of speech, press, and assembly.

"We are surrounded by people, classes, and governments which openly express their hatred of us," wrote Lenin. (Collected Works, vol. 27, p. 117, Russian edition.) Thus by specifically highlighting "classes" he emphasized one of the elementary concepts of Marxist philosophy. To whom are the Soviets referring when they unleash their diatribes against the "classes"? Just what do they mean when they refer to "class warfare"?

To the followers of Stalin as to the followers of Marx, the term class brings to mind the struggle of the worker against the bourgeoisie. Contrary to the popular belief that the Communists are referring only to the white collar class and the upper income group when they hiss their displeasure with the bourgeoisie, Marxist followers teach that all of capitalistic society is tarred with the same brush and must be eliminated. Do you happen to own a corner grocery store and operate it with your wife while a neighborhood boy occasionally delivers orders? Do you own a cigar store and hire a relief clerk to permit you a day off occasionally? In either case you are a filthy bourgeois and can look forward to harsh treatment from the Commies. In his Manfesto Marx outlined the dangers of considering the small shopkeeper class as friends of communism. He wrote, "The lower middle class, the small manufacturer, the shopkeeper, the peasant . . . are not revolutionary but conservative. Nay more: they are reactionary for they try to roll back the wheel of history. If by chance they are revolutionary, they are so only in view of their impending transfer into the proletariat; they thus defend not their present, but their future interest."

Communism recognizes but one class: the worker. He who earns his daily bread through his own singlehanded effort, he alone, is deemed fit to enter into the ranks of Communism. Everyone else, regardless of nationality, sex, or creed, is to be denied economic security as promised to the followers of Marx and Lenin. To the dyed-in-the-wool communist, it is "easier for a camel to go through the eye of a needle. . ."

When the New York *Times* on December 4, 1947 editorialized "There is no doubt about Mr. Molotov's cleverness in using a certain set of words to express opposite intentions," and then concluded, "It is the business of the Western Powers to find an answer to these tactics," this eminent newspaper placed proper emphasis on the necessity of our acquiring a working knowledge of language as employed by the Russians. A New Guinea native and a Park Avenue dowager can come closer to an understanding by means of the sign language than can two PhD's when the latter use identical words which to each have a different meaning. Until we understand the language of Soviet propaganda, we shall continue at a disadvantage in attempting to evaluate Russian actions both at home and abroad. International poker is fraught with danger when the wild cards are known only to one of the players!

If War Comes To The Arctic*

By Colonel Paul V. Kane, Field Artillery

Winter warfare in the Arctic or Sub-Arctic regions would provide a test for man and machine more severe than any recorded to date in military history.

When one contemplates war in the Arctic regions it is natural to ask: "What would be the objectives in the Arctic?" An examination of a map will readily show that there are no industrial areas, no great centers of population, no large ports, no network of communication and no great deposits of natural resources in the Arctic.

How then could the Arctic regions figure in any war in the future? The answer, of course, is that since the shortest inter-continental air routes pass over the Arctic regions, these areas contain the air highways over which invading armies may move in the future.

It is now commonly accepted that any future war will start with a tremendous air attack, followed by an airborne invasion. Anyone who has even the slightest acquaintance with the situation in the northernmost areas of the North American Continent will readily admit that an airborne attack is the only feasible manner of attack in those areas.

Since communications as known in the Temperate Zone are nonexistent in northern areas, it would be practically impossible to move large masses of troops overland. And as there are no industrial areas in the extreme northern regions, the only objective an invading army could find there would be the existing air bases or areas considered suitable as potential bases.

Winter warfare in the Arctic is such a serious problem that it is believed no nation would risk it unless it felt that it had sufficient force available to achieve a quick, easy victory and push through into the vital areas farther south.

The advantage, of course, will be with the attacker in an invasion through the Arctic, because he can choose the time and the weather which favors his manner of attack. However, if the initial attack fails to achieve complete success, it is believed the advantage will quickly shift to the defensive. That has happened twice in invasions of Russia. The invading armies initially had the advantage, but as their communications lengthened and supplies became scarce, the advantage quickly passed to the defending troops who had short communication lines, ample supplies and comfortable shelters.

Although a war may start as an airborne attack, if a stalemate develops, it is certain that other ground forces will be employed as soon as they can be transported to the battlefield by any means available. Someone has said that no matter how or where wars start, they all end in mud.

The question as to which season of the year favors the invader in the Arctic seems to have no clear-cut answer. For a nation that has a large number of troops, well trained in winter warfare and inured to the rigors of an Arctic winter, it would appear that the winter would be the ideal time to launch an attack. This would be particularly true if the nation attacked were one poorly equipped for, or untrained in winter warfare. The winter season offers many advantages. The flying conditions at that time are ideal. The frozen lakes and rivers covered with a layer of soft snow, furnish excellent emergency landing fields for airplanes and gliders, and also ideal drop zones for paratroops. Even the frozen tundra, covered with forty inches of snow, affords better emergency landing facilities than the spongy marshes of the summertime.

While the rigors of winter warfare for ground forces are very severe in extremely low temperatures, the personnel of the air force and airborne troops transported in heated planes will not suffer any appreciable loss in efficiency until ground operations start.

It is admittedly difficult for troops to move on foot through deep snow, but in many cases it is easier to move over deep snow than over the spongy muskeg found almost everywhere in the summertime. There is no way to escape the wet muskeg in the summertime, as it exists wherever the permafrost prevents subsurface drainage. Another distinct disadvantage in a summertime attack is the presence of an enormous number of mosquitoes that thrive in the stagnant water of the small lakes and ponds. However, inasmuch as the anopheles mosquito is rarely found in the Arctic the control of malaria should not be a serious problem.

Although an airborne attack could be launched at any time of the year, it is believed that late fall or early winter offers the best conditions for such an attack since at that time the snow is not deep and the lakes and rivers are frozen sufficiently to support light tracked vehicles. Because of the difficulties foot troops encounter in moving through deep snow, it is believed that any plan for an airborne attack in the Arctic would provide for jumping directly on to the objective or in a drop zone in very close proximity to it. At extremely low temperatures, it would also be necessary to drop stoves, fuel and small, light tents to protect troops required to remain in the open for protracted periods.

The most serious problem confronting any force operating in the Arctic will be that of logistics. In any area where ninety per cent of the goods consumed have to be imported, neither the invader nor the defender can hope to live off the land or even obtain any assistance from local sources.

In the initial stages of an Arctic war, almost all supplies would have to be airborne. This would certainly be true for the invading forces and would also be true for the de-

*Reprinted, courtesy of *Military Review*.

fending forces unless foresight and vision had provided for large reserves of supplies.

This fact would place a definite limit on the size and weight of the weapons available to the attacking force.

If the invading force can seize air bases early and maintain air supremacy, the problem of supply by air is relatively simple. If at any time, however, the invader loses complete mastery of the air, or is forced out of his air bases and compelled to depend on air drop for his supplies, his supply problems increase one hundred fold. Supply by air drop is one of the most costly methods of supply yet encountered in military operations. Even when goods are well packaged and dropped by parachute, the losses are considerable as many crates fall into areas from which they cannot be recovered. When free drop is employed, even at low altitudes, there is an enormous amount of wastage from broken packages and widely scattered supplies. If suitable, cleared areas are available, supply by glider is a much more practical and efficient method than that of dropping supplies.

The question is often asked: "Will an Arctic war require an entirely new weapon or vehicle?" The answer to that at the present time, is no. All the present weapons and vehicles will function at extremely low temperatures if proper lubrication is provided. The very best of maintenance is required on all weapons and vehicles and, of course, the rate of movement for both man and vehicle is greatly reduced in deep snow. Wheeled vehicles will have very limited use in Arctic warfare and will probably be replaced by full-track vehicles. Present vehicles will undergo some changes to give better over-snow traction and more rapid starting of engines.

Arctic warfare will probably see no great changes in tactical doctrine. The principles that have been sound in temperate climates apply as well in the extreme cold. Men operating in deep snow, and low temperatures, become exhausted much sooner than under more favorable conditions, and will have to be replaced after very short periods of combat.

This means that units must have much greater depth in attack formations, and reserves must be readily available with sufficient transportation to move them quickly to front-line positions without taxing their energy unduly. Reserves must also be protected from the elements as long as possible before their employment, otherwise they will be nearly as exhausted as the troops they relieve.

Maintenance becomes a very serious problem at extremely low temperatures. Any given operation such as replacing a track on a tank will require five times as long at −50°F. as it will at +40°F. This means that all maintenance personnel must be greatly increased if a reasonably high standard of maintenance is to be secured in Arctic operations.

Casualties will be much greater in Arctic warfare than in any war to date. Added to the normal hazards of the battlefield will be that of freezing. An uncovered human hand will start to turn white after two minutes exposure at −50°F. After one hour of exposure at this temperature, it would probably have to be amputated. Even a slightly wounded man usually suffers some shock and loss of body heat. At temperatures below 0°F. a wounded man must be placed immediately in a very warm casualty bag and given hot beverages if he is to survive. This means that all medical personnel must be greatly increased over that provided for in present tables of organization, and sufficient equipment must be provided to insure prompt and efficient evacuation of wounded. If this is not done, the percentage of deaths among the wounded in Arctic warfare will be staggering.

Since history has not recorded to date a single war in the the Arctic regions, there is no experience to draw upon in visualizing what a war in those areas would really be like. Although the experiences of Napoleon's Army in Russia in 1812 and those of the Germans during the winter of 1941-1942 give a valuable preview of what may be expected in Arctic warfare, the conditions those armies encountered were not nearly so severe as might be encountered in the coldest regions of the Arctic.

There is a great deal of difference between conditions encountered at −30°F. and those met at −60°F. Likewise, operating in populated areas where there are buildings and roads is much less difficult than in a barren land where habitations and roads scarcely exist.

Operations in the Arctic regions will always be classed as special operations and will call for very carefully selected and trained men. Extremely heavy casualties will be the price that must be paid if this precaution is not taken. Also, ground troops must have the very best of equipment in excellent condition and big reserves of supplies.

Although war in the Arctic may be initially an air or airborne war, if it should develop into a stalemate, the side which can first bring its armor to bear will have a big advantage. Any ground combat in the Arctic, involving the use of armor, would place the aggressor force at a distinct disadvantage, as it is unlikely that anything other than the very lightest of armored vehicles could be brought in by air transport.

Although the tank moves more slowly in deep snow than on cleared ground, it can serve a double purpose in breaking trail for the advancing infantryman, and at the same time covering his advance by fire. The tremendous shock action of armor is no less valuable in the Arctic than elsewhere. In fact, it appears to be more pronounced because the foot soldier cannot escape the tank, inasmuch as foxholes in snow offer no protection, and it is practically impossible to dig foxholes in the frozen ground. Although deep snow reduces the speed of a tank, there are few real obstacles to a tank in the Arctic. Rivers and lakes are usually frozen solidly enough to take even the heaviest tanks. Where thin ice has to be crossed, it can be reinforced with timber. Forests in the Arctic are no serious obstacle because at very low temperatures all trees except the very largest ones will snap and break like matchwood when struck by a tank. Any tracked vehicle can cross with impunity a mine field which is covered with eighteen inches of snow.

In view of the tremendous strides that have been made in recent years in the development of weapons and in the tactics and technique of the various branches of the armed forces, even the most experienced military man hesitates to assume the role of prophet. However, it is believed that

a round-table discussion on future Arctic warfare by a group including scientists, explorers, and army and navy officers who have had experience in the Arctic Regions, and who are familiar with modern weapons and equipment, would find almost unanimous agreement on the following salient points:

1. If war comes to the Arctic, it will come in the form of a tremendous air attack, or possibly a sneak airborne attack followed by a big advance of air forces.

2. An enemy advancing through the Arctic will probably seize what bases he needs and destroy all others.

3. No nation will risk warfare in the Arctic until it has ample supply of the very best equipment obtainable and has an ample force of men trained especially for cold weather operations with the particular equipment necessary.

4. No military force will tarry in the Arctic any longer than is necessary. It will probably leave sufficient force to protect its lines of communications and then hurry on to its main objective farther south.

5. The best way to stop an air invasion through the Arctic is to throw a deep air block in the way of the enemy. This requires a warning net and intelligence organization of the most dependable type.

6. In Arctic warfare, fortune will always favor the side with the "warmest suits" and the most "reliable engines." Neither raw courage nor even all the intangibles together can ever compensate for the lack of proper equipment and the Arctic "know how."

Signal Corps Makes Blizzards To Order

Man-made blizzards, equalling the intensity of storms experienced in the most remote Arctic regions, are being manufactured at will by engineers in the climatic test chambers of the Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey.

The Signal Corps' development of actual snow on a continuous basis, and in sufficient quantity to test military equipment under simulated Arctic climatic conditions, is believed to be the first accomplishment of its kind on record.

The results developed by the Signal Corps are considered of major importance as compared with previous snow-making endeavors which were confined to refrigerating machines. These produced snowflakes, but not in the three- to four-inch depth which makes Signal apparatus testing possible in a chamber large enough to house many men and many articles of equipment.

The made-to-order blizzard is produced in a large low temperature test chamber, slightly larger than a four-room house, and spacious enough to accommodate a large truck and trailer. Its action may be viewed through large multi-plane glass observation windows, specially designed and built to prevent frosting. The temperature is maintained at 40 degrees below zero by one of the largest low temperature refrigerating plants in the East using large ammonia compressors powered by more than 700 horsepower of electric motors. Test engineers are clothed in fur-lined parkas, boots and mittens, giving a colorful aspect to the performance.

A careful pre-conditioning of the test room precedes the manufacture of snow. This period is of sufficient length to remove much of the heat stored in the air, walls and floors of the test chamber. Saturated steam at high temperature is then injected into the test room to create an atmosphere saturated with moisture and containing water vapor in suspension which forms a visible cloud or fog.

This cloud rapidly cools to a temperature below the freezing point of water (32°F) to form a super-cooled cloud identical to those found in nature. When the super-cooled cloud reaches a temperature of plus 5° to 10° above zero nucleation may be induced through the simple process of shaking a small bag of dry ice, about the size of a finger tip, in it. When the cloud reaches a temperature near minus 40°F the water vapor crystallizes, forming literally billions of microscopic snow crystals.

The hexagonal crystals are carried in the air and immediately collide with other crystals, then pick up still others to form the small snowflakes that pile into a mass of snow that blankets the test room floor.

With steam vapor continually entering the test room and the temperatures carefully controlled, the snow process is maintained. A minimum of 36 hours of operation is needed to accumulate the snow of worthwhile depth and workable quantities for equipment testing use. In a recent test, snow accumulated over a three-day period of manufacture, completely hid walls and ceiling and covered the floors and equipment under test to a depth of three to four inches.

High velocity winds, carrying the fine, dry snow particles. are produced by a high-speed motor-driven propeller.

Production of a small scale Arctic-type blizzard in a laboratory is the result of many months of study into natural atmospheric phenomena and factors essential in the process of snow creation. This was supplemented by many hours of experimentation to mechanize the process, plus determination of critical factors affecting the formation of true snow crystals.

But, the engineers say, much has yet to be accomplished before the necessary controls are defined and established to place the generator procedure entirely under the control of the test engineer.

The blizzard-making tests already serve a twofold value. Besides providing a reproduceable test condition simulating actual Arctic climate found in natural environments, the man-made snow in sub-zero atmosphere eliminates much of the disadvantages and expense of transporting equipment and personnel to distant locations for actual tests.

Defense Against Aircraft and Jet-Propelled Missiles*

By Constantin Paul Lent

In any future wars rockets and thermal-jets will be used to a great extent. The United Nations will eventually have to set up restrictions for the use of rockets. From the expert's point of view, there is no efficient and sure protection against aircraft, propelled or jet driven, carrying atom bombs, unless they can be detected and destroyed before reaching their objectives. The expert knows that right now no such detection is possible in the case of rockets. As for the layman, he has been told again and again that there is no defense against atomic bombs and that control by the U.N. is the only way out.

The real menace is not the atom bomb itself, but the plane or rocket carrying the bomb. Bubonic plague can be spread to this country by rats brought from the Orient in ships. In this case the rats are not the real menace; it is the ship bringing in the rats. As long as ships coming from the Orient are forced to pass a strict quarantine, the rats will be destroyed at the source, and the spreading of the plague will be halted. This form of thinking applies in the case of atom bombs carried by rockets. The rocket ship of the future will be the bearer of that undesirable stowaway, the atomic rat. To control the spread of the atomic disease will require the control of the use of the rocket. Atomic power, just like the rat, cannot be completely eliminated. It will stay with us, but the movements of the rocket ship carrying the atomic menace can be controlled and quarantined.

In the event of another war, large cities and industrial centers will feel the first brunt of enemy attack. The enemy will launch his attack by air and remote control. Rockets and long-range bombers will be used. Rockets with atomic war heads are in the process of development. If atomic force is outlawed, you can be sure that the enemy will throw anything that he can get his hands on and that can fly long distance. Long-range bombers, jet-propelled or otherwise, will be used in great numbers, showering down blockbuster bombs.

Both sides might use atomic rockets and bombs, but only as a last resort. Nations will be wary of using atomic missiles because of public opinion.

To abolish future wars, disarmament of all nations is the only answer, but until this comes to pass, and for the sake of being on the safe side, preparedness is the thing. Naturally, attack weapons are needed to win a war, but defense weapons are also needed in great quantities in order to stay in the fight. Otherwise a nation can be knocked out in the first few hours of conflict. Since this book has not been written to propagate war, I will simply discuss those weapons needed for defense against an attack from the air. I will also delve into the manner in which an attack can be launched by remote controlled bombers or rockets.

In the future, bombing will be carried out by pilotless planes and rockets called "drones." Drones are not new. Small, specially built radio-controlled planes were used as far back as 1926. The name "drone" originated in England during the war. The mother ship from which a "drone" is controlled was named the "Queen" by the British. In the United States, the "Queen" is known as "Mother" while the drone is called the "babe." Radio control used in drones can be applied to super bombers and rockets.

Crewless planes or rockets can be flown anywhere in any kind of weather, a fact which must be considered in preparing defenses for future wars. Fleets of drones, carrying blockbuster or atomic bombs, can destroy any major city in no time at all. Making things even more difficult, the defenders will not know which of the attacking craft are real and which are dummies. All craft—friendly, enemy, real, dummy, pilotless, or otherwise—will have to be blasted out of the sky to insure adequate defense.

The control center for a drone is a box with a small stick and several buttons. The box is portable and its operator is known as the "Beep-pilot." The drone can be controlled by moving the "stick" several times, or by manipulating the buttons; this operation transmits a radio signal which is picked up by the drone. The transmitter usually works on a high frequency wave, which operates on one radio channel having ten audio-frequencies, each corresponding to the number of control operations for directing the drone in flight, take-off, and landing.

The drone is equipped with a receiver and the signals are amplified to control a number of relays. In many instances a pair of television cameras are used to extend the range of the drone beyond normal visual distance. One camera scans the instrument panel, and the other looks out of the cockpit of the drone. What they see is sent back to the mother plane or to the operator on the ground.

By means of a two-way switch, the television images re-

*Extracted from Mr. Lent's book, "Rocketry," by permission of the author.

ceived from the drone can show a tele-picture either of the instrument panel in the "babe" or the area in front of the craft. The operator can control the drone from the ground or from the mother plane, but this arrangement is good only as long as the "babe" remains fairly close and within range of the television transmitter, because television waves operate in a straight line of vision and cannot bend around corners or the horizon.

Eventually this difficulty will have to be overcome so that the drone can be controlled hundreds or even thousands of miles away from the operator. I think the problem can be solved by the use of relay stations. These stations can be placed 60 to 100 miles apart, parallel with the course of the "babe." They will be located mostly on elevated ground or in high flying balloons moored to rafts on the water or to the earth by means of weights. In this way, airplane drones can be controlled from very far off.

For rockets, the situation is more difficult. To facilitate longer control ranges for rockets, relay stations will have to be located upon secondary rockets instead of upon the ground or in balloons. This plan calls for the sending off of a number of relay rockets beforehand, with the rocket carrying the atomic war head coming last. For a distance of 3,000 miles across the ocean, five or six of such relay rocket stations might be sent out preliminary to launching the rocket carrying the explosives.

Of course, the business of the defenders will be to try to intercept these rockets. Several counter-rockets of their own might be sent up in the hope of scoring a bull's-eye hit on the enemy missiles. But this is a ticklish task. I believe that scoring a bull's-eye on an enemy rocket is close to impossible, although it might be done. To intercept one object traveling at 4,000 miles per hour with another object traveling at the same or even higher speed, will mean that both bodies will have to meet head-on at a relative speed of 8,000 m.p.h.

The impossibility of such a task is apparent. Because enemy rockets will approach at speeds many times higher than the speed of sound, they cannot be detected from afar by the usual sound detection equipment. Nor can radar be used, as short waves do not bend around the horizon. Consequently, it is believed that at present there is practically no defense against rockets. Even if there was a slim chance of destroying the enemy rocket missiles before they reached the target, at least one rocket might pass through the defense, meaning the end of the defenders. Destruction of all missiles in the air is the only answer.

To prevent the mishap of even one atom rocket bypassing the defense, I am suggesting the use of a new kind of anti-rocket defense. I call it the Multibulleted Proximity Fuse Rocket. My plan is to saturate the air above the defended target with a great number of explosive pellets or bullets so as to provide a protective screen or umbrella. Any missile trying to pass this screen will be destroyed.

The proximity fuse itself is not a new device. It was used effectively against the German rockets in the V-1 robot bomb attack on the English shores. It was first used in shells way back in 1940 by the U. S. Army, and really represents the answer to an artillery man's prayer. The fuse is so effective that the aiming of shells has been improved by about 500 per cent.

The fuse works on the so-called "Doppler Effect," which is nothing else but a rebounding wave signal. The working of the Doppler effect can be compared with the change in the pitch of sound when one approaches a waterfall and again when one goes away from it. As the falls are approached, the pitch of sound of the tumbling waters rises. Now the proximity fuse is equipped with a small radio set which sends out radio signals. These signals rebound from the objects in the path of the shell, and as the shell comes closer and closer to the object, the pitch of the rebounding radio wave goes up until it reaches certain proportions. To detonate the bursting charge within the shell, a detonator is hooked with the fuse in such a manner as to explode the charge at the right moment, depending upon the pitch of the rebounding wave.

The radio set of the proximity fuse is very small. It is just 1½ inches in diameter and only a few inches in length. It fits easily into the front portion of a four-inch shell, and the amplifier tubes are about 1¼ inches long. The proximity fuse has been used in bombs, torpedoes, and rockets with telling effect.

The proximity fuse could be used with the Multibulleted Rocket. The latter consists for the most part of a war head studded with a plurality of explosive bullets located in the head of the missile, a bursting charge inside the shell to drive the explosive bullets, and a rocket driving charge which is contained in a long tube located in the rear.

Depending on the size of the rockets, the war head is equipped with from 50 to 500 explosive bullets set in a cast-steel shell which has many circular cavities formed all around the head and equally spaced from each other. The outside of the head is fitted with a pointed metal hood covering the tips of the bullets, while the inner portion of the shell carries an explosive charge and a detonator. The detonator is touched off by the proximity fuse which is located in the upper portion of the rocket.

In the rear, the rocket is fitted with a tube carrying a sufficient quantity of propelling charge. As this kind of rocket will be used exclusively for defense against atomic rockets, the driving charge must be sufficient to lift the rocket into the regions visited by the enemy atomic missiles.

I believe that these rockets can best be used close to the regions at which the enemy rockets are aiming. It is understood that the first business of the defenders will be to destroy all possible enemy rockets before they reach their targets. Should some of them go through, they can be dealt with by the Multibulleted Rocket barrage. The rockets in question will be launched against the enemy missiles from racks or specially constructed rocket guns, and will be fired in volleys of several hundred at a time. The firing will have to begin immediately upon the announcement by detector stations that some enemy missiles have passed the first line of defense and are nearing the vicinity of the objective.

As soon as the rockets have been launched by the defenders and have passed beyond the tallest buildings in their vicinity, the proximity fuse will commence sending out sound waves. Should the waves be deflected by an object in the air, the pre-set detonator will detonate the charge and will allow the bullets to be discharged in bunches all around the enemy missiles.

The destruction area of a large antiaircraft rocket or

shell is a few dozen feet at the very most. The advantage of the Multibulleted antiaircraft shells or rockets over standard varieties is the fact that the explosive bullets ejected from the war head traverse a much larger distance than shrapnel, and might be made to travel even farther than a machine-gun bullet. Any object in the vicinity of several hundred feet from the explosion area of the rocket will therefore be hit. The proximity fuse might be set to operate the detonator when the rocket is 50 to 100 feet from the target.

To defend an area, the enemy rockets must first be intercepted before the target is reached; and secondly, any rockets that have passed the first line of defense must be destroyed right above the objective. This strategy calls for an umbrella defense consisting of a screen of thousands of explosive bullets.

In many cases the fuse might detonate the rocket due to the proximity of other defense rockets in the rocket barrage, but this will not decrease its effectiveness. The main object is to cover the space above the defended area with an umbrella of explosive bullets. As long as the umbrella is maintained, any enemy rocket trying to pierce it will be destroyed.

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Willy Ley as mentioned in the last issue is one of the outstanding authorities on rockets. He came to this country in 1934 after being vice-president of the German Rocket Society. For several years he was Science Editor of the New York daily, *PM;* but is now a research engineer with the Washington Institute of Technology. (Page 25)

Major H. F. Rolph served in the Pacific for thirty-six months as a gun battery commander, gun battalion S-3 and and group S-3. He is now assigned to the Department of Tactics, AA and GM Branch, The Artillery School and is currently teaching the subject about which he writes. (Page 30)

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Major General C. T. Robinson was assigned by the then Secretary of War to investigate foreign logistical organization and methods in April 1947 and continued this work till August 1947. This article is virtually part of the completed report which General Robinson submitted to the Secretary of the Army based on the findings of his committee. (Page 37)

Colonel Carl F. Tischbein contributes his third article on Russia to the JOURNAL in this issue. The study of Russia is one of his main interests and his articles reflect the amount of knowledge he has gathered on the subject. (Page 43)

Colonel Paul V. Kane was commanding officer of Task Force Frigid which conducted cold weather tests in Alaska during the winter of 1946-47. (Page 46)

Constantin Paul Lent is the author of the book "Rocketry" from which this article is extracted. He is also editor and publisher of the magazine, *"Rocket-Jet Flying."* (Page 49)

G. Edward Pendray has been associated with the development of rockets since 1930 and helped organize the American Rocket Society. He is now assistant to the President of Westinghouse. His article is extracted from his book, "The Coming Age of Rocket Power." (Page 52)

THE PERSISTENT MAN*

By G. Edward Pendray

After Congreve, the rocket had to make a new start. The start was supplied by Dr. Robert Hutchings Goddard, a young American physicist of Worcester, Mass.

A native New Englander, Dr. Goddard was a slender, quiet young man; early bald, careful of words and precise in thinking. He has always disliked publicity, and to this day he is almost unknown as a person, though famous for his work. His correspondence with fellow rocket experimenters has been a series of firm, crisp, disappointing negative. He declines to enter into any of the lengthy discussions by mail which other experimenters and enthusiasts enjoy so greatly. When asked for word of his current work, it is his custom to say that it has not yet progressed sufficiently to justify a report.

Yet more than anyone else this steadfast, inventive and intuitive man has been responsible for the world-wide renaissance of the rocket in our time. Goddard is the true father of modern dry-fuel and liquid-fuel rocketry.

Born in Worcester on October 5, 1882, his early schooling and his college work were all obtained at Boston, where he lived until he was sixteen, and at Worcester, where he was graduated from the Worcester Polytechnic Institute in 1908. His academic career was conventional, rising in the usual steps from fellowship to instructor to assistant professor and finally to full professor at Clark University. His only "foreign" adventure was to accept a research fellowship at Princeton, in 1912, the year following completion of his work for the degree of Doctor or Philosophy at Clark.

In his school days he was a serious young man, with an odd streak of scientific speculativeness in his nature. He enjoyed mathematics, was fond of figuring out faster ways to travel, and better ways to do things in general. In his freshman year at college one of his professors assigned the topic "Traveling in 1950" as a theme subject. Goddard produced a bold paper which he read before the class, describing in some detail a railway line in which the cars were supported electromagnetically without any metal-to-metal contact, in a tube from which the air had been exhausted. With such a vacuum railroad he calculated it would be perfectly possible to make enormous velocities safely; for example, a running time of ten minutes from Boston to New York.

Ten years later, when the French inventor Emile Bachelet proposed a similar plan for an electromagnetic railway, the editor of the *Journal* of the Worcester Polytechnic Institute remembered Goddard and wrote him for comment. Goddard produced a thorough mathematical critique of Bachelet's "frictionless railway," and sent along a short story based on the theme, which he had written about 1906.

As a young professor of physics, Goddard made contributions of importance on the conduction of electricity in powders, the development of crystal rectifiers, the balancing of airplanes, and the production of gases by electrical discharges in vacuum tubes. During his fellowship at Princeton, he produced the first laboratory demonstration of mechanical force from a "displacement current" in a magnetic field; this current being the fundamental concept in Maxwell's theory of electromagnetic waves (radio). These exploits however were merely by-products and tune-ups. His real love, after he had been led into it by curiosity about the upper stratosphere, was rockets and jet propulsion.

Goddard comes of an old New England family; one of his ancestors was Captain Levi Pease, who operated an early stagecoach line between Boston and New York. His father was in the business of manufacturing power-driven knives of the sort used in cutting paper and wood. The whole Goddard family was interested in transportation and mechanics: he grew up in an atmosphere of machinery and engineering accomplishment.

He doesn't remember exactly when he made his first experiments with rockets, but recalls quite vividly carrying on some static tests with small rockets in 1908, in the basement of Worcester Tech. He promptly filled the whole place with smoke, and had to talk fast to get out of trouble. While at Princeton in the season of 1912-13 he made the computations that formed the basis of his Smithsonian paper of 1919. It was in this period, when about thirty, that the great excitement of discovery first began to come to him. The calculations showed that only a little fuel, relatively, would be needed to lift a pay load to really great heights by rocket. The theory, in fact, was so promising he could hardly wait to begin transforming his figures into actuality.

Upon returning to Clark in 1914 he began experimenting with ship rockets, which he purchased out of his slender salary as an instructor. Next came tests with steel rockets using smokeless powder, fired both in air and in a vacuum. Connection to a vacuum pump required the installing of extensive piping in the basement workroom at Clark. On one occasion Dr. A. G. Webster, head of the physics department, viewed the pipe system with an admiring eye. "Well, Robert," he exclaimed, "when you go I hope you leave all this tubing here!"

In the course of these experiments, Goddard spent some eight hundred dollars of his own money, and by 1916 had reached the limit of what he thought he could do on his own resources. Being inexperienced in the ways of self-promotion, he could think of no way to obtain a backer except to make out a report of what he had done with rockets, and

*Extracted by permission from Mr. Pendray's book "The Coming Age of Rocket Power," copyright 1945, 1947, by Harper & Brothers.

project what he thought could finally be accomplished. With characteristic thoroughness, he cast the paper into the best scientific form, rewriting it several times. To complete the job he bound it in a special cover with a neat gold border, and sent it away to one foundation after another, hoping for support.

The Smithsonian Institution was almost the last address on his list. After filing away the collection of polite refusals he had received from the others, it was with some hesitation he sent the document forth once again. This time, after an interval of about three weeks, he received a letter from Dr. Charles D. Walcott, then secretary of the Smithsonian, commending him on his report, and asking how much would be needed to continue the work. Goddard debated between asking a safe $2,500, which he felt would be inadequate, and $10,000, which perhaps would be enough but might be refused. Finally he compromised on $5,000—and by return mail received a warm letter granting his request. Folded with the letter was an advance of $1,000; the largest check he had ever seen.

Then began the series of experiments which were to launch modern rocketry and gain Goddard world-wide prominence. Almost nobody except those immediately engaged knew what these experiments were until the first Monday morning in January, 1920, when the Smithsonian Institution issued a news release on the work and simultaneously published the Worcester scientist's first paper on rockets: a modest sixty-nine-page monograph bound in brown paper, entitled "A Method of Reaching Extreme Altitudes." It was issued as a part of the Smithsonian Miscellaneous Collections, Volume 71, No. 2. Exactly 1,750 copies were published. This classical treatise, which marked the beginning of an era, is now out of print. Since the war it has become such a collector's item that even photostatic copies are quoted by booksellers at $35 each.

Goddard divided his initial paper into three parts, dealing respectively with the theory of rockets, the experiments he made before 1919 (some of them at Worcester Polytechnic Institute and the others at Mount Wilson Observatory during the first World War)* and the calculations derived from theory and experiment.

It is these calculations which are today the most interesting. Among other things he figured out the "initial masses" of a series of theoretical rockets which would be powerful enough to lift a pay load of one pound to various heights in the atmosphere. Making some assumptions as to the jet velocities attainable, and the efficiency of his reaction motors, he concluded that to raise one final pound of rocket to a height of 35 miles would require a starting weight of only 3.66 pounds, provided an "effective velocity" of 7,000 feet per second could be obtained.

This "effective velocity" was a figure representing the performance of the rocket. Goddard assumed that it would not be impossible to attain an "effective velocity" of 7,000 feet per second, though today this proposition does not appear as simple as his early calculations made it seem.

To show what really great altitudes could be obtained with a relatively small starting weight, continuing to assume an "effective velocity" of 7,000 feet per second, he showed that an altitude of 71 miles would be reached with a total starting weight of 5.14 pounds; 115 miles with a starting weight of 6.40 pounds, and 437 miles with an initial mass of only 12.33 pounds.

Just in case these high "effective velocities" would not be forthcoming, Goddard also made calculations for an "effective velocity" of 3,500 feet per second, which he declared would allow of "considerable inefficiency in the rocket apparatus." The starting weights for the various altitudes now came out higher: 12.6 pounds for 35 miles, 24.36 pounds for 71 miles, 38.1 pounds for 115 miles, and 267.7 pounds for 437 miles. Even here, Goddard concluded, "the mass is sufficiently moderate to render the method perfectly practicable."

As a way to construct rockets with a suitable ratio of propellant to structure to permit of such high altitudes, Goddard went on to give a clear explanation of the theory of the step-rocket, a device upon which he had himself received the basic patent nearly six years earlier, July 7, 1914. A step-rocket, of course, is a multiple rocket, in which the larger part is consumed, to give high velocity to the smaller part. Two, three or more rockets may be joined together in this way and shot in series, each charge giving increased velocity to the portion that remains.

He also disclosed that he had put to rest the old fallacy that a rocket thrusts by "pushing against the air." He had shot rocket motors in partial vacuum, and obtained results equal to or even better than at atmospheric pressure. Likewise, he had tackled the problem of constructing dry-fuel motors separate from the powder charge, and had developed successful intermittent motors in which the propellants were inserted by a device working on the general principle of the machine gun.

He ended the report with what was, for 1919, a startling conclusion: that in theory at least it should be perfectly possible to shoot a rocket at such velocity that it would not return to the earth. With a total launching weight of only eight or ten tons, he estimated, a rocket could be constructed capable of carrying enough magnesium powder to create a telescopically visible flash against the dark side of the moon.

It was this discussion of a possible moon-rocket, rather than the less spectacular but more practical work reflected by the rest of the book, that most forcefully reached the public. Newspaper readers across the continent were moved to excitement, comment and derision. The rocket came forth once more out of the history books and military museums and began to have the beginnings of a new world prominence—only this time with an ironic twist. During the period when for the first time it was really undergoing something like genuine scientific development, the rocket was to become, to many unthinking people, a symbol of

*After the entry of the United States into the war in 1917, Goddard volunteered his services and was set to the task of exploring the military possibilities of rockets. He succeeded in developing a trajectory rocket which fired intermittently, the charges being injected into the combustion chamber by a method similar to that of the repeating rifle. The rocket had five charges and was capable of carrying an iron weight which simulated a war head. He also developed projectile rockets up to three inches in diameter, intended to be fired at tanks and military personnel from a launching tube held in the hands and steadied by two short rear legs; a device in many respects similar to the "bazooka" of World War II. These weapons were demonstrated at Aberdeen Proving Grounds on November 10, 1917, before representatives of the Signal Corps, the Air Corps, the Army Ordnance and others. The demonstrations went off successfully, but the Armistice next day put an end to the war and also to the experiments. Goddard's data on these weapons have ever since been locked in the archives of the War Department at Washington.

impractical ideas and fantastic schemes. Everyone who had to do with rockets during the next two decades was to be branded as "queer"; and rocketors were to inherit the mantle of ridicule previously worn by airplane pioneers.

The publicity accompanying the release of Goddard's report made a stir abroad as well as in this country. In 1919 rocketry was completely dead in Europe, and had been since before the turn of the century. Unexpectedly in 1923, there appeared a highly technical little book printed in Munich at the author's own expense, called Die Rakete zu den Planetenraumen, or in English, "The Rocket into Interplanetary Space." The author was an unknown professor of Hermannstadt, Transylvania, named Hermann Oberth. His book bristled with technical language and obscurities.

Oberth had received a copy of Goddard's 1919 report directly from the author in late May or June of 1922, in response to a quaintly worded letter in English written from Heidelberg May 3 of that year.

Dear Sir: (Oberth wrote Goddard)

Already many years I work at the problem to pass over the atmosphere of our earth by means of a rocket. When I was now publishing the result of my examinations and calculations, I learned by the newspaper, that I am not alone in my inquiries and that you, dear Sir, have already done much important works at this sphere. In spite of my efforts, I did not succeed in getting your books about this object. Therefore I beg you, dear Sir, to let them have me. At once after coming out of my work I will be honored to send it to you, for I think that only by common work of the scholars of all nations can be solved this great problem.

Yours very truly,
Hermann Oberth, stud. math. Heidelberg.

Oberth's book set forth in greater detail than Goddard's reports the theoretical background of possible interplanetary travel by means of rocket power, and touched off a great controversy. Technical men in high places, some of whom had apparently not even read the book, criticized and ridiculed it. Oberth also had his adherents; men of similar ideas began to write books in defense and explanation.

One of the volumes soon to follow was written by Dr. Walter Hohmann, city architect of Essen-on-the-Ruhr. Its confounding title was Die Erreichbarkeit der Himmelskorper, or "The Attainability of the Celestial Bodies." He dealt, in a fashion even more bloodless and mathematical than Oberth, on the theoretical problems of departure from the earth, return to the earth, free coasting in space, circular orbits around other planets, and landing on the celestial bodies.

It was not until Max Valier, later to become famous as a spectacular experimenter with rockets and rocket cars, wrote his book, Der Vorstoss in den Weltraum ("A Dash into Space") late in 1924 that the subject began to come down out of the clouds and take on a semblance of something that ordinary people could understand. Valier's book discussed interplanetary flight in laymen's language. It still contained mathematical passages (written for him, it has been reported, by Oberth) but these could be skipped by the reader without losing any of the sense of the argument.

In 1926, Willy Ley, a young man who was later to become one of the organizers of the Verein fur Ramschiffahn (the German Rocket Society), joined this battle of the books with a small volume of eighty-three pages, entitled Die Fahrt ins Weltall ("Traveling in Space"). In the ensuing five years many other German books appeared on rockets, rocketry and flight to interplanetary space. These included, besides the technical and popular books, a manuscript for a film entitled Frau im Mond ("The Girl in the Moon"), written by Thea von Harbau, then the wife of Fritz Lang, the motion-picture director. This later was turned into a popular movie and also a novel, and was to play a curious part in the story of rocketry in Germany. In France, at least one important book on rockets and interplanetary flight soon appeared: a small monograph by Robert Esnault-Pelterie, an aircraft engineer and manufacturer. It was later enlarged into a major book, L'Astronautique. In Russia, books on rocketry and interplanetary travel began coming from the press as early as 1924.

But in terms of furtherance of the rocket, all this unfortunately meant very little. The Germans were too busy arguing the merits of space flight to do any actual experimenting. The British and French were entirely oblivious of the practical side of the matter. The Russians were making some preliminary moves toward experimentation, but had not begun to do anything. In the meantime Goddard was going doggedly ahead, making and shooting rockets.

After the publication of "A Method of Reaching Extreme Altitudes," which dealt so optimistically with dry-fuel propellants, Goddard came to the conclusion that despite the convenience of these fuels they could not bring about the results he had in mind. Accordingly he gave them up and turned his attention to the problems of developing liquid-fuel rockets.

From 1920 until 1922 he made what are now known as proving stand tests with liquid-fuel motors, trying liquid oxygen and various liquid hydrocarbons, including gasoline, liquefield propane and ether. He presently decided that liquid oxygen and gasoline made the most practical combination; virtually all of his subsequent liquid-fuel experiments were carried out with these liquids.

By 1923—the year Oberth's book appeared in Europe—Goddard had reached the point of trying an actual shot with a liquid-fuel rocket. Still working with funds supplied by the Smithsonian Institution, he constructed a small rocket in which the fuels were fed to the motor through pumps. This contrivance was tried on the proving stand, but was not released for flight. Two years of further experiment followed, culminating in the production of a second gasoline and liquid-oxygen rocket. This one dispensed with pumps and made use of nitrogen gas under pressure to force the propellants into the combustion chamber. Like its predecessor, it was not considered good enough to release for actual flight.

A year later Goddard finished his third liquid-fuel rocket, and on March 16, 1926, let it fly. This was the first actual shot of a liquid-fuel rocket anywhere in the world. It occurred at Auburn, Massachusetts, on a cold, clear spring day. There was snow on the ground, a couple of inches or so. The experimenter and his assistants were heavily

bundled up: Goddard in a huge double-breasted overcoat and a flat cloth cap. Though his associates wore gloves, he went barehanded, his gloves crammed into the bulging pocket of his coat.

The only witnesses to that historic flight other than Dr. Goddard himself were Henry Sachs, machinist and instrument maker of the Clark University shop; Dr. P. M. Roope, assistant professor of physics at Clark (now head of the physics department), and Mrs. Goddard, who came along to take the pictures which later documented the report.

The rocket was an odd and fragile-looking contrivance. The motor, with its metal nozzle nearly as long as the cylindrical blast chamber, was mounted at the forward part of the rocket in a slender frame consisting of the fuel pipes, crossed by a bracing strut engaging the nozzle. The whole rocket was about ten feet tall; the motor measured over all about two feet, and fuel tanks were about two and a half feet long. The motor was thus separated from the rest of the rocket by an air gap of four or five feet, bridged by the thin metal tubing that conducted the propellants.

The purpose of this arrangement was to place the motor at the front, where Goddard then believed the thrust should be applied for the best stability in flight. The motor was ignited through a tube at the top, the ignition being supplied by an assistant equipped with a blowtorch on a six-foot pole. In pictures taken before the shot, the assistant is shown posing calmly with the blowtorch held at the ignition point. It is probable he was not quite so collected when the actual shot occurred, for the ignition period is a touchy moment in the launching of any rocket—if it is going to explode, it most likely will do so then.

Goddard's 1926 rocket did not explode. Instead, it took off with a loud roar, rose in a high trajectory, and flew for two and a half seconds, traveling a distance of 184 feet. Timing it with a stop watch, he calculated later that its average speed was 60 miles an hour.

This pioneer rocket was not, obviously, very well laid out for flight. The design was unnecessarily awkward because the motor had been placed at the front—an early error of almost all rocket experimenters.

The location of the motor with respect to the center of gravity of rockets is still a subject for some debate among experimenters, but Goddard, who has built many since that day in 1926, has delivered himself unequivocally on the subject.

(The combustion chamber and nozzle were located forward of the remainder of the rocket, to which connection was made by two pipes. This plan was of advantage in keeping the flame away from the tanks, but was of no value in producing stabilization. This was evident from the fact that the propelling force lay along the axis of the rocket, and not in the direction in which it was intended the rocket should travel, the condition therefore being the same as that in which the chamber is in the rear of the rocket. The case is altogether different from pulling an object upward by a force which is constantly vertical, when stability depends merely on having the force applied above the center of gravity.)*

The 1926 rocket had another feature of interest: the fuels were forced into the motor by oxygen gas pressure. The evaporation of the liquid oxygen, together with oxygen pressure gas supplied before starting, furnished pressure during the flight.

Following this first shot, other short flights with liquid-fuel rockets were made at Auburn; all very quietly, with such elaborate secrecy that nobody but the experimenter and his immediate circle knew what was going on. But rocket experimentation is hard to keep a secret; the rocket itself is a mighty self-advertiser. On July 17, 1929, Goddard shot a rocket of some size, big enough to carry a small barometer and a camera. It made noise in proportion. Someone who witnessed the flight from a distance mistook the rocket for a burning airplane and notified the police and fire departments.

Goddard was on the front pages of the newspapers again the next day: for the first time, virtually, since the publication of his "A Method of Reaching Extreme Altitudes." This time the uses of publicity were to be proved to him in a most pleasant and exciting way. Colonel Charles A. Lindbergh, then at the height of his popularity, read about Goddard's experiments and became interested. He communicated his interest to Daniel Guggenheim, and the capitalist made a grant of funds to put Goddard's work on a considerably more adequate financial basis.

Goddard meanwhile had moved his experiments to more secluded quarters at Fort Devens, Massachusetts, on ground placed at his disposal by the United States Army. Here, though he was free from unwelcome visitors, the work was going slowly, principally because of the difficulties of transportation.

When word came of the Guggenheim grant, the first job was to select a suitable site for the experiments. He chose New Mexico, it being a country "of clear air, few storms, moderate winds and level terrain." The final decision fell upon the vicinity of Roswell, in the south, where there were good power and transportation facilities. The actual site was the Mescalero Ranch, where a shop was erected in September, 1930, large enough for himself and four assistants. A small tower 20 feet high was then built near the shop for static tests, equipped with heavy weights to keep the test rockets from rising out of the tower. A 60-foot launching tower previously used at Auburn and Fort Devens was put up about 15 miles away, for flight tests.

The first project was to develop a standard rocket motor which would deliver dependable power. The motor finally produced was 5¾ inches in diameter and weighed 5 pounds. Its maximum thrust was 289 pounds and it could burn 20 seconds or more. Goddard later stated that this motor produced the equivalent of 1,030 horsepower, or 206 horsepower per pound, the horsepower being calculated from the energy of motion of the blast, with the rocket held at rest.

On December 30, 1930, the first flight of a rocket at the New Mexico site took place. The rocket was 11 feet long, and weighed a little over 33 pounds. It reached an altitude of 2,000 feet, and a maximum speed of 500 miles an hour.

It was big, but it set no altitude record, for as Goddard later pointed out, his first objective was to produce a dependable rocket, not to see how high he could shoot. To this end he also began studying the problem of stabilizing

*Liquid Propellant Rocket Development (Smithsonian Institution) 1936.

the flight, for he had become convinced that it was impossible for a rocket to fly even straight up without some sort of controlling device.

The first flight of a gyroscopically controlled rocket was made on April 19, 1932. In this rocket the steering vanes were forced into the blast of the rocket motor by gas pressure—the pressure, and therefore the amount of steering, being controlled by a small gyroscope. The scheme showed some signs of working, but the test was hardly a complete success. Goddard concluded that the vanes used in the experimental model were too small.

When the original Guggenheim grant was made, it had been agreed to undertake the work in New Mexico for two years; then study the results with a view to a two-year extension. To supervise things, a committee had been named, headed by Dr. John C. Merriam, then president of the Carnegie Institution, and including such other scientific figures as Dr. Charles G. Abbot, then secretary of the Smithsonian Institution, Dr. Walter S. Adams, director of the Mount Wilson Observatory, Dr. Robert H. Millikan, president of the California Institute of Technology, and Colonel Lindbergh.

This committee gravely studied Goddard's reports, and recommended the granting of funds for the two additional years. But the great depression was then on. Goddard went back to Clark University to resume his teaching. The Smithsonian Institution, loath to see the research come to an end, made a small grant to permit some laboratory tests that did not require rocket flights. In the following year the Daniel and Florence Guggenheim Foundation also came to the rescue, and work was resumed in New Mexico in 1934. Taking another leave from Clark University, Goddard went back to Roswell, swept out the shop, cleaned the lathes, fixed up the towers, and resumed his experiments.

The job, now, as he saw it, was to develop fully stabilized flight, by whatever would be the simplest and most effective means.

In the beginning he tried a device to which many an experimenter has given thought—a stabilizer operated by a pendulum. Some stabilization effect can be obtained by this means, but as the rocket's acceleration increases, the pendulum becomes less effective, because the direction of the pendulum is inevitably a resultant between the acceleration of gravity and the acceleration of the rocket.

Goddard's pendulum-controlled rocket rose about 1,000 feet, bellied over, flew horizontally for about two miles, and landed 11,000 feet from the launching tower. At one point the speed exceeded 700 miles an hour—or nearly the speed of sound.

Goddard next approached the stabilizer problem by returning to his first idea, a small gyroscope. With his gyro-control, a series of beautiful rocket shots were made, beginning March 8, 1935, when the gyro-rocket reached an altitude of 4,800 feet, flew a horizontal distance of 13,000 feet, and made a maximum speed of 550 miles an hour. The gyroscope was set to correct the flight when it deviated 10 degrees or more from the vertical. Since this permitted a considerable lag, especially at the beginning, the first few hundred feet of flight looked like a fish swimming gracefully upward into the air. As the rocket picked up speed, the oscillations became much smaller, then virtually disappeared.

The equipment was gradually improved. A notable gyro-controlled flight was made on October 14, 1935, when the rocket rose 4,000 feet. On May 31, 1935, a gyro-rocket reached an altitude of 7,500 feet, or nearly a mile and a half. As in the previous experiments, Goddard was not attempting to set altitude marks in these shots, but was still concentrating on the complicated task of developing the apparatus to a state of reliable performance. His gyro-rockets weighed from 58 to 85 pounds at starting, and some were 10 to 15 feet in length.

Goddard concluded his latest report, in 1936, with the remark that the next step in the development of liquid-propellant rockets is the reduction of weight to a mimimum, a natural prelude to high-altitude shots.

"Some progress along this line," he dryly remarked, "has already been made." The exact nature of this progress has not yet been disclosed, but it is known to have included the development of liquid-fuel pumps, which may make gas pressure unnecessary in future Goddard rockets.

In 1940, Goddard reported to Washington, along with many another rocket experimenter, for work on projects which understandably cannot now be described. Responding to a query from an officer of the American Rocket Society, of which he is of course a member, he recently declared that he has definite plans to continue his rocket research in New Mexico as soon as war conditions will permit. And this time he may be ready, at last, to see some altitude records.

Consult the Book List in this issue and use the Handy Order Form to order any books on the list or any others you may desire.

General Henagan

General Sage

General Fisher

General Moore

General Hausauer

FEDERAL RECOGNITION GIVEN CAC NATIONAL GUARD GENERALS

Five prominent CAC National Guard officers; Brigadier Generals John C. Henagan, Charles G. Sage, George W. Fisher, Russell Y. Moore and Karl F. Hausauer, have been Federally recognized.

General Henagan has long been associated with National Guard CAC activities. After lengthy service in the 263d CA Regiment of South Carolina, he assumed command of the 107th CA Battalion which he took overseas in 1942. He was later given command of the 5th AAA Group after his promotion to Colonel, and he remained in that position till his return to the United States in August 1945.

While overseas General Henagan participated in seven campaigns.

His present National Guard assignment is that of Assistant Division Commander of the 51st Infantry Division.

General Sage is well remembered by Coast Artillerymen as Commanding Officer of the 200th CA Regiment of the New Mexico National Guard and later as Commanding Officer of the Philippine Provisional Coast Artillery Brigade. He surrendered with his Brigade to the Japanese on Luzon on 9 April 1942 after distinguished service, and he was held as a prisoner of war until his liberation on 15 October 1945.

He was appointed Adjutant General of the State of New Mexico on 1 May 1946, and now commands the 111th AAA Brigade of the New Mexico National Guard.

General Fisher has a record of overseas service in both wars with the Coast Artillery Corps. He was assigned to the 65th CA Regiment in World War I. In the last war he took the 377th AAA AW Battalion overseas in September 1943 and commanded this Battalion during its combat service with the 4th Infantry Division throughout the entire European campaign.

General Fisher now commands the 114th AAA Brigade of the California National Guard.

General Moore has a long record of service in the Connecticut National Guard, particularly with the 242d CA Regiment which he commanded from 1932 until 1944. During the course of the recent war he commanded a provisional C.A. Brigade at Fort Leonard Wood, Missouri, and served on the War Department General Staff.

He was Chairman and later steering member of the War Department General Staff Committee on National Guard Policy.

He is at present Acting Assistant Adjutant General of the State of Connecticut and commands the 103d AAA Brigade of the National Guard of that state.

General Hausauer helped to organize and recruit the 209th CA Regiment of New York. He brought part of the Regiment into Federal service in 1941 and sailed with the Regiment to Ireland in May 1942.

After arriving in Ireland, he was transferred to the Artillery Staff of V Corps.

Later he became Chief of Transportation, Signal and Ordnance of the G-4 Section, ETOUSA, SOS.

He was then assigned to the Overlord planning staff in London. After approval of the invasion plan by the Combined Chiefs of Staff, he was assigned to the General Staff of SHAEF where he served until his return to the United States after VJ Day.

General Hausauer now commands the 105th AAA Brigade of the New York National Guard.

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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

Although not attached to the 31st Brigade at the particular time this picture was taken, the 214th AAA Gun Battalion was with the Brigade during part of its operations in combat.

New Assignment for General Lutes

Secretary of Defense Forrestal has recently designated our Association President, Lieutenant General LeR. Lutes, as Deputy Chairman of the Executive Committee of the Munitions Board. In this assignment he will act as Deputy to Mr. Thomas J. Hargrave in the latter's capacity as ex-officio Chairman of the Executive Committee.

General Lutes assumes his new position after a tour as Director of the Service, Supply and Procurement Division of the Army, a position which the General occupied during the critical period following the cessation of hostilities.

We know that General Lutes carries the good wishes of the entire Corps with him as he assumes the responsibilities consistent with his new assignment.

Rockets and Guided Missiles Discussed

Although the rocket today is in the same stage of development as was the airplane at the end of World War I, it has brought more knowledge about the earth's upper atmosphere in the past year than had been acquired in the previous 20 years.

This new information has been acquired by the installation of scientific instruments in the warheads of V-2 rockets fired at the White Sands Proving Ground in New Mexico, according to Dr. C. F. Green, consulting engineer in General Electric's Aeronautic and Ordnance Systems Divisions in Schenectady, N. Y., who spoke recently before a joint meeting of the Engineering Society of Milwaukee and the Milwaukee chapters of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

Discussing "Rockets and Guided Missiles," Dr. Green said, "Rockets and guided missiles are demanding attention today because the possibilities for the future are so great. In no other branch of technical endeavor, except possibly one, is there such a variety of fields of science involved. Advances in all of these fields are required to make possible the needed performance for future usable weapons."

He listed requirements as including new and greater energy fuels and propellants, more powerful motors, new heat-resistant materials, more accurate guiding and navigation equipment, better control means, radar of improved types. "Above all," he declared, "is needed greater knowledge of ballistics, aerodynamics, particularly supersonic and upper atmosphere conditions."

Missiles that fly continuously around the earth at terrific speeds, and even inter-planetary missiles are indicated for the future, according to the speaker, who pointed out technical advances made in rocket development work.

"Exercise Snowdrop" Completes First Training Phase

The first of four phases of "Exercise Snowdrop," the Army Ground Forces' cold weather training exercise being carried out by the 505th Airborne Battalion Combat Team at Pine Camp, New York, has been completed.

Included in the first month of the exercise was individual training in the use of weapons and equipment, cold weather survival instruction and methods of constructing temporary shelters. Even though the command "Mount Skis" was never given due to lack of sufficient snow, instruction in skiing and snowshoeing was given the airborne troops by an expert ski team from Camp Carson, Colorado.

In preparation for the airborne missions of the exercise, the parachute maintenance section of the combat team has been improving apparatus for special equipment drops, in addition to improvising on standard equipment for carrying cold weather equipment during jumps.

An engineer platoon has cleared the training drop zones of stumps and other obstructions. Training for the Engineers during the first month consisted of basic bridge construction and laying mine fields.

Service firing of 75mm Pack Howitzers by "A" Battery of the 456th Parachute Field Artillery Battalion highlighted the artillery training. "A" Battery is commanded by Captain Wallace Beulow, a veteran of last year's Task Force Frigid in Alaska.

Lieutenant Colonel Robert H. Wienecke, of Glencoe, Illinois, "Snowdrop" Commander, told his troops: "Our first phase has been entirely successful. If this individual training phase is indicative of the over-all success of the Exercise, I feel extremely confident we will more than justify our fortunate selection to do this job."

The paratroopers are now poised to enter the second phase of the exercise which will emphasize squad size tactical training and practical use of instruction on skis and snowshoes. Pine Camp is now covered with approximately 12 inches of snow and the second bivouac in freezing temperatures by the airborne men began in December.

Company problems, including an airborne mission and 48 hours in tactical training over the snow-covered terrain, will be included in the third phase of "Exercise Snowdrop." Climaxed by a 72-hour airborne exercise built around the establishment of an airhead, "Exercise Snowdrop" will be concluded sometime in February.

Automatic Weather Stations

The Signal Corps has developed an automatic weather station designed to replace manned stations where it is impossible to maintain observers. The equipment contains elements for measuring atmospheric pressure, temperature, relative humidity, wind direction, and rainfall.

Radar Fire Control

A recent report revealed that the Navy has designed a 3-inch twin automatic gun which may be an answer in part to the missiles of the future.

It will be equipped with a revolutionary radar fire-control system by which the mount automatically picks up any enemy aircraft or missile, tracks it, computes all necessary corrections for windage, temperature, and similar factors, and opens fire at effective range.

New Members of Association Executive Council

The following officers have been elected to the Executive Council as a result of the balloting conducted in the September-October and November-December issues of the JOURNAL:

Vice President
- Major General Lyman L. Lemnitzer

Council Members
- Colonel Paul H. French
- Colonel Leonard L. Davis
- Colonel John H. Madison
- Lieutenant Colonel Sam C. Russell

The Council as it is now constituted may be seen in the masthead on the opposite page.

Standby Reenlistments Authorized for GI's Crowded Out of Colleges

The Army and the Air Force have acted to take some of the pressure off the Nation's overcrowded educational institutions in 1948. Recognizing that veterans using their GI Bill of Rights benefits have jammed the housing accommodations and classes at most of the Nation's colleges and universities, the services have now made it possible for short-term men to continue in uniform on a standby basis until the institution they wish to attend under the GI Bill has room for them.

Under the new plan those serving short-term enlistments in the Army or Air Force who have unused educational benefits under the GI Bill of Rights may extend their enlistments to three, four or five years with the promise that they will be discharged at any time subsequent to completion of their original term of enlistments in order to use their educational benefits.

Discharge will be granted when an application is accompanied by a letter from the registrar or other appropriate official of an accredited educational institution stating that the applicant has been accepted for enrollment during a specific school term. In every case, discharge will be accomplished a full month before the beginning of the school term.

New Weapons Research

The Government is spending hundreds of millions of dollars in preparation for possible war in the upper atmosphere, war involving supersonic speed, and war in Arctic cold, President Truman's scientific research board reported recently. Discussed in the report are studies for development of guided missiles, jet and rocket aircraft, atomic weapons, and a host of electronic devices.

Among the more significant electronic developments is a "revolutionary radar fire-control system" which may one day be perfected into a defense against rocket-borne weapons of atomic warfare.

Unit History Received

The following unit history has been received since the

last issue of the JOURNAL:

184th AAA Gun Battalion.

Any other CAC units which have completed histories are requested to forward a copy to the JOURNAL office where they will be kept in a permanent file as a readily accessible source of historical information.

Additional National Guard Units

The following National Guard Coast Artillery Corps units have been Federally recognized since the last issue of the JOURNAL:

California:
- Battery "B," 272d AAA AW Battalion, San Diego
- Battery "A," 682d AAA AW Battalion, San Diego
- Battery "C," 682d AAA AW Battalion, Lynwood
- Battery "B," 720th AAA Gun Battalion, Long Beach
- Battery "B," 746th AAA Gun Battalion, San Diego

Connecticut:
- Battery "C," 745th AAA Gun Battalion, New London
- Battery "D," 745th AAA Gun Battalion, New Haven

District of Columbia:
- Battery "A," 340th AAA AW Battalion, Washington
- Battery "B," 340th AAA AW Battalion, Washington
- Battery "C," 340th AAA AW Battalion (SP), Washington
- Battery "B," 380th AAA AW Battalion, Washington

Illinois:
- Battery "B," 396th AAA AW Battalion (SM), Bloomington
- Medical Detachment, 396th AAA AW Battalion (SM), Bloomington
- Battery "C," 693d AAA AW Battalion, Chicago
- Battery "B," 698th AAA Gun Battalion, Chicago
- Medical Detachment, 698th AAA Gun Battalion, Chicago

Minnesota:
- Battery "B," 256th AAA AW Battalion (SP), St. Paul
- Battery "C," 256th AAA AW Battalion (SP), St. Paul
- Battery "D," 256th AAA AW Battalion (SP), St. Paul
- Battery "C," 598th AAA Gun Battalion, Duluth
- 723rd Ordnance Maintenance Company AA, Duluth

New Hampshire:
- Headquarters & Headquarters Battery, 210th AAA AW Battalion, Berlin
- Battery "D," 210th AAA AW Battalion, Franklin
- Headquarters & Headquarters Detachment, 237th CA Battalion, Dover

New Jersey:
- Medical Detachment, 122d AAA Gun Battalion, Atlantic City
- Battery "B," 122d AAA Gun Battalion, Atlantic City
- Headquarters & Headquarters Battery, 311th AAA AW Battalion, Newark
- Battery "A," 311th AAA AW Battalion, Newark
- Medical Detachment, 311th AAA AW Battalion, Newark
- Headquarters & Headquarters Battery, 372d AAA Group, Newark

Nevada:
- Battery "B," 421st AAA Gun Battalion, Winnemucca

New Mexico:
- Headquarters, 200th AAA Group, Roswell
- Headquarters, 515th AAA Group, Roswell
- Headquarters, 697th AAA AW Battalion, Roswell
- Battery "B," 697th AAA AW Battalion, Carlsbad
- Battery "C," 697th AAA AW Battalion, Artesia
- Headquarters Battery, 716th AAA Gun Bn., Deming
- Battery "C," 716th AAA Gun Battalion, Lordsburg
- Battery "D," 716th AAA Gun Battalion, Hot Springs
- Headquarters Battery, 717th AAA Gun Battalion, Albuquerque
- Battery "A," 717th AAA Gun Battalion, Farmington
- Battery "C," 717th AAA Gun Battalion, Socorro
- Headquarters Battery, 726th AAA Battalion, Albuquerque
- Battery "C," 725th AAA Battalion, Santa Fe
- Headquarters Battery, 804th AAA AW Battalion, Tucumcari
- Battery "D," 804th AAA AW Battalion, Clayton
- Headquarters Battery, 894th AAA AW Battalion, Tucumcari

New York:
- Headquarters & Headquarters Battery, 7th AAA AW Battalion (SM), Albany
- Battery "A," 7th AAA AW Battalion (SM), Albany
- Battery "C," 7th AAA AW Battalion (SM), Albany
- Medical Detachment, 7th AAA AW Battalion (SM), Albany
- Headquarters & Headquarters Battery, 72d AAA Gun Battalion, Buffalo
- Battery "A," 72d AAA Gun Battalion, Buffalo
- Headquarters & Headquarters Battery, 223d AAA Group, Brooklyn
- Headquarters & Headquarters Battery, 244th CA Group, New York City
- Headquarters & Headquarters Battery, 245th AAA Battalion, Brooklyn
- Battery "A," 245th AAA Battalion, Brooklyn
- Battery "C," 245th AAA Battalion, Brooklyn
- Headquarters & Headquarters Detachment, 259th CA Battalion, New York City
- Headquarters & Headquarters Detachment, 289th CA Battalion, New York City
- Headquarters & Headquarters Battery, 336th AAA Gun Battalion, Utica
- Medical Detachment, 369th AAA Gun Battalion, New York City
- Headquarters & Headquarters Battery, 369th AAA Gun Battalion, New York City
- Battery "A," 369th AAA Gun Battalion, New York City
- Battery "B," 369th AAA Gun Battalion, New York City
- Battery "C," 369th AAA Gun Battalion, New York City
- Battery "D," 369th AAA Gun Battalion, New York City
- Headquarters & Headquarters Battery, 870th AAA AW Battalion (SP), New York City
- Battery "A," 870th AAA AW Battalion (SP), New York City
- Battery "B," 870th AAA AW Battalion (SP), New York City
- Battery "C," 870th AAA AW Battalion (SP), New York City

Battery "D," 870th AAA AW Battalion (SP), New York City
Battery "C," 989th AAA AW Battalion, Rochester
Headquarters Battery, 952d 6" Gun, New York City
Headquarters Battery, 953d 6" Gun, New York City
CA Battery, 986th, 90mm (AMTB), New York City
CA Battery, 987th, 90mm (AMTB), New York City
CA Battery, 988th, 90mm (AMTB), New York City

North Carolina:
Headquarters & Headquarters Battery, 150th AAA Gun Battalion, Wilmington
Battery "A," 150th AAA Gun Battalion, Wilmington

Ohio:
Headquarters & Headquarters Battery, 183d AAA AW Battalion, Ft. Hayes
Headquarters & Headquarters Battery, 371st AAA Group, Dayton

Pennsylvania:
Headquarters & Headquarters Battery, 118th AAA Group, Philadelphia
Battery "A," 689th AAA AW Battalion (SP), Pittsburgh
Battery "B," 689th AAA AW Battalion (SP), Pittsburgh
Headquarters & Headquarters Battery, 709th AAA Gun Battalion, Philadelphia
Medical Detachment, 724th AAA Gun Battalion, Pittsburgh

Rhode Island:
Battery "A," 243d AAA AW Battalion, Providence

South Carolina:
Battery "A," 713th AAA Gun Battalion, York

Virginia:
Medical Detachment, 691st AAA AW Battalion (SP), Portsmouth

Washington:
Headquarters & Headquarters Battery, 420th AAA Gun Battalion, Yakima
Battery "B," 420th AAA Gun Battalion, Prosser
Battery "C," 420th AAA Gun Battalion, Pasco
Battery "D," 420th AAA Gun Battalion, Pasco
Battery "B," 700th AAA AW Battalion (SP), Shelton
Battery "D," 770th AAA Gun Battalion, Seattle

National Guard to Get More Weapons, Equipment

An increase in weapons and other equipment issued to National Guard Army units to meet their expanded strength since Federal recognition has been announced by Major General Kenneth F. Cramer of the National Guard Bureau.

"The amount of ordnance equipment available to hundreds of units will be doubled or tripled in accordance with their growth since they were Federally recognized, contingent on adequate storage facilities and existing supply conditions," General Cramer said.

"The National Guard, with approximately 200,000 men in training, has reached the stage where equipment, storage and training facilities are of prime importance."

Of the more than 3,400 Army units Federally recognized since postwar organization of the National Guard began in June 1946, approximately 2,200 in the States, the Territories and the District of Columbia will be eligible for the higher equipment allotments.

Units reaching Stage III in assigned strength (40 per cent officers and 30 per cent enlisted men) will be able to requisition up to 50 per cent of their peace strength allotment in crew-served weapons, vehicles and gas masks, and up to 75 per cent in individual weapons. (Crew served weapons, such as machine guns, artillery, etc., require more than one man for operation.) (Full peacetime strength of National Guard units is set at 80 per cent of the full wartime strength tables of organization.)

Units reaching Stage V (60 per cent officers, 50 per cent enlisted men) will be eligible to requisition up to 100 per cent of individual weapons, up to 75 per cent of the others.

Equipment for National Guard Army units is supplied by the Department of the Army. In general, units are issued 25 per cent of their ultimate equipment allotment, dependent on the supply status of individual items, on being granted Federal recognition. Units are eligible for recognition on reaching 25 per cent officer and 10 per cent enlisted strength.

Equipment used by the National Guard is equivalent to that of the Regular components.

For example, on Federal recognition an infantry rifle company is issued carbines, machine guns, mortars, grenade and rocket launchers, as well as automatic and garand rifles, automatic pistols and vehicles of various types.

Units that have now reached the required stage strengths will have their equipment augmented in line with the new percentage allowances as quickly as possible under requisition from the states and contingent on storage and existing supply factors.

National Guard Increases Fire Power of its AAA

The Army will increase the fire power of its National Guard Antiaircraft Artillery by eliminating all searchlight battalions and converting its semi-mobile gun and semi-mobile automatic weapons battalions to completely mobile outfits according to the Chief of the National Guard Bureau.

"As an integral component of the Nation's security establishment, the new National Guard is organized to be most effective in any emergency," General Cramer said. "This action, which is in accord with policy approved by Secretary of the Army Royall, will increase the mobility of the Guard's Antiaircraft Artillery and keep it in line with the Regular Army."

Six searchlight battalions, 21 semi-mobile automatic weapons battalions and 24 semi-mobile gun battalions which already have received Federal recognition are immediately affected. They will be converted to mobile automatic weapons and gun battalions as quickly as new equipment can be supplied.

Ultimately, 98 battalions and supporting elements will be affected, including some 600 individual units with a planned strength of 58,975 men. The postwar National Guard was given an allotment of 21 searchlight battalions, 32 semi-mobile gun battalions and 45 semi-mobile automatic weapons battalion.

Although no increase in the number of Antiaircraft Artillery battalions is contemplated, approximately 2,500 officers and enlisted men will be added to the troop basis.

The new-type battalions, being completely mobile, will

be able to move all their equipment at one time instead of returning for part of their equipment or requiring attachment of outside transportation as was the case with the semi-mobile units.

New Officer Promotion Policy Adopted for National Guard

A new promotion policy for officers of National Guard Army units has been announced by Major General Kenneth F. Cramer, Chief of the National Guard Bureau.

Under its terms, minimum service in grade in the postwar National Guard plus a rating of excellent will make officers eligible for promotion to the next grade. Affected are the ranks of first and second lieutenant, captain, major and lieutenant colonel.

Hitherto, vacancies in these grades, with the exception of second lieutenancies, could be filled only by men having held similar positions in grade or responsibility during active Federal wartime service. Second Lieutenants may be commissioned from among eligible enlisted men of the first three grades.

For promotion to the next grade the following minimum service in grade in the postwar National Guard is required with the exception that service in a similar rank during the war may also be counted toward the minimum requirement:

Second Lieutenant	2 years
First Lieutenant	3 years
Captain	5 years
Major	3 years
Lieutenant Colonel	4 years

Under a special provision, officers appointed to a lower grade because there was no vacancy in their unit for the higher grade but actually performing the duties of the higher grade may be promoted to the higher position after a minimum of one year service with an efficiency rating of excellent.

The new rules will prevent a loss of valuable officer material to the National Guard. Under the wartime service requirement it was necessary to fill many vacancies with officers who were within a year or less of the maximum age level for their particular grade. Instead of the men being forced to resign when they reach the maximum age limit for their grade they may now be promoted to vacancies in the higher grade if they meet the new minimum service requirements.

Officers Federally recognized in the postwar National Guard in the grades affected included 1,095 lieutenant colonels, 644 majors, 4,732 captains, 4,936 first lieutenants and 2,093 second lieutenants, for a total of 13,500, as of October 31, 1947.

Bombs Buried

Shortage of magazine storage space for the large quantity of ammunition now on hand has led to the development by the Ordnance Department of a process of burying bombs in the earth to preserve them. Called "Operation Buried Alive," this new project, which is still in the experimental stage but which gives every promise of being completely successful, can result in substantial savings.

First, it can eliminate need for new magazine construction; secondly, it will cut surveillance to a minimum; and thirdly, it will make no longer necessary periodic inspections with possible renovation and repeated coating with preservative materials.

Additional ORC Units

The following ORC unit has been activated since the last issue of the JOURNAL:

California:

330th Coast Artillery Battery, HD (6" Gun), Maywood.

New Airborne Tactics

General Jacob L. Devers, Commanding General of the Army Ground Forces, predicted recently that in future wars infantry troops will drop from the skies with full combat equipment in detachable airplane compartments. Each parachute unit would contain several men. Paratroops using individual parachutes, he said, are on the way out.

These developments may take the form of droppable or detachable compartments. Eventually, the entire plane will parachute to a landing, utilizing some refinement of the German-invented ribbon parachute which is already undergoing tests for landing cargo, he said.

With airborne infantry divisions, and with standard infantry divisions completely air-transportable, airheads within striking distance of an enemy's factories, stockpiles, launching sites, and airfields could be established more quickly and easily than beachheads far remote from the sources of his attacks.

Correction to Address Supplement

The following officer's address was erroneously listed in the address supplement which accompanied the September-October issue:

Colonel Ferdinand F. Gallagher, 935 26th Street, Arlington, Virginia.

New Powder

A patent on a new method for making rifle powder has been granted to a New Jersey man. The new propellant uses violent explosives like TNT and PETN, formerly employed only as bursting charges in high-explosive projectiles, for boosting bullet speeds.

The trick lies in finely pulverizing the high explosive and imbedding each of its tiny grains (about .003-inch in diameter) in a pellet of conventional smokeless powder. This sets off thousands of small bursts of high energy behind the bullet, without generating uneven or dangerously high pressure in the weapon's bore. The new propellants have been tested in both military and sporting cartridges.

Remember the Journal and the discounts we grant if you are interested in purchasing books, magazines or engraving.

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 WILLIAM L. SCHREIBER
LIEUTENANT COLONEL FREDERICK N. WALKER, JR.
MAJOR FRANCIS J. PALLISTER
CAPTAIN HAROLD R. BRANTNER
CAPTAIN KARL S. HARRIS

Metal Pontoons for Seacoast Artillery Target M10. This Section recently has received these pontoons for service test. There are two pontoons to replace the three wooden pontoons presently used on the M10 target. These pontoons are made of light gauge steel and are each divided into eleven watertight compartments, each of which is fitted with a covered hand hole at the top so that the interior may be reached and serviced. These pontoons were designed to save weight and for greater ease of repair. Metal pontoons for the M10 target were tested first by this Section in May 1946, but were found to be of insufficient strength. The present metal pontoons were designed to correct the deficiencies found as a result of the original test.

Seacoast Artillery Target T12 with Metal Pontoons. This target is a high speed radar target with a corner reflector mounted on top of the mast. The target was designed originally to use wooden pontoons. These targets with wooden pontoons have been used extensively by the Seacoast Branch of The Artillery School during target practices. The wooden pontoons have been subject to frequent leaks and are difficult to repair. The first metal pontoons for these targets were tested by the Coast Artillery Board in May 1945. It was found that the metal pontoons were too heavy, and tests were suspended pending modification. Modifications suggested as a result of the original test have been incorporated in the pontoons for the present target. The complete target has been assembled and it is anticipated that it will be service tested in the very near future.

Photographic Recording Instrumentation. A new photographic recording system, for use during dynamic tests of gun data computers, has been designed and built by this Section. Seven Bell & Howell 16-mm motion picture cameras are mounted on adjustable racks to photograph seven computer dials. An individual electro-magnetic frame counter is mounted on the bracket for each camera in a manner so that the counter is photographed simultaneously with the dial. The camera shutters are operated in single frame steps by a solenoid tripper synchronized by a timing pulse from a precise electronic timer. Illumination is provided by a series of Edgerton strobo-flash units. This system provides an exact shutter speed of 10 microseconds (1/100,000th of a second) which is more than sufficient to stop a dial in motion. The master electronic timer is capable of controlling any number of cameras, and synchronizing them with strobo-flash units at any interval from 1 to 60 seconds with an accuracy of better than ± .25 seconds.

Radar Horizontal Control in Mine Planting. This Section is conducting a study to determine if the AN/MPG-1 radar can be used for horizontal control in mine planting. The possible advantages by this system would be that the planting operation would be faster, since it would be possible to furnish positions to the Mine Planter more rapidly than before. Also the use of radar would allow mine planting under conditions of poor visibility.

Coast Artillery Newsletters

The Seacoast Branch, The Artillery School

BRIGADIER GENERAL WILLIAM S. LAWTON,
Officer in Charge

The Department of Engineering, SBAS, has developed training aids of advanced type for the Seacoast Artillery Technicians Course (enlisted) and Seacoast Electronics Course (officers). One of these advanced type training aids is a projecting oscilloscope which throws an enlarged image of the cathode ray tube face on a screen. This enables the instructor to point out characteristics of electrical phenomena to an entire class at one time.

Most Coast Artillerymen will remember the old "canned courses" used for training purposes on the plotting board. But today, the use of the M-8 electronic data computer and data transmission system precludes the use of "canned courses." The Gunnery and Tactics Department at SBAS has devised a very clever answer to this problem which should be of practical value to all Reserve and National Guard Seacoast Artillery Units for training purposes. First, they built a wooden platform, using a transit to build into scale the earth's curvature on the platform surface. Then a simple pulley system was rigged up, using a reversible electric motor, to move scale model ships across the platform. A DPF set a few feet away and elevated slightly higher than the platform (again to scale for proper ht. of sight) produces a realistic field of view for the observer. The only difficulty encountered in this operation was the adjustment of the DPF lenses for the ultra short ranges. This was overcome by obtaining an ordinary eyeglass with a plus 0.25 diopter spherical lens, costing about sixty cents, which was placed over the lens of the DPF, thus bringing the near objects into clear focus. At the time of this writing, the Department Director, Colonel Carl W. Holcomb, is working on a radar adaptation for similar training purposes, utilizing motion picture film. Recently, Colonel Holcomb published a pamphlet on 90mm Gun Battery AMTB Fire Control using SCR-584 radar. The purpose of this pamphlet is to explain the employment of the 90mm gun battery by Seacoast Artillery in the attack of motor torpedo boats.

The Artillery Detachment of the School had a busy week in December, 1947, when they fired 1300 rounds of 90mm and 155mm ammunition in training and demonstration firing.

The Department of Submarine Mining graduated its first Submarine Mine Operations Class of enlisted men. These men will fill key NCO vacancies in Harbor Defense Commands.

Instructors in the Submarine Mine School have just completed a 225-square-foot scale model of San Francisco's harbor and channel approaches in full color. The ocean's floor is in detailed and accurately scaled contours of 1" to 100' in height and ½" to 100' in width. The ocean's floor is visible through a sheet of transparent plastic which represents the ocean's surface. On this plastic surface are miniature anchorage lights and buoys in their correct positions which wink off and on, and on the ocean's floor are tiny rows of lights which represent the mine fields. By means of a pulley, a miniature submarine is drawn beneath the surface and enters the mine field. As this is happening, a synchronized transcription gives a verbal picture to the audience of what is taking place. The actual sound of a sub's propellers recorded over an underwater mike serves as a dramatic background for the narrator's description. An actual full scale mine casemate is installed in the room and the lights flash their warning upon the sub's approach to the field. The dramatic highlight of the show is when the sub passes over an activated mine and the recorded sound of the mine's detonation comes over the loud speaker.

The following changes occurred during the months of November and December 1947:

DEPARTURES

Lieutenant Colonel Frank S. Harris, detailed in USAF 41st AF Base Unit Air University, Maxwell Field, Ala.
Captain George G. Tillery, transferred to 1156th ASU Conn NG, Hartford, Conn.
Captain Bernard C. Elders, relieved from active duty.

138TH ANTIAIRCRAFT ARTILLERY GROUP

YOKOHAMA, JAPAN, APO 503

LIEUTENANT COLONEL ARTHUR L. FULLER,

Commanding

During the period covered by this report, the main theme has been antiaircraft training. Due to personnel shortages and guard requirements it has been impossible to maintain full time training in all units. To combat this condition, some batteries were reduced to approximately cadre strength and others brought to full strength. By doing this, it has been possible to keep one battery in each battalion on full time training.

Four new Department of the Army Technical Instruction teams arrived and have been assigned to the group. These additional AAAIS, Searchlight, and Automatic Weapons teams were reassigned from MARBO. The searchlight team is composed of: Captains K. C. Hicks and R. H. LeMaster and Lieutenants W. J. Bizjak and R. L. Dunn. The AAAIS teams are composed of: Captains A. F. Brindley and J. M. Lown, Lieutenants W. H. Tomlinson and R. C. Coleman Jr., and the following enlisted men: M/Sgt. Aaron Temes, T/Sgt. Howard Scruggs, T/Sgt. Boyd Gibson and S/Sgt. Charley Mayfield.

All Department of the Army Instruction Teams are currently conducting courses for officers and enlisted men of this command. The Gun Team, commanded by Lieutenant Colonel Beaver, has begun a series of two-week courses on 120mm guns and the SCR 584 radar for all officers of the 753d AAA Gun Battalion (SM). AAAIS classes are being conducted in the 76th AAA AW Battalion (SP) for officers and AAAIS personnel. A series of courses in Automatic Weapons matériel have been conducted in both the 76th and the 933d AAA AW Battalions. At Johnson Army Air Base, the Searchlight team is assisting in the instruction of the searchlight battery personnel while members of the AAAIS team are working with the 162d AAA Operations Detachment instructing AAOR personnel. In addition to the above, communications instruction has been given in both Automatic Weapons battalions by members of the Automatic Weapons teams.

A provisional 120mm gun battery composed of key personnel of the 753d AAA Gun Battalion (SM) was formed as a firing battery under the command of Captain Charles L. Allen and proceeded to the AAA Firing Range at Choshi in Chiba Prefecture, Honshu, Japan, on 6 October 1947 where the guns were set up in firing position. Preliminary practices were conducted for six days, targets being PQ type radio-controlled aircraft targets flown by the 8061st Radio Controlled Airplane Target Detachment. The firing of the 120mm guns, the largest of their type in Japan, chalked up another "First" for the 138th AAA Group and the battery was quite proud of having shot down 5 targets on its first series of practices. The battery returned to Yokohama on 28 October 1947.

A field problem was conducted at Johnson and Yokota Army Air Bases during the period 13-20 November 1947. All units in the group participated. OP's, both visual and radar, were established and guns were emplaced in tactical positions under simulated combat conditions. Aircraft from the 314th Composite Wing flew a series of simulated strafing and bombing missions adding greatly to the reality of the problem. The problem was controlled from the Antiaircraft Artillery Operations Room at Johnson Army Air Base.

Upon the completion of the field problem, Battery B, 76th AAA AW Battalion (SP) convoyed to Mito Firing Range to conduct practice firing. Familiarization firing had already been conducted by this unit at Chigasaki beach on 21 October 1947. This practice firing will conclude the eighteen-week intensive training program which has been conducted in this battery. Immediately following this firing, Battery C, 933d AAA AW Battalion (SM) will conduct preliminary 40mm and cal. .50 machine-gun firings at Mito.

Athletic activities are now in full swing as the group prepares to go "All Out" during the basketball season this year. The group team is now undergoing rigid practices with an eye on the Eighth Army championship. Inter-battalion play has already begun and intensive rivalry has sprung up between the units.

The following arrivals and assignments of officers have occurred since the last newsletter:

Hq 138th AAA Group: Captain Arthur F. Brindley, Captain James M. Lown, and Captain Roger H. LeMaster.

933d AAA AW Battalion (SM): Captain Harold F. Via, First Lieutenant John J. Harvey, First Lieutenant Clarence D. Flood and First Lieutenant Arthur Mousset.

538th AAA Slt Battery (Sep): Captain Kenneth C. Hicks, First Lieutenant William J. Bizjak and First Lieutenant Robert L. Dunn.

162d AAA Operations Detachment: First Lieutenant William H. Tomlinson and Second Lieutenant Rennie C. Coleman.

The following officers have departed from the 138th AAA Group since the last newsletter.

For return to the Zone of Interior: Major George W. Best, Major Gerald R. Underwood; Captains John M. Simmons, James F. Stanley (Chap) and Robert E. Kahn; First Lieutenant Albert C. Johnson and CWO Charles T. Gray.

For reassignment within Japan: Captains Charles F. Pettin, Burnes L. Feaster, Daniel M. Recksiek and William L. Wyatt; First Lieutenant George M. Sutton.

OKINAWA, APO 331

LIEUTENANT COLONEL JOHN S. SABINE, *Commanding*

The New Year finds the 87th AAA Group (PS) in a dual role. While continuing its training under the War Department Gun and Automatic Weapons Instruction Teams, it is also performing service missions at the Engineer and Ordnance Depots, the Station Hospital and the Headquarters of the Ryukyus Command.

Most spectacular of the Group's recent service missions was the erection of two mammoth ordnance shops. Philippine Scouts of Battery A, 532d AAA Gun Battalion and Battery C, 511th AAA Automatic Weapons Battalion under the supervision of Major Charles O. May, Jr.

The Marine Barracks area and Kuba-Saki, both on the east side of the island but some eight miles apart, were occupied in October 1947 by the Group, its former location at Gofugi being turned over to the Air Force. The automatic weapons battalion moved to Kuba-Saki and the other elements of the group, except Battery B of the gun battalion on duty at the Sobe Engineer Depot, settled down in the Marine Barracks area.

Both sites are well laid out, with such conveniences as barber and tailor shops, laundries, the already-mentioned service clubs, and libraries well stocked with current best-sellers, magazines and reference works. But their utilities—electric generators, water systems, etc.—are old and tired and become inopportunely inoperative, the electricity when the housewife has her dinner half cooked and the water when her husband has worked up a good lather in the shower.

In the Marine Barracks area are four sets of dependents quarters and in nearby Tengan fourteen more, the servicing of which is slowly progressing (erroneous, of course). Meanwhile by dint of ingenuity, unorthodox mechanics and cannibalization of parts, utilities are slowly being improved to where there is the resemblance to stateside life.

* * *

305TH ANTIAIRCRAFT ARTILLERY BRIGADE, ORC

NEW YORK CITY

COLONEL H. RUSSELL DROWNE, *Commanding*

In accordance with directives issued by First Army, Headquarters 305th AAA Brigade and its attached units participated in a CPX the 5th, 6th, 7th December 1947. The AAA units held their exercises at Fort Wadsworth, New York, and the Harbor Defense units at Fort Tilden, New York. A total of 164 officers and 10 enlisted men were ordered to active duty for that three-day period.

The Antiaircraft Artillery scenario was drawn for the purpose of illustrating what might possibly happen in the next war, namely, the immediate need for the defense of the Metropolitan area which is the primary mission of this Brigade. The scenario for the Harbor Defense units called for setting up the defense of New York Harbor.

The play of the exercises continued from Friday evening 5 December until noon 7 December.

A great amount of enthusiasm was shown by all participating and the desire was expressed for additional CPX's at three-month intervals.

The units participating were:

Headquarters and Headquarters Battery 305th AAA Brigade.
326th AAA Operations Department
138th, 145th, 153d, 160th CA Groups
397th AAA AW Battalion (Sp)
430th AAA AW Battalion
313th Harbor Defense Regiment
315th Harbor Defense Regiment
316th Harbor Defense Regiment

* * *

341ST ANTIAIRCRAFT ARTILLERY BRIGADE, ORC

SEATTLE, WASHINGTON

COLONEL DANIEL C. NUTTING, *CA Res., Commanding*

After a number of attempts at training under the War Department program, none of which resulted in much interest on the part of the personnel, the Brigade is now working on a map problem involving Army level planning under a fictitous directive from an army headquarters. The directive calls for all the basic planning which would be done normally by the Army staff, such as priority lists, numbers of troops, requirements for construction materials, requirements for special troops such as radar repair teams, ordnance repair companies, etc., and is expected to continue for at least three months at the end of which period a further directive postulating a state of war will be issued. This problem is meeting with considerable interest.

The 328th AAA Operations Detachment (ORC) and the 322d AAA AW Battalion (SP) have very recently been assigned to the brigade for administration and training, and planning is proceeding looking toward an integrated program.

Full officer strength has been assigned, and an intensive program of recruiting began on 1 January, with the hope of attaining the B status for which all three units are designated.

207TH ANTIAIRCRAFT ARTILLERY GROUP

New York National Guard

Colonel William L. Immer, *Commanding*

Albany, N. Y., capital of the Empire State, long the stronghold of infantry is gradually warming to its AAA Units, specifically the 207th AAA Group and the 7th AAA Automatic Weapons Battalion.

Starting from scratch, the first antiaircraft unit to be Federalized was the Group Headquarters on 29 September under the command of Colonel William L. Immer of Schenectady. An impressive ceremony was held at the newly designated Antiaircraft Armory in cooperation with the inactivated unit, 1st Regiment N. Y. Guard. Colonel John F. Connors, commanding officer of the 1st Regiment had his men march in review while the band played "Auld Lang Syne." Headquarters Battery 207th Group was then inspected by the Federal team and the new officers assumed their duties. Lieutenant Colonel Harold L. Hart was designated as Executive Officer, Major James Gayle assumed the duties of S-3, and Major Wayland Griffiths was appointed S-1.

Refreshments were served to members of the old regiment and the new National Guard Group.

The 7th AAA Automatic Weapons Battalion, commanded by Lieutenant Colonel George T. Stillman was not far behind the Group in its preparations and was Federalized on 3 Nov. with Headquarters and Headquarters Battery, Batteries A, C, and Med Det while D Battery was Federalized on 15 December. The 7th Battalion was the hit of the Armistice Day parade in Albany when it entered a M-16 half track in it. A gunner rode in the turret and continuously swung the guns in elevation and azimuth, thus affording many citizens their first glimpse of one of our most deadly and versatile weapons.

Headquarters and Headquarters Battery 336th AAA Gun Battalion, commanded by Lieutenant Colonel Addison M. White in Utica, stood its inspection on 30 October and A Battery on 22 December, thus augmenting the Group with 2 battalions.

Another unit was Federalized on 30 October in Utica, the 3646th Ordnance Medium Automotive Maintenance Company. This unit is attached to the 336th Battalion, and thus gives the Group a total of 4 units.

Meanwhile recruiting has been intensified with colorful posters displayed in prominent places, and the remaining batteries will be inspected for recognition in the near future.

65TH ANTIAIRCRAFT ARTILLERY GROUP

Fort Amador, Canal Zone

Colonel Paul B. Nelson, *Commanding*

The 65th AAA Group completed satisfactorily 1947's advanced training requirements during the last two months of the old year. Major emphasis was placed on the occupation of assigned and alternate positions by the automatic weapons and gun battalions, the 903d and the 764th respectively. Along with this, mobility and reconnaissance were stressed. The last units of the 65th completed training in air-transportability. The training of each unit was climaxed by an actual air movement.

Selected personnel from the 65th AAA Group are attending each of the courses of the following U. S. Army Caribbean schools: Clerical, Non-Commissioned Officers Leadership, Food Service, Motor Mechanics, and Supplementary Education and Training of Officers. A member of the 65th, Tec 3 Angel Silvestre, recently finished first in the Mess Stewards' Class of the Food Service School.

Units of the 65th Group have been visited or inspected by a number of dignitaries during the past two months.

A class of about 35 officers from the Colombian War College, visited positions of the Group on the Pacific side. These officers were accompanied by the Commandant of the War College, General Mora, and several instructors.

The 764th AAA Gun Battalion, which is on the Atlantic side of the Isthmus, has established a permanent guard of honor to welcome to the Canal Zone, various dignitaries who arrive at Cristobal on the Panama Line.

Eighteen men and one officer from the Group, along with about 150 others from the Air Forces, Navy, and other Army units, took a two-week cruise on the Navy's submarine tender, the U.S.S. *Orion*, to Callao and Lima, Peru.

Early in December the 65th AAA Group held an infantry drill contest at Fort Amador. Each of the 11 batteries within the group was represented by a 22-man "crack" drill platoon. The contest was judged by senior officers from U. S. Army Caribbean and the 33d Combat Team. Each platoon performed for five minutes under close scrutiny of the judges. The winner was Battery C, 903d AAA Battalion, which is commanded by First Lieutenant Tom M. Kelly, and the runner-up was Headquarters Battery, 903d AAA Battalion, which is commanded by First Lieutenant Kenneth W. Janz.

All Army units stationed on the Pacific side, including Headquarters 65th AAA Group and the 903d AAA AW Battalion, held a farewell review at Fort Clayton early in January for General Porter, who is leaving for Puerto Rico shortly to assume command of U. S. Army Forces, Antilles.

Changes In Officer Personnel

Recent arrivals, with assignments:

2d Lt. Lynn W. Hoskins, Jr.	Btry Officer, 903d AAA AW Battalion.
Lt. Col. Charles B. Bottoms	Special Projects Officer, 65th AAA Group.
1st Lt. Paul L. Wortheley	Btry Officer, 903d AAA AW Battalion.
1st Lt. Harold C. Dolstad	Btry Officer, 764th AAA Gun Battalion.
1st Lt. Clarence P. Lines	Btry Officer, 903d AAA AW Battalion.
WO (JG) Clifford D. Shaw	Personnel Officer, 903d AAA AW Battalion.

Recent departures, with destinations:

Major Bernard C. Luebkert, returned to U. S. for separation.

Captain Richard E. Brown, Geodetic Section, CDC.

First Lieutenant Duane E. Radford, returned to U. S. for separation.

South Sector Command

FORT RUGER, T. H. APO 956

BRIGADIER GENERAL JAMES E. MOORE, *Commanding*

During the past two months the arrival of many replacements from the Zone of the Interior makes possible the resumption of training throughout the command. Included in normal operations is the training of the command's contribution to the USARPAC Provisional Regiment.

The regiment is an island-wide activity, established by Lieutenant General John E. Hull, Commanding General, United States Army, Pacific, in keeping with a policy instructing the commanding general of any theater to provide his area with the necessary troops to defend the region in time of emergency. The second battalion of this regiment, organized mainly from men of the several South Sector posts, is commanded by Lieutenant Colonel Oliver H. Kupau, Commanding Officer of Fort Armstrong and Camp Sand Island.

The regiment will be equipped with the most modern combat weapons authorized by the latest infantry division tables of equipment. During the month of November small-arms firing for record was conducted throughout the second battalion with an unusually high percentage of qualifications. The men fired for record with their primary weapons and familiarization with other organizational arms. During this period the M1 rifle, carbine, and automatic rifle were fired. During January, courses in the mortar, pistol, and light machine gun were conducted. Plans are also under way to train men in the use of the 57mm and 75mm recoilless rifles.

Battalion training is conducted in weekly four-hour periods, plus an extra training period for officers. In addition, the schedule includes practice road marches, overnight bivouacs, and patrol activities both at night and in daylight hours.

98TH ANTIAIRCRAFT ARTILLERY GROUP

FORT KAMEHAMEHA, T. H. APO 956

COLONEL JOHN HARRY, Commanding

Now in operation is a three-phase training program that promises to school the men of the command in organizational functions from the ground up. First of the phases in the program is a 15-week schedule concentrating on artillery drill and allied subjects.

The over-all training program includes basic, advanced, and small unit instruction. Integrated into the schedule is a two-month course in gunnery which is being conducted by a special team of instructors from the AA and Guided Missiles Branch of The Artillery School. The course is attended by Group officers and men, and also by several Marine officers and enlisted men from the Fleet Marine Force.

The USARPAC service schools are well attended by AAA men from the 98th. In January approximately 50 men will begin courses in radar and radio at the Signal Center. Others will attend the Food Service School and the Ordnance Maintenance School at the Hawaiian Ordnance Depot.

An important part of training is the reinstitution of predischarge training for separatees. The men are given a complete orientation which enables them to enter civilian life with considerably more confidence about civilian matters. Included is a job preparation course and complete information on the operations of the Veterans Administration and benefits of schooling and on-the-job training under the G.I. Bill of Rights.

The 88th Searchlight Battery stationed at Schofield Barracks continues its normal operations. The Searchlighters have better training facilities at Schofield than if they were located at this post, where training exercises would interfere with the operations of nearby Hickam Field and John Rodgers Airport.

35TH COAST ARTILLERY MAINTENANCE DETACHMENT

FORT RUGER, T. H. APO 956

COLONEL DONALD C. HAWLEY, *Commanding*

Testing of preservative materials on equipment of a typical battery is almost complete. Of the two guns in the battery, Number One has been covered with conventional storage materials while Number Two gun has been covered with a newer, Navy-type, plastic coat. Both are six-inch barbette-type guns, pit-mounted with three inches of armor to protect gun crews.

Number One gun receives normal maintenance with a thin film on moving parts and heavy grease on others. Barrel, carriage, and trunnions regularly receive a coating of oil and solvent, which has proved beneficial in protecting the metals from blown sand and salt air. Since the installations is in an exposed position on the shore of the island, it is subjected to all weather conditions of this area and results of the test should be most conclusive.

Temperature records show that Number One gun undergoes greater changes than the gun in its plastic seal. The sealed gun has remained at an almost constant 90 degrees Fahrenheit while Number One fluctuates from 80 to 90 degrees. Humidity in the sealed gun has remained at an average of 30 per cent, while the unsealed gun varies but averages 65 per cent.

During the first nine months of the experiment, only 35 man-hours were spent in maintaining the sealed gun while the normally maintained weapon received almost 15 times that amount. The inspection will reveal the results of the experiment when the wrappings are removed. Some old-timers, who are skeptical about keeping guns in fixed positions for years at a time, prophesy flattened bearings and frozen parts. Personnel conducting the experiments, however, believe the tests will produce very favorable results.

267TH ANTIAIRCRAFT ARTILLERY GROUP

FORT BLISS, TEXAS

COLONEL GRANGER ANDERSON, *Commanding*

On the 29th November 1947, Colonel Granger Anderson assumed command of the 267th AAA Group, succeeding Colonel Edgar W. King, who left this station on pre-embarkation leave, prior to a tour of duty in Hawaii. Colonel Anderson came to the 267th Group after a tour of duty with the Military Mission to China.

The 267th AAA Group, organized in June 1946 here at Fort Bliss, now has the following among its units: the 284th AAA AW Battalion (SP), the 384th AAA Gun Battalion and the 165th AAA Operations Detachment. A cadre of the 87th FA Rocket Battalion is also attached to the Group.

The missions of the Group and its attached units have been many and varied during the past several months. One of the main requirements has been demonstration fire for the AA & GM Branch of the Artillery School, the 284th AAA AW Battalion (SP) has fired 40mm AA and multiple Cal. .50 AAA, Anti-mechanized, and AW Support of Infantry demonstrations for training units of the U.S.M.A. cadets, ORC and National Guard units. The 384th AAA Gun Battalion has fired 90mm and 120mm AA guns for the same units, including some Field Artillery demonstrations.

The 284th AAA AW Battalion (SP) recently celebrated its second anniversary. Activated at Fort Bliss on 8 December 1945, it was the first AAA unit activated in the United States after the war.

On 10 December 1947, General Thomas T. Handy, Commanding General of the Fourth Army arrived at Fort Bliss to inspect the 267th Group, among other units. On 16 December, Major-General J. A. Gascoigne, Deputy Commander of the British Army Staff in Washington, arrived on the Post. The Group furnished the honor guard that heralded his arrival. Units of the Group have also participated in all parades and reviews at Fort Bliss, the Tuesday afternoon parade being a regular event.

The Group put on a fine exhibit at the Third International Aviation Celebration, held on the 4th and 5th of December at the El Paso Airport.

102D ANTIAIRCRAFT ARTILLERY BRIGADE

NEW YORK NATIONAL GUARD

COLONEL WILLIAM M. HAMILTON, *Commanding*

1. Activities within the Brigade have centered about the recruiting drive with the units also conducting basic training. Brigade Headquarters Battery held a Christmas party with members bringing friends interested in joining the battery. The party proved a success on both points, a fine time being enjoyed by those present and several new recruits being signed up.

2. The 212th AAA Group Headquarters and its units, the 212th AAA AW Battalion, and the 773d AAA Gun Battalion, have all been Federally recognized. They are very close to the third phase of their recruiting quota while being in their second time phase. Bi-weekly basketball games with free admission to each guard member and a friend serve as an incentive to get new recruits. Master charts showing the progress of the recruiting drive with quotas for the various units are hung in the armory and are closely watched. Basic training is stressed in the units with emphasis on developing a well trained cadre capable of expansion to fill T/O strength.

3. The 223d AAA Group and its units, the 245th AAA Gun Battalion, and the 715th AAA Gun Battalion, are completing their organization. The Group Headquarters and the 245th AAA Gun Battalion are now recognized and the 715th AAA Gun Battalion expects to be ready for recognition in the very near future. Recruiting has been the main activity in the Group with units also conducting basic training.

4. The 369th AAA Group Headquarters and its units, the 369th AAA Gun Battalion, 870th AAA AW Battalion, and the 369th Radar Maintenance Unit have all been Federally recognized and have attained approximately 30% of their T/O officer strength, and 40% of their T/O enlisted strength. In conjunction with the New York Pioneer Athletic Club the units of the Group are sponsoring a track meet in March, its purpose being to foster the memories of those members of the units who were athletes and were killed during the past war. Prizes are being donated for the meet by local merchants and this should create a good deal of interest in the units, which will no doubt bring in some new members.

Training within the Group has centered about basic instruction, emphasis being placed on the accuracy of this instruction for the development of noncommissioned officers, and well trained cadres. Schools for all officers have been started to refresh and increase their knowledge of Antiaircraft Artillery.

COAST ARTILLERY ORDERS

WD and AGF Special Orders covering the period 28 October 1947 through 31 December 1947. Promotions and Demotions are not included.

Lieutenant General

Lutes, LeR., to Munitions Board National Military Establishment, Washington, D. C., for dy as Deputy Chairman of the Executive Committee Munitions Board.

Colonels

Adams, Edward F., to Office US Military Attache, Havana, Cuba, for dy as Asst Mil Attache

Adams, Nyal L., to Hq Fifth Army, Chicago, Ill.

Anderson, George B., to OC of S Washington, D. C. w/Office of Inspector General SSUSA.

Campbell, Alexander H., to Office Joint Chiefs of Staff, Washington, D. C. for dy w/Joint Staff.

Carlson, William R., to be retired.

Carey, George R., to OC of S Washington, D. C. for dy w/Plans & Oper Div GSUSA.

De Camp, John Taylor, to 1272d ASU Office Sr NG Instr for NY, 270 Broadway, New York City. Detailed as CAC Instr.

Duval, Henry H., to Far East Command, Korea. Address: Casual Pers Sec 14th BPO APO 815, c/o PM, San Francisco, Calif.

Franklin, Albert G. Jr., to Office Joint Chiefs of Staff, Washington, D. C. for dy w/Joint Staff.

Hennig, William H., to 267th AAA Gp, Ft Bliss, Texas.

Ingram, Wharton G., to be retired.

Moss, Joe D., to European Command, Bremerhaven, Germany. Address: New Arrivals Sec 25th BPO APO 743, c/o PM, New York, N. Y.

Nicholson, Arthur B., to be retired.

Pamplin, Douglass G., to Fifth Army 5306th ASU Minnesota-Dakotas Rctg Dist, 182 Federal Bldg, Minneapolis, Minn.

Papenfoth, William H., to reld fr detail as member of GSC.

Perry, Willis A., to OMA, London, England for dy as Asst Military Attache.

Pierce, Harry R., to Washington, D. C. for dy w/Army Personnel Records Board.

Smith, Perry McC., to OC of S Washington, D. C. for dy w/Pers & Adm Div GSUSA.

Sturman, J. Foxhall, Jr., to Far East Command, Yokohama, Japan. Address: Casual Pers Sec Central Mail Directory, APO 503, c/o PM, San Francisco, Calif.

Taliaferro, Edward H., to be retired.

Warren, Albert H., to be retired.

Waters, Thomas L., to 1152d ASU Office Sr NG Instr for Maine, Cp Keyes, Augusta, Me. w/sta South Portland, Me. Detailed as CAC Instr.

White, Thomas B., to transfd to USAF.

Young, George E., to Far East Command, Yokohama, Japan. Address: Casual Pers Sec Central Mail Directory, APO 503, c/o PM, San Francisco, Calif.

Lieutenant Colonels

Baynes, William H., to transfrd to USAF.

Blumenfield, Charles H., to Office Under Sec. of the Army, Washington, D. C.

Boys, Richard C., to transfrd to USAF.

Brucker, Wallace H., to Gen. Staff, US Army.

Cauthen, William A., to 3344th ASU Georgia NG Instr, Macon, Ga. w/sta Washington, Ga. Detailed as CAC Instr.

Chandler, Martin B., to OC of S, Washington, D. C. for dy w/ Pers & Adm Div GSUSA.

Cooley, LaVell I., to AA & GM Br the Arty Sch, Ft Bliss, Texas.

Croker, George W., to transfrd to USAF.

Foster, Kenneth W., to OC of S, Washington, D. C. for dy w/ CAD SSUSA.

Frith, Robert E., to Detailed in QMC.

Gallant, Edward B., to transfrd to USAF.

George, Frank A., to First Army, 1104th ASU HD of Portland, Ft Williams, Me.

Hardy, Robert M., to Resigned.

Harris, Frank S., to Detailed in USAF, 41st AF Base Unit, Air Univ, Maxwell Field, Ala.

Holt, Roger H., to Far East Command, Korea. Address: Casual Officers Co, Cp Stoneman Pers Cen, Pittsburg, Calif.

Howard, Charles E., to 5252d ASU Office Ill. State Sr Instr Orc Res, Chicago, Ill. Detailed as Instr.

Hunt, Paul M., to Far East Command, Korea. Address: Casual Officers Co. Cp Stoneman Pers Center, Pittsburg, Calif.

Johnson, Harold O., to Research & Development Board, Washington, D. C.

Kopcsak, Arpad A., to 6601st ASU Calif NG Instr Gp, 1215 16th St., Sacramento, Calif. w/Sta Long Beach, Calif. Detailed as CAC Instr., Calif N.

Kramer, Arthur L., to Hq Second Army, Ft Geo G. Meade, Md.

Lazar, Aaron M., to detailed as a member GSC & asgd to Gen Staff US Army.

Ledeboer, Frederick W., to detailed at 6813th ROTC, Univ of Santa Clara, Santa Clara, Calif.

Manley, John B., to detailed in CMP.

MacNeill, John P., to Fifth Army 5036th ASU St Louis Adm Ctr, 4300 Goodfellow Blvd, St Louis, Mo.

Martin, Murry J., to United States Army Pacific, Ft Shafter, TH.

Moses, DeMaurice, to Office of the Secretary of the Army, Washington, D. C.

Naylor, Arthur S., to 5257th ASU Office Missouri State Sr Instr OR, St Louis Medical Depot, 12th & Spruce Sts, St Louis, Mo. Detailed as Instr.

Ogden, Milton L., to OC of S, Washington, D. C. for dy w/Pers & Adm Div GSUSA.

Peterson, Arthur C., to detailed as member GSC & asdg to Gen Staff US Army.

Pohl, Marion G., to OC of S, Washington, D. C. for dy w/Sv Supply & Procurement Div GSUSA.

Quinlan, Edward W., to Far East Command, Korea. Address: Casual Officers Co. Cp Stoneman Pers Ctr, Pittsburg, Calif.

Sommer, Arnold L., to Office Joint Chiefs of Staff, Washington, D. C. for dy w/Joint Staff.

Steele, Preston, to Hq First Army, Governors Island, N. Y. for dy w/New York-New Jersey-Delaware Mil Dist, 90 Church St, New York, N. Y.

Waller, Marvin E., to 5202d ASU Office Sr Ground Instr. Illinois NG, 234 E. Chicago Ave, Chicago, Ill.

Weber, Milan G., to Washington, D. C. for dy w/Army Pers Records Board.

Wickham, Kenneth G., to Army Advisory Gp, Nanking, China. Address: Casual Pers Sec. APO 917, c/o PM San Francisco.

Woodbury, Kenneth J., to Far East Command, Korea. Address: Casual Pers Sec 14th BPO APO 815, c/o PM, San Francisco, Calif.

Majors

Bailey, John R., to detailed in Ord Dept.

Benner, John A., to OC of S, Washington, D. C. for dy w/Pers & Adm Div GSUSA.

Best, George W. Jr., to OC of S US Army, Washington, D. C. for dy w/Intelligence Div GSUSA.

Blair, Warren S., to 384th AAA Gun Bn, Ft Bliss, Texas.

Boone, Harry F., to transfrd to USAF.

Burrell, Walter E., to Armed Forces Special Wpns Project Sandia Base, Albuquerque, N. Mex.

Cairns, Monival A., to Detailed in Sp S Fourth Army 4005th ASU Cp Hood, Texas.

Corbett, John B., to Office Joint Chiefs of Staff Washington, D. C. for dy w/Joint Staff.

Cunningham, Henry A., to Hq AGF, Ft Monroe, Va. w/sta General Electric Co., Schenectady, N. Y.

DeLatour, Frank A. to Hq First Army, Governors Island, N. Y.

Denton, Earl L., to 5261st ASU Office of Wisconsin State Sr Instr ORC, 622 N. Water St, Milwaukee, Wisc. w/sta Madison, Wisc. Detailed as Instr.

DuParc, Jules M., to AGF Board 4, Ft Bliss, Texas.

Ellers, Conway L., to 5202d ASU Illinois NG, Chicago, Ill.

Fisher, Sydney G., to transfrd to USAF.

Fox, Elmer W., to 267th AAA Gp, Ft. Bliss, Texas.

Gordon, Thomas F., to 6807th ASU ROTC, Univ of Calif, Berkeley, Calif.

Graham, Harold E., to 5412th ASU ROTC Chicago High Schools, Chicago, Ill.

Hudson, James A., to 916th AF Base Unit, Ft Slocum, N. Y.

Lederman, Milton D., to European Command, Bremerhaven, Germany. Address: Co. G, Embarkee Regt., Cp Kilmer, N. J.

Maline, Paul J., to Research & Development Board, Washington, D. C.

Matthews, Maurice D., to Arty Sch, Ft Sill, Okla. for dy w/Staff & Faculty.

Quist, Frederick F. to AA & GM Br the Arty Sch, Ft Bliss, Texas for dy w/Staff & Faculty.

Regan, James L. Jr., to OC of S, Washington, D. C. for dy w/Pers & Adm Div GSUSA.

Roberts, Charles C., to Philippine-Ryukyus Command, Manila, PI.

Rousseau, Thomas H., to Far East Command, Yokohama, Japan. Address: Casual Officers Co. Cp Stoneman Pers Ctr, Pittsburg, Calif.

Sawyer, Tom J., to Hq Army Security Agency, Washington, D. C.

Smith, Grant H. Jr., to Far East Command, Korea. Address: Casual Officers Co, Cp Stoneman Pers Ctr, Pittsburg, Calif.

Snow, John R., to OC of S, Washington, D. C for dy w/Pers & Adm Div, GSUSA.

Spann, Charles W., to 6605th ASU Washington NG Instr Gp Cp Murray, Ft Lewis, Wash, w/sta Yakima, Wash. Detailed as CA Instr, Washington NG.

Tasker, Leighton E., to First Army 1106th ASU Hq & Hq Det HD of Boston, Ft Banks, Mass.

Watson, Ronald, to 267th AAA Gp, Ft Bliss, Texas.

White, John M. Jr. to transfrd to USAF.

Wolff, Paul B., to First Army 1225th ASU HD of N. Y., Ft Hancock, N. Y.

Captains

Barton, Richard L., to Detailed in SP S.

Brooks, Engle R. Jr. to Marianas-Bonin Command, Guam, Marianas.

Brown, Ernest A., to Far East Command, Yokohama, Japan. Address: Casual Officers Co, Camp Stoneman Pers Ctr, Pittsburg, Calif.

Bullard, W. R. Jr., to Antilles Dept. Address: Casual Officers Sec, New Orleans Pers Ctr, New Orleans 12, La.

Callahan, Thomas H., to reld fr detail in FD.

Chilton, Carl E., to First Army 1104th ASU Hq & Hq Det HD of Portland, Ft Williams, Me.

Conkle, John D., to AA & Gm Br Arty Sch, Ft Bliss, Texas.

Cox, John P. Jr., to Army Security Agency Sch, Arlington Hall Sta, Arlington, Va.

Carey, Nelson Bert, to CA Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas.

Case, David L., to 5253d ASU Office Iowa State Sr Instr OR, 425 Federal Bldg, Des Moines, Iowa. Detailed as Instr.
Cassell, Robert S., to European Command, Bremerhaven, Germany. Address: Co G. Embarkee Regt., Cp Kilmer, N. J.
DeCristoforo, Wilfred H., to First Army 1109th ASU, Ft H. G. Wright, N. Y.
Donaldson, Francis Jr., to 1106th ASU HD of Boston, Ft Banks, Mass.
Douglass, John F., to Far East Command, Korea. Address: Casual Officers Co, Cp Stoneman Pers Ctr, Pittsburg, Calif.
Eccleston, Thomas A., to 109th CIC Det Second Army, Ft Geo G. Meade, Md, w/sta Philadelphia, Pa.
Fawcett, John R., to Hq Fourth Army, Ft Sam Houston, Texas. w/sta Kansas City QM Depot, Kansas City, Kans.
Gilman, Bernard A., to First Army, 1202d ASU Rctg Det No. 1, Chimes Bldg, Syracuse, N. Y. w/sta Det US Army Rctg Sta Post Office Bldg, Utica, N. Y.
Greco, Frank, to Third Army 3160th ASU Birmingham Rctg Dist. US Army & USAF Rctg Sv, Birmingham. Ala. w/sta 3160th ASU Det US Army & USAF Rctg Sta 504 Post Office Bldg, Jackson, Miss.
Grier, Charles V., to 165th AAA Operations Det, Ft Bliss, Texas.
Griffith, Hiram H., to Marianas-Bonin Command, Guam, Marianas.
Hecht, Chris M., to AGO Casuals, Washington, D. C. for dy w/Army Pers Records Board.
Helmick, Glenn B., to OC of S, Washington, D. C. for dy w/Intel Div GSUSA.
Hinton, Malcolm E., to First Army 1109th ASU Hq & Hq Det HD of Long Island Sound, Ft H. G. Wright, N. Y.
Hufstetler, John R., to 3344th ASU Georgia NG, Macon, Ga. w/sta Savannah, Ga.
Igersheimer, Milo, to AA & GM Br Arty Sch, Ft Bliss, Texas.
Jemmott, Arthur H. Jr., to Detailed in MSC, Ft Totten AMC, Ft Totten, N. Y.
Joyce, Eugene V., to Far East Command, Yokohama, Japan. Address: Casual Officers Sec, Casual APO, Ft Lawton, Washington.
Koenig, August, to Far East Command, Yokohama, Japan. Address: Casual Officers Co, Cp Stoneman Pers Ctr, Pittsburg, Calif.
La Bounty, James R., to Second Army 2286th ASU Escort Det, Ft Hayes, Columbus, Ohio.
Lantz, Dale R., to Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas.
Levine, Alexander, to AA & GM Br Arty Sch, Ft Bliss, Texas.
Lopez, Raymond A., to CDC.
McCrory, Raymond J. Jr., to Stu Det Army Language Sch, Presidio of Monterey, Calif.
McKinsey, Millard F., to AA & GM Br Arty Sch, Ft Bliss, Texas.
MacDonald, George E., to 5254th ASU Office Kansas State Sr Instr OR, Topeka, Kans, w/sta Wichita, Kansas. Detailed as Instr.
Manning, John F., to Office Military Attache, Nanking, China for dy as Asst Military Attache.
Marx, George H.; to AA & GM Br Arty Sch, Ft Bliss, Texas.
Moore, James C., to US Army Pacific, Ft Shafter, TH.
Nemeth, Stephen A., to Antilles Dept. Address: Casual Officers Sec. New Orleans Pers Ctr, New Orleans 12, La.
Nuwer, John E., to AA & GM Br Arty Sch, Ft Bliss, Texas.
Pallman, George H., to Stu Det AA&GM Br Arty Sch, Fort Bliss, Texas.
Phillips, Hal B., to Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas.
Prugh, George S., to detailed in JAGD Stu Det Hq Sixth Army, Presidio of San Francisco, Calif. w/sta Hastings College of Law, Univ of Calif, San Francisco, Calif.
Rowe, Gerald W., to Fourth Army, Ft Crockett, Texas.
Ryan, Daniel D., to AA & GM Br Arty Sch, Ft Bliss, Texas.
Schwyn, James M., to Army Security Agency Vint Hill Farms, Warrenton, Va.
Scully, Bernard R., to Marianas-Bonin Command, Guam, Marianas.
Shook, Theodore, to 284th AAA AW Bn, Ft Bliss, Texas.
Sims, Leonard H., to Hq Fourth Army, Ft Sam Houston, Texas.
Smith, Bowen N., to Far East Command, Korea. Address: Casual Officers Co. Cp Stoneman Pers Ctr, Pittsburg, Calif.
Smith, George R., to Sixth Army 6006th ASU Post Operating Co, Ft Lewis, Wash.
Spence, Laurence A., to First Army 1202d ASU Det US Army & USAF Rctg Sta, Post Office Bldg, Worcester, Mass.
Stamatis, Michael G., to detailed at 1291st ASU ROTC, St Bonaventure College, St Bonaventure, N. Y.
Stewart, Loren F., to Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas.
Stoval, Jim P., to Fourth Army 4203d ASU Okla US Army & USAF Rctg Sta, Oklahoma City, Okla.
Thaxton, Halbert C., to 384th AAA Gun Bn, Ft Bliss, Texas.
Thorne, John H., to Antilles Dept. Address; Casual Officers Sec New Orleans Pers Ctr, New Orleans 12, La.
Trussell, Albert R., to Sixth Army 6000th ASU, Presidio of San Francisco, Calif.
Turkovich, Joseph Paul, to Marianas-Bonin Command, Guam, Marianas.
Walmer, Richard, to 284th AAA AW Bn, Ft Bliss, Texas.
Waple, Louis A., to Stu Det Army Language Sch, Presidio of Monterey, Calif.
Waters, Fred D., to AA & GM Br Arty Sch, Ft Bliss, Texas.
Whitcomb, Robert J., to AA & GM Br Arty Sch, Ft Bliss, Texas.
Wilke, Robert G., to Far East Command, Yokohama, Japan. Address: Casual Officers Co, Cp Stoneman Pers Ctr, Pittsburg, Calif.
Wynne, Albert K., to Fifth Inf Div, Ft Jackson, S. C.

First Lieutenants

Adam , John P., to 1st GM Bn, Ft Bliss, Texas.
Bezich, Vincent W., to 384th AAA Gun Bn, Ft Bliss, Texas.
Borgstrom, Charles E., to US Army Caribbean, Quarry Heights, CZ.
Caylor, Ed Lee, to CA 1104th ASU HD of Portland, Ft Williams, Me.
Cleary, Louis X., to 384th AAA Gun Bn, Ft Bliss, Texas.
Clements, Morris Warren, to CA Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas.
Conn, Archie E., to AA & GM Br Arty Sch, Ft Bliss, Texas.
Day, Evan B., to Sixth Army 6003d ASU, Ft Ord, Calif.
Dickinson, Charles W., to reld fr detail in CE.
Donohue, Joseph J., to detailed in AGD AGO, Washington, D. C. for dy w/Pers Bureau.
Doyle, Arthur L, to 83d Slt Btry, Ft Bliss, Texas.
Evans, Daniel, to 82d Abn Div, Ft Bragg, N. C.
Falco, Anthony, to AA & GM Br Arty Sch, Ft Bliss, Texas.
Frick, Edwin J., to 5th Inf Div, Ft Jackson, S. C.
Furman, Hezekiah, to 284th AAA AW Bn, Ft Bliss, Texas.
Gale, Don S., to Far East Command, Yokohama, Japan. Address: Casual Officers Co, Cp Stoneman Pers Ctr, Pittsburg, Calif.
Gardner, Ralph V., to Far East Command, Yokohama, Japan. Address: Casual Officers Sec, Casual APO, Ft Lawton, Wash.
Hereth, Raymond Joseph, to CA 1st AA & GM Bn, Ft Bliss, Texas.
Hoffman, John H., to Antilles Dept. Address: Casual Officers Sec. New Orleans Pers Ctr, New Orleans 12, La.
Ingham, James D., 284th AAA AW Bn, Ft Bliss, Texas.
Johns, Carol N., to 83d AAA Slt Btry, Ft Bliss, Texas.
Johnston, Francis I., to Second Army 2318th ASU Louisville Rctg Dist, Louisville, Ky, w/sta 2318th ASU Det US Army Rctg Sta, 159 Barr St, Lexington, Ky
Kerrigan, Thomas D., to detailed in Tc.
Kruse, Lee G., to 83d AAA Slt Btry, Ft Bliss, Texas
McManus, Ray J., to Antilles Dept. Address; Casual Officers Sec New Orleans Pers Ctr, New Orleans 12, La.
Macri, James F., to Far East Command, Yokohama, Japan. Address: Casual Officers Sec, Casual APO, Ft Lawton, Wash.
Mantiply, Samuel T., to Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas.
Marrero, John, to Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas.
Marsland, Howard I., to AA & GM Br Arty Sch, Ft Bliss, Texas
Martin, Guy V., to Antilles Dept. Address: Casual Officers Sec New Orleans Pers Ctr, New Orleans 12, La
Merbach, Edward, to detailed in Sp S.
Monroe, Keith L., to AA & GM Br Arty Sch, Ft Bliss, Texas
Myers, Charles H. Jr., to Stu Det AA & GM Br Arty Sch, Ft Bliss, Texas
Netko, Elmer B., to Fifth Army 5309th ASU Wisconsin Rctg Dist, Clintonville, Wisc.
Orzechowski, Edward A., to 384th AAA Gun Bn. Ft Bliss, Texas
Palm, William J., to 4th Inf Div, Ft Ord, Calif
Rothwell, Joseph Byron Jr., to 1st GM Bn, Ft Bliss, Texas.
Waring, Robert C., to Stu Det Army Language Sch, Presidio of Monterey, Calif.
Williams, Russell H., to AA & GM Br Arty Sch, Ft Bliss, Texas.
Wilson, David J., to 113th CIC Det Hq Fifth Army, Chicago, Ill. w/sta Detroit, Mich.

Second Lieutenants

Garvey, Daniel J., to AA & GM Br Arty Sch, Ft Bliss, Texas.
Hollander, Bennet N., to Stu Det Arty Sch, Ft Sill, Okla.
Maliko, Joseph, to AA & GM Br Arty Sch, Ft Bliss, Texas.
Shelhorse, George L., to 284th AAA AW Bn, Ft Bliss, Texas.
Yost, Rollin D., to 384th AAA Gun Bn, Ft Bliss, Texas.

ASSIGNMENT CORRECTIONS: QUOTED INCORRECTLY IN LAST ISSUE

Colonels

Gallagher, Ferdinand F., to Army Personnel Records Board, Office of Secretary of Army.
Jones, Clifford R., to Army Personnel Records Board, Office of Secretary of Army.
Supple, Edward L., to Army Personnel Records Board, Office of Secretary of Army.
Turnbull, Harold T., to Army Personnel Records Board, Office of Secretary of Army.

BOOK REVIEWS

Throw It Away—and Get the ACD

AMERICAN COLLEGE DICTIONARY. Edited by Clarence L. Barnhart with the Assistance of 355 Authorities and Specialists. Random House. 1432 Pages; $5.00.

It makes little difference how recently you acquired your last dictionary. It's pretty obsolete now, in comparison with the new *American College Dictionary*, which is new and up-to-date in every respect. My suggestion is that you throw away your old one and get the first fully American all-around dictionary ever published.

Your old dictionary (that one on your desk or your shelf) may have a famous American dictionary name. It may have been a competent job of dictionary making, when it was last thoroughly revised. If you go by the definitions of military terms in all past dictionaries, the later revisions have been largely the patch-up kind, despite the vast world war that brought in thousands of new air, sea, and ground army terms now known to millions.

The publishers of the *American College Dictionary* obtained the services of some military and naval people who ought to know today's military language.[1] And although it is a general and not a technical dictionary, its military terms and their explanations come right up into the age of atomic and global warfare, and do not consist chiefly of war words from *Caesar's Gallic Wars*, *Ivanhoe* and *Gone With the Wind*.

But that's not the main point I want to make. To a soldier or a sailor or an airman, an up-to-date dictionary treatment of thousands of the more common and modern military, air and naval terms is certainly a boon. But the *American College Dictionary* has the very great advantage over other dictionaries of being *American* in the fullest sense. A highly able staff of American dictionary makers has recognized the fact that we have long had, here in the U. S., our own distinct language. It is English we speak, beyond a doubt, but it's American English, unhampered and uninhibited—except sometimes in Boston and one or two other points—by conscious or unconscious allegiance to the present form of the Mother Tongue as spoken and written across the sea. In short, the *American College Dictionary* is a book of the American language.

In the modest way of professional dictionary makers, the staff of the *American College Dictionary* explain that they took nobody's word for it but went right out into the country—into the professions, into the fields of politics, labor, industry, and all the arts and sciences, including the military—and *listened*—listened to the *American* (not to the English) language. And what they found they put first in their book. They realized, of course, that we in America read all good English writings of today and yesterday, and that therefore a good American dictionary must include thousands of shades of English meanings. But these, in the *American College Dictionary*, are made secondary, listed after the chief American usages of the word are listed.

And while they were at it, the makers of the *American College Dictionary* did a thorough, accurate and conscientious job in every respect. They had therefore to make a considerably larger book than that obsolete or obsolescent word-book on your desk or in your bookcase. The 350-odd "distinguished American authorities" who checked and built the *ACD* have come up with 132,000 words and 140,000 definitions of those words. They have used 26,000 illustrative examples and 1600 maps and illustrations to tell today's word-by-word story of the language we speak here in America.

And they have done one other thing that is a profound blessing to the man who uses a dictionary. They have put everything in a single alphabetical arrangement. You don't have to plow through one back section after another to find a place word or a name word with its brief description or biography. Every word is in its proper alphabetical place, whether it begins with a capital letter or small one. So is every common abbreviation.

The front matter in this new reference work is also extremely valuable. In about 12,000 words, Harrison Platt, Jr., gives a "Guide To Usage" of American English, which is the best and most modern brief grammar available anywhere. There are also fine articles on pronunciation, treatment of etymologies, synonyms and antonyms, usage labels and dialect distribution, and British and American usage.

I not only recommend the new ACD for individual use but I will make a still broader recommendation, and urgently. Not only are there sound reasons why the Army, Air, and Navy man as an individual should now ditch his old dictionary and get the *American College*[2] *Dictionary*. There are equally vital reasons why the United States Government, and the Departments of State and National Defense in particular, should collect all dictionaries now in official use and sell them at the current rate for old paper (after carefully chopping them up in bits so no one could possibly use them for reference again) and equip the people who turn the wheels of our atomic-age Government with an atomic-age dictionary. God knows such a vital, modern and American book of daily, essential reference is a tool that could, through sheer startling of the Government mind long limited to pseudo-American expression by lack of a truly American handy reference dictionary—could make the difference between clear understanding and half understanding which is no under-

[1] Col. S. L. A. Marshall, Col. R. Ernest Dupuy, Col. W. F. Heavey, and Mr. Stephen Grancsay, Curator of Arms and Armor at the Metropolitan Museum of Art, and the Editor of the INFANTRY JOURNAL were the advisers on the air and military words.

[2] The "College" is a logical and reasonable come-on, an appeal to the academic world in the *American* language of advertisement and textbook-sales-appeal.

standing at all. Could make the difference between the minimum and the maximum of static in what the servant of the people—the Government employee—hears when he listens to his chief or to his fellows. Could make *all* the difference between a successful or a non-successful solution to national and world affairs.

You tell *me* whether a clear communication between one American Government mind and another—and between the American Government mind and the general American mind—and between the Government mind and the non-American mind—wouldn't make a big difference.

What *is* our principal problem—now and until we solve it? It is simply one of getting together. It is one of learning to speak the same words with the same general meaning for all men on earth.

And that begins at home. It begins right here in America. Beyond the United States of America it begins wherever American or American-English or English is spoken or read. And that, today, is everywhere in the world.

The words to be spoken include the words of war, the words of war and potential war. They have to be said and said clearly—as long as our minds hold hate or fear. They have to be spoken and written and recited or else they stay hidden—hidden and more chain-explosive than the atomic bomb itself. They have to be spoken and written. They have to be quoted and recited. They have to be expressed in unmistakable language for all to hear and read and understand and accept—in reaching a solution.

The words of potential war are true, for it could come. And the more accurate we make them, the better we shall see their truth, the sooner we shall see how that truth is dreadful and aimless and destructive.

A new and American dictionary is a welcome tool of accurate expression at a time when clear language and closer understanding could mean a permanent peace. —G. V.

Disappointing Survey

DANGER FROM THE EAST. By Richard E. Lauterbach. Harper & Brothers. 430 Pages; Index; $3.75.

This brilliant but disappointing book is a mixture of superb reporting and ideological preaching. When Mr. Lauterbach is describing things which he met face-on, at first hand, he is very good indeed; no reporter living could do a better job than his chapter "'Operation Dove' in Manchuria." But when, under the stimulus of Stateside libraries and our more pontifical intelligentsia, he tries to hew a new form of democracy out of the chaos in Asia, he becomes unclear, inconclusive, and at times even pious.

Thus, in the book as a whole, you will find the best available all-around survey of the postwar Far East. Sections on MacArthur's Japan, Hodge's Korea, and Marshall's China combine shrewd description with vivid firsthand history. But the survey is impaired by the author's resolute determination not to be conventional or naïve. He is so anxious not to be a sucker for Americanism that he gives General MacArthur's staff rude and unkind treatment. While commending the Soviet general, Derevyanko, he takes a dim view of American Korea and a much brighter one of the Soviet zone, and he ends his book with the startling and unjustified conclusion that if the U. S. does not promote Leftist social-democracy in Asia, America will become "authoritarian" here at home. This reviewer believes that when and if local storm troopers ever march in the streets of Joplin, Missouri, there will be a million complex causes which will have brought them into being, but the Leftism or Rightism of the people in Shihchiachwang will not be on that list of the first million causes. Democracy in Asia, like ancient despotism in Asia, may be strategically near us, but it is still culturally far away. Americans need have no fear of being seduced to Chiangism or Hirohitoism if they survived contact with Tsarism and Napoleonics in the past.

Mr. Lauterbach's previous work dealt with the Soviet Union, but he does not develop the basic contrasts—for which he is uniquely qualified—between Japan and China on the one hand and Russia on the other. When he mentions similarities or differences, he does so in such a striking manner that the reader's appetite is whetted without being satisfied. It is to be hoped that he will return to straight reporting, minus the polemics, next time. His personal attacks on the late George Atcheson—who was the darling of the Leftist intellectuals when he defied General Hurley in Chungking, but their bogey when he supported General MacArthur in Tokyo—and his excursions into deep political and social theory (such as the brand-new international law on page 368!) hurt an otherwise impressive book. Indeed, he is so anxious to make sure the Far Eastern "fascists" (in plain English, non-Leftists) come out with a black eye that he accuses a "Kuomintang agent" of a new-type but unsuccessful assassination of an anti-Chiang Chinese. The democrat, says Lauterbach, ". . . was run down in the street by a Kuomintang agent and badly injured." (340) He does not say whether it was with an automobile, a bicycle, a pedicab, a rickshaw, a wheelbarrow, a tram car, a bus, a steam roller, or just plain feet. One reader would like to know.—PAUL M. A. LINEBARGER.

Comment On Soviet Methods

OPERATION MOSCOW. By Christopher Norborg. E. P. Dutton & Co., Inc. 319 Pages; $3.50.

What has happened since VE-day? Why did peace turn into tragedy and bring tyranny to hundreds of millions of people? These questions are raised in Dr. Norborg's clear and concise presentation of the facts of international life.

The author, a minister, publishes a NKVD document, classified STRICTLY SECRET and entitled "Regarding the Manner of Conducting the Deportation of the Anti-Soviet Elements." In this document, which should receive the widest possible distribution, we read: "The deportation of anti-Soviet elements from the Baltic States is a task of great political importance . . . The basic premise is that the operation should be conducted without noise and panic, so as not to permit any demonstrations or other excesses not only by the deportees, but also by a certain part of the surrounding population inimically inclined toward the Soviet administration." Deportation, Dr. Norborg shows, is one of the methods by which the Soviets introduced their brand of "democracy" into the "liberated" countries.

Slave labor, he says, is a device essential to the functioning of the Soviet planned economy, and only through one of the most savage types of slavery the world has ever seen do the Russians succeed in carrying out their five-year plans.

The Kremlin, the author says, has started on a conquest for global control. The plan is definite and cannot be altered by means of verbal persuasion. Through terror and deportation, "representative," *i.e.*, Soviet-controlled governments are established to rule the "independent nations" of Eastern Europe. The Politburo, says Dr. Norborg, is trying to impress upon the world that to obtain the cooperation of the Soviets they must be pampered and appeased. "VE-day brought Eastern Europe . . . nothing less than . . . a carefully planned and grimly executed Sovietization." Occupation of the satellite states is only a milestone on the road to the domination of Europe, and ultimately, the entire world.

The Soviet Union will not under any circumstances, this author insists, cooperate to protect any kind of non-Soviet state. "Stalin," he writes, "joined the United Nations reluctantly and has adhered to that organization only because it has given him everything he wanted and cost him nothing in return. From his vantage point in the Security Council he is now enabled to set at naught the joint will of the world for an assured peace based upon justice for all nations."

After having clarified the salient fact of the present international situation, namely the Politburo's attempt to Sovietize the world, the author ponders how the democracies might overcome the Soviet threat. In Dr. Norborg's opinion, the atomic age presents an opportunity for achieving a new spiritual cohesion which has been lacking in the democracies for some decades past, but he does not indicate a method by which that spiritual re-awakening could be brought about. Just as everybody is against sin, everybody is for a spiritual and moral renaissance of western culture. The prize question is precisely how this desirable goal can be reached. Like most exhortative writers before him, Dr. Norborg has not come forth with any answer.

Moreover, he neglects to point out absolute necessity for the democracies to maintain, or rather to re-establish, their military strength. The Kremlin believes in power. Sermons do not cut the Soviet ice. If the democracies really want to check it, military strength is the indispensable prerequisite, though it must be based on, and allied with, spiritual power.—L. ROSENZWEIG.

They Are Communists

LAST CHANCE IN CHINA. By Freda Utley. The Bobbs-Merrill Company. 408 Pages; Index; $3.50.

The tough-minded author of *Last Chance In China* was once a Communist. Taking her former political faith seriously, she went to Russia to live and during her years there became completely disillusioned. Since turning strongly anti-Communist, she has written several vigorous books that point out the weaknesses in the Communist doctrines and describe in considerable detail the methods through which the Communist Party tries to move toward eventual world rule. Naturally, she has come under the harshest attack from the Communist press but especially so from the Leftist sympathizers who cannot face the rough facts she presents on Communist dealings.

In this book, Miss Utley devotes much space to answering the question whether the Chinese Communists are governed from Moscow, or whether they are the simple countrified democrats so many friendly American writers about them insist they are. To my mind, she establishes a strong case to the effect that Chinese Communists are Communists in the Marx-Lenin-Stalin sense, governed from the central headquarters of the Party. She piles up much proof, though the reader needs at times to allow for her marked enmity toward all things Communistic, an emotion apparently made the stronger by the fact that she once thought they were good and learned through harsh and direct experience how they were not.

Miss Utley has a good deal to say about General Stilwell and General Wedemeyer. She has little good to say about Stilwell and everything good to say about Wedemeyer. General Joe, she insists, was far too sympathetic toward the Chinese Communist and far too lacking in sympathy for Chiang Kai-shek. She goes so far as to insist that General Stilwell surrounded himself with Communist sympathizers, which is undoubtedly an exaggeration. I feel very certain, from knowledge of the officers concerned, that neither Stilwell nor his official family were "sympathizers" in the usual sense, though they might have felt that the Communist forces of China were willing to fight the Japanese, more willing perhaps than other forces. It is simply silly to attribute any deep political sympathy with Communist beliefs.

General Al Wedemeyer, Miss Utley assures us, really knows the score. He saw at once and still sees clearly that the only possible action by the United States was and is to assist the one, strong anti-Communist leader of China, the Generalissimo, to hold back and eventually overcome the Soviet advance guard in the form of the Chinese Communist armies. This we must do, she insists, and we have a last chance left to do it. Her extensive remarks about General Wedemeyer make me all the more eager to see his most recent report on China released—the report which the newspapers have so often reported as held from release for reasons not clear.

Certainly China is of utmost importance to the future of the United States and the rest of the democratic world. The Marshall Plan and the urgencies of Europe have made the Chinese situation seem less urgent. But I am strongly inclined to agree with this author and others who see more clearly than most what a huge addition to the Communist world a Soviet-controlled China would be, and how there is desperate need to prevent that control. Miss Utley's book is well worth the close attention of all military readers as one of several important and current comments on the state of the world.—G. V.

World Relations

THE FOREIGN AFFAIRS READER. Edited by Hamilton Fish Armstrong. Harper & Brothers, 492 Pages; $5.00.

Twenty-five years ago the first issue of the magazine, *Foreign Affairs*, was published. From this and subsequent issues the editor of the magazine has chosen twenty-nine articles as case studies in the evolution of international relations. A quick look at a few of these articles indicates the care with which the selections were made.

The first issue featured an article by America's elder statesman, Elihu Root, stressing the necessity for teaching all the people the principles of international affairs. He wrote at a time when the United States was bringing home American occupation troops from the Rhineland. There followed an article by Jules Cambon, one of France's great diplomats, who told why France, deserted by the United States and Great Britain in the quest for security, was attempting to contain Germany by a singlehanded occupation of German territory and by alliances with other European countries encircling Germany.

Giovanni Gentile justified the Fascist glorification of force. Baron Wakatsuki, a Japanese statesman known for his moderation, told the United States through the pages of *Foreign Affairs* that Japan must have a bigger navy; that she must have more living room; that she must expand on the mainland of Asia.

But not many of the people of the United States were reading articles by foreign diplomats and presently they were caught unaware by a business depression. The Dean of the Harvard Graduate School, Edwin Gay, wrote that the "World Depression demonstrates the economic interdependence of the United States with other states. It cannot be a hermit nation." The Americans built their tariff walls higher, dumped their excess commodities overseas, and insisted on full payment of all war debts.

In Germany the middle class, ruined by the inflation that came with French occupation of the Ruhr, by the inflexible collection of reparations, by the effects of the depression on their industrial economy, turned to Hitler's Nazi Party for salvation. Gustav Stolper, refugee liberal statesman from Nazi Germany, warned the United States through *Foreign Affairs* that no country could remain unaffected by "the moral and intellectual consequences of the war any more than by its political and economic effects."

To the threat of war in Europe the United States responded by passing the Neutrality Acts, determined that this country would not go to war again whatever happened in Europe. Hitler and Stalin signed a pact of mutual non-aggression and presently were invading Poland from the east and from the west.

Great Britain and France went to war: the Americans began to awaken to the realities of international affairs. Dorothy Thompson, back from Germany, wrote one of her most eloquent pleas for American understanding in "The Problem Child of Europe." Professor Eugene Staley, from the Fletcher School of Law and Diplomacy, warned the United States of the imminent danger of Axis aggression in the Western Hemisphere with "The Myth of the Continents." The French philosopher Julien Benda sent in an article in which he said, "It is absolutely contrary to the democratic ideal to watch from a distance, without interfering, while a strong nation crushes a weaker one and deprives it of its liberty." Four months later the United States was at war with the Axis nations.

Have we Americans now learned to keep abreast of developments in the international arena? In the first issue of *Foreign Affairs*, Elihu Root wrote of the "Bolshevik rulers of Russia," who were "trying to repudiate all the obligations resulting from their country's membership in the community of nations." There followed other *Foreign Affairs* articles by members of the inner circle of Bolshevik rulers—Radek, Bukharin and Trotsky, expounding the principles of proletarian movement "toward the victory of world revolution." At the same time they disclaimed any Soviet aims toward "the conquest of Port Arthur or Dairen," and they emphasized Soviet non-aggression pacts with Poland, Latvia, Esthonia, Finland, Iran and Turkey.

As early as 1919, comments the editor, Sir Halford Mackinder was warning Great Britain and the United States of the danger to the British Commonwealth and the Western Hemisphere that would inevitably follow the domination of the Eurasian Heartland by a single strong military

power. In 1943 he wrote in *Foreign Affairs* "the conclusion is unavoidable that if the Soviet Union emerges from this war as conqueror of Germany, she must rank as the greatest land power on the globe," and he urged a close working alliance between the United States, Great Britain, and France, with the cooperation of China.

The most recent article reprinted from *Foreign Affairs* is the widely quoted "Sources of Soviet Conduct" by "X," who says that American "policy toward the Soviet Union must be that of long term, patient but firm and vigilant containment of Russia's expansive tendencies."

The *Foreign Affairs Reader* might well serve as a textbook for those senior officers of the military services, who, together with selected officials of the Department of State, are currently taking a special course at the National War College in the principles of American foreign policies but it should also have a much wider military reading.—Col. Presley W. Melton.

Eyewitnesses of the Civil War

THE AMERICAN ILIAD. The Epic Story of the Civil War. By Otto Eisenschiml and Ralph Newman. The Bobbs-Merrill Company. 720 Pages; Index; Illustrated; $5.00.

To tell the story of the American Civil War in the words of eyewitnesses and contemporaries is an original and meritorious idea. From every point of view the result is worthy of praise and in the vast literature and history of the Civil War this book is unique. Messrs. Eisenschiml and Newman have selected with care and understanding excerpts from the diaries, memoirs, letters, etc., of participants in the war. These include the top civil and military leaders and lowly but articulate men in the ranks, men and women who were keen observers at home and at the front, about equally divided between North and South. The authors have welded those selections together with brief and pungent commentary to form a well integrated history that provides more light and better understanding of the war for the specialist and a dramatic and unforgettable account for the uninitiated.

Examples will show how this result has been achieved. Jefferson Davis tells why Lee's invasion of Maryland and Pennsylvania in June 1863 was a military necessity. A balloon observer writes of what he saw across the Rappahannock as Lee's army started on the campaign that ended at Gettysburg. Gen. George E. Pickett of the famous charge, Lt. Robert Stiles and others report entertainingly episodes in the march through Pennsylvania. A war correspondent describes the transfer of command of the Federal Army from General Hooker to General Meade. The story of the spy who furnished Lee information concerning the movement of the Northerners completely altered the Confederate's objective. A reporter from the *Boston Journal* describes the meeting engagement on July 1 and General Longstreet testifies that the unexpected and unwanted battle was a surprise.

The action of the next two days follows in the words of many doughboys and artillerymen, officers and men in the two armies. The shift from one side to the other, from one flank to the opposite end of the line results in a vivid and fascinating account of the combat that has few equals in military history. Out of this chapter comes an accurate report on the battle that includes consideration of strategy, tactics, terrain, morale, weather, weapons, supply, leadership and the influence of time and change. And we have this for most of the important engagements of the war.

What is it that sets this book apart from previous historics? Undoubtedly it is the emphasis on the human element in war. Here the student of military history will find the important contribution of this novel approach to a study of our Civil War. The brilliant achievements of great leaders, the catastrophic disasters of the inadequate, the revelations of American character in victory and defeat are of lasting value to the American soldier in the atomic age. In this book we have military history that is stirring, impressive, readable as a novel and yet accurate and authentic. —Brig. Gen. Donald Armstrong.

Excellent History of Japan

THE PAGEANT OF JAPANESE HISTORY. By Marion May Dilts. Longmans, Green & Company. 418 Pages; Illustrated; Index; $4.00.

Are high-school children *people?* Book publishers have been trying to answer that question for many years. There is a big subadult market to which they would like to sell books, but they find it difficult to decide just how adult the books should be. The more sensible publishers prepare books for this group as though they were issuing them to the adult public—making doubly sure, however, that the books are authoritative, clear, noncontroversial, and interesting. The product is often a book which is excellent by any standards.

Miss Dilts' history of Japan is a case in point. It is one of the best books in the field. The only other up-to-date history of Japan is E. O. Reischauer's superb little epitome, *Japan: Past and Present.* The Reischauer book is better reading for trained students, for busy staff officers and for people who already know something about Japan. Miss Dilts' book is ideal for the leisurely reader, who is reading half for pleasure and half for instruction. It assumes no knowledge whatever of Japan and consequently can be counted on to explain everything fully, plainly, in black and white.

The book is self-contained. Notes, pictures, maps, and a very useful two-page chart of Japanese history are all included. The treatment of postwar Japan is fair to both the Japanese and the Occupation. Its judiciousness will impress those readers who are tired of flip and ready controversy.

If this is the kind of book our high-school students are getting, we might take a careful look at the textbook shelves. We may be missing more good things like this. —Paul M. A. Linebarger.

The Armstrong Plan

THE CALCULATED RISK. By Hamilton Fish Armstrong. The Macmillan Company. 68 Pages; $1.50.

The author is the editor of the well-known magazine, *Foreign Affairs,* a man who has often helped his Government with expert advice on international matters. He first lines up the present situation in Europe and then proposes a firm step for the democratic nations to take in order to prevent the overwhelming of Europe by Communistic Russia.

Mr. Armstrong thinks that the people of Europe must first have some way of living before they can decide upon their way of life, and we must help them with both. But above all, the democratic nations can make better use of the United Nations. It must be made stronger in structure. Still acting within its framework, the nations that want to work together can actually do so. They can even establish a democratic program and go ahead with it—without Russia and her satellites.

The method of doing this is somewhat complicated. Mr. Armstrong devotes many pages of the second half of *The Calculated Risk* to showing just how the United Nations setup can be made to lend itself to a program for democracy that does not have the nations unanimously behind them but has most of them.

Mr. Armstrong's plan has already been highly praised as a practicable solution of the deadlock between Soviet Russia and the rest of the world. All military men need a grasp of this plan, for it may well become the procedure we shall be following.—G. V.

A Moving Book

RICHER BY ASIA. By Edmond Taylor. Houghton Mifflin Company. 432 Pages; $3.75.

People who dealt with OSS will remember Mr. Edmond Taylor, the gifted writer whose book, *The Strategy of Terror,* was a terrifying description of the Nazi psychological warfare techniques. During the war he served with General Donovan's staff in Washington until he became weary to death of the battle of documents. He then sought and obtained assignment to SEAC and CBI, where he worked on psychological warfare. This book is his report of wartime experiences.

Richer by Asia is a surprise. It's not I-was-there stuff, nor inside gossip about the Stilwell-Mountbatten disagreements, Anglo-American propaganda policy differences, or other interallied quarrelling—interesting though this might have been. In-

stead, it is a moving and reflective diary deeply and sincerely personal, and almost religious in tone, which shows what Asia did to the mind and sensibilities of one intelligent American during World War II. Beautifully written, it expresses things which many Americans must have felt, but which few of them had the skill or unembarrassedness to express—the surprise of a secular man, practical, busy, forthright, coming into a world in which religion saturates society and even tints the landscape with its architectural reminders and its symbolic use of hills, trees, tanks, rivers. People who are not ashamed of having souls will enjoy this book.—P. M. A. LINEBARGER.

Best Handbook on China

CHINA HANDBOOK 1937-1945. Compiled by the Chinese Ministry of Information. The Macmillan Company. 862 Pages; Index; $6.00.

Intelligence people and staff officers are sometimes confused by the number of yearbooks which come out in English on China. The first and longest-lived of these was the old, British-edited *China Year Book,* which has not reappeared since World War II. Next was the Chinese-sponsored *Chinese Year Book,* which was compiled under the left-handed auspices of the Chinese Foreign Ministry. The Nationalist publicity service did not like the stuffy, academic richness of this and got out the *China Handbook* in competition with the Foreign Office. Finally, the Chinese quislings under Wang Ch'ing-wei issued the *China Annual,* presenting their version of China; copies of this are found in some American libraries.

This volume is the up-to-date version of the *China Handbook.* It is one of the best official manuals in the world if . . . If you allow for its presenting a governmental point of view. If you remember that Chinese statistics are weird, fearful, and inexplicable in their birth. (Nobody really knows, plus or minus within fifty million people, what the population of China is.) If you consider that the Chinese are strong on courtesy and often prone to describe hopes, desires or laws as accomplished facts, when they are not. These are sharp limitations, but the book is still preeminently useful. Physically, it is sturdily well made and moderately priced. This is the outstanding book in its quaintly competitive field.—P. M. A. LINEBARGER.

Occupation Finances

THE FINANCES OF EUROPEAN LIBERATION. By Frank A. Southard, Jr. Published for the Carnegie Endowment for International Peace by Columbia University Press. 206 Pages; Index; $3.00.

Of all the diversified activities of a military government staff, none is more complicated and more aggravating than the management of the finances of occupied territory. Dr. Southard, Professor of Economics at Cornell University and Special Consultant to the U.S. Treasury Department, is well qualified to write an authoritative book on this subject for the lay reader. A naval officer, he was instrumental in organizing the Allied Military Financial Agency before the invasion of Sicily. During the Italian campaign, he was financial advisor in the GHQ Allied Military Government Division. When France was invaded, he served as chief of the Civil Affairs Economics Branch with the Headquarters of the Seventh Army.

Dr. Southard thus had a major responsibility in the formulation and administration of the fiscal policies he discusses. It is apparent that he speaks with authority on matters of banking, foreign exchange, and inflation control, tax revision, currency depreciation, the impact of military procurement during the military government of conquered nations and the civil affairs administration of defeated countries in Europe.

The officer concerned with military government or civil affairs will find especially interesting the chapters devoted to the occupation money and currency procedures developed for occupied nations of Europe, including the Balkan countries. Dr. Southard anticipated the difficulties which resulted when the U. S. Government, overruling the Treasury Department's protests, gave Russia a set of plates to print occupation marks for Germany.—COL. PRESLEY W. MELTON.

U. S. Guidebook

GUIDE TO AMERICA. Edited by Elmer Jenkins. Public Affairs Press. 705 Pages; Maps; Index; $5.00.

Based on information collected by the American Automobile Association, this book is the closest thing to an American Baedeker that has come to The JOURNAL's attention. The text tells much of the history, geography, agriculture, plant and animal life, and industries of each state; the noteworthy sights, institutions, museums, public buildings, etc., of each city and town of any importance; the background and origin of significant shrines, battlefields, etc.; and reports when and where outstanding events are held regularly.

The book, despite its 705 pages, is a masterpiece of compression. People who travel extensively by automobile will find it particularly valuable; it should also be of considerable worth in libraries, day rooms, and like installations.—A. S.

Seventh Infantry History

FROM FEDALA TO BERCHTESGADEN: A HISTORY OF THE 7TH UNITED STATES INFANTRY IN WORLD WAR II. By Nathan W. White. Published by the Author. 320 Pages; Illustrated; $7.50.

From Fedala to Berchtesgaden is the World War II combat history of one of the United States Army's oldest and proudest regiments, the 7th Infantry. The author has prepared a detailed account of the operations of the regiment, illustrated by sketch maps of principal actions, and photographs of combat scenes as well as individual photographs of many of the members of the Regiment who were killed in action.

The book is a fitting tribute to the 7th Infantry and should be of much interest to the men who fought with the Regiment in any of its World War II operations. However, the author's style of writing and method of approach to his subject are not such that the book will be of wide general interest, since he limits himself to a carefully prepared, entirely factual report of operations.—O. C. S.

Brief Reviews

THE HORSE OF THE AMERICAS. By Robert Moorman Denhardt. The University of Oklahoma Press. 286 Pages. Illustrated; Index; $5.00. An account of the arrival, spread and development of the Spanish horse in the new world from Columbus to the modern Quarter Horse.

TORTILLA FLAT. By John Steinbeck. The Viking Press. 213 Pages; Illustrated; $6.00. A new and illustrated edition with seventeen paintings by Peggy Worthington.

UNSEEN HARVESTS. Edited by Claude M. Fuess and Emory S. Basford. The Macmillan Company. 678 Pages; Index; $5.00. An autobiography of tributes to teachers and teaching.

LANDS OF THE ANDES: PERU AND BOLIVIA. By T. R. Ybarra. Coward-McCann, Inc. 273 Pages; Index; $4.00.

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