HEADQUARTERS
EUROPEAN COMMAND
OFFICE OF THE CHIEF HISTORIAN

MS # D-011

MANUSCRIPT DATA SHEET

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II. Title of Report: The Development of the Super Battery in ZI Air Defenses between 1940 and 1945.

III. Assigned: 2 April 1947

IV. Sources: None - written from memory

A. Personal:

B. Reference Sources (American, German Documents; Diaries; Other Material; etc.):

EUCOM: HD: CHGB : Form 6A-2

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[-1-] Walther von Axthelm. Garmisch, 2 April, 1947.

The Development of the "Super Battery" in German ZI Air Defenses between 1940 and 1945.

During the first two years of World War II, four-gun flak batteries, their number varying according to the size and importance of the objective screened, were adequate for defense against enemy air raids on ZI targets. These raids were carried out by single aircraft or by very small and loose formations flying at an altitude of approximately 5000 meters. They presented a disturbing manifestation of warfare, but did not seriously threaten or endanger the target being raided. On the other hand, flak artillery was excellently equipped with the fire director and the 88-mm. and/105-mm. guns. Officers and enlisted men were well-trained. Training standards, which had dropped as a result of the activation of mobilization units, quickly returned to peace-time levels during the first months of 1940. In addition daytime raids were rare. Daytime raiders did not penetrate far into the interior. For use in nighttime air defense against single raiders flying on a straight course and at medium altitudes the very well trained 1.5 m. searchlight batteries were absolutely adequate. These were used in conjunction with listening apparatus -- so-called conical sound locators -- some of which were echeloned frontier-ward so as to permit them to detect approaching enemy aircraft before these arrived over the searchlight batteries. The latter were able to pick up enemy raiders at an early stage, tracking them in the spotlight until flak shot down the raiding aircraft or forced it to turn back. Several

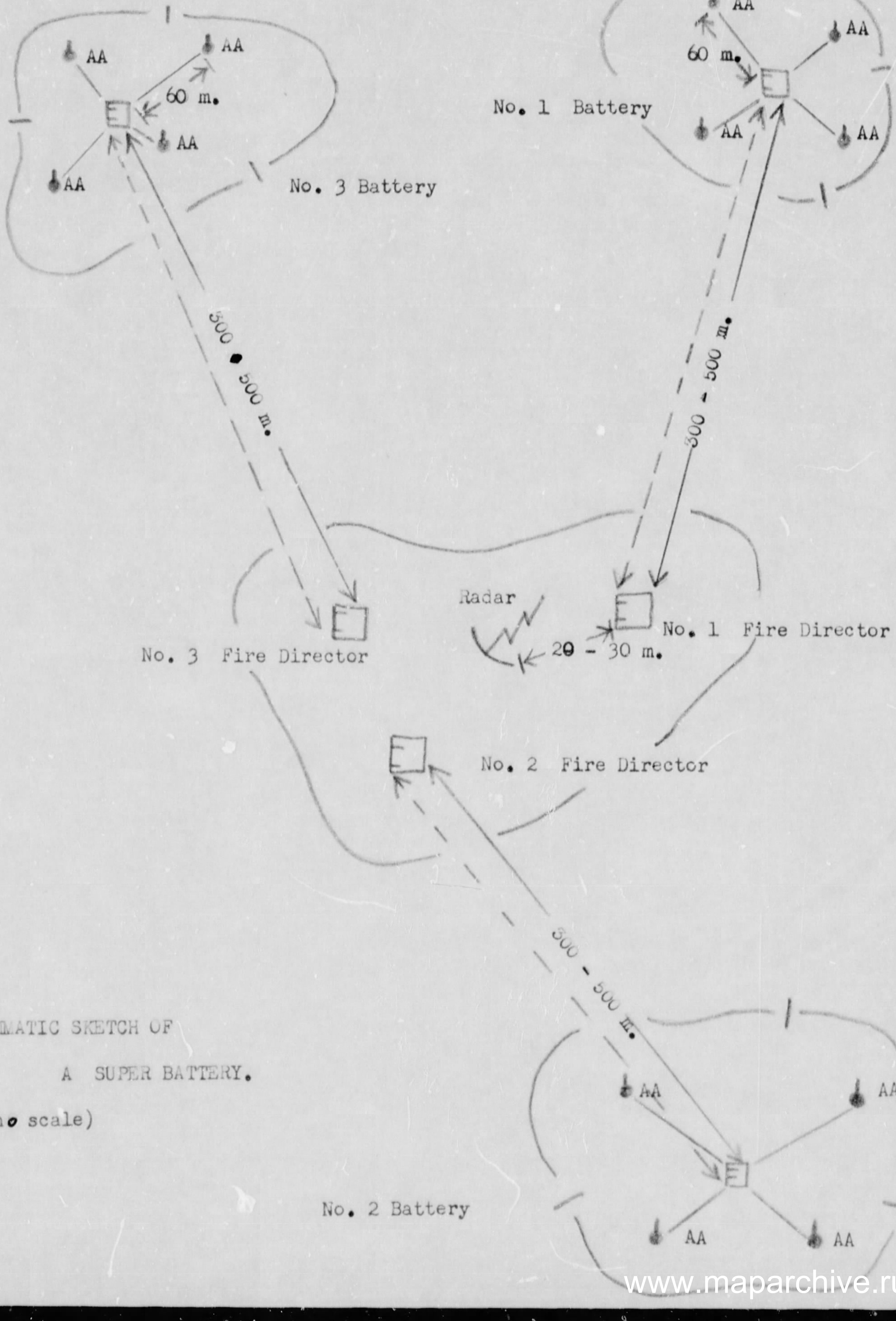
serious raids, flown from different directions and at varying altitudes, were launched mainly against the Reich capital. There, however, the raiding formations were driven off by a heavy volume of fire from strong flak concentrations. There was little damage, excepting such as resulted from a few accidental hits. During the course of 1941 and 1942, enemy air raids were gradually made from higher altitudes, at increased speeds, and with enemy formations enjoying ever greater invulnerability from antiaircraft fire. It devolved upon flak to devise corresponding countermeasures.

One of these measures was an idea which appeared in its basic outline in the autumn of 1941. This idea -- among other solutions -- envisaged an increase in the number of guns per battery in an effort to increase the mathematical probability of hits.

In the meantime the number of guns in some batteries was increased from four to eight for experimental purposes. These eight-gun batteries were employed as so-called "twin batteries." The number of enemy aircraft downed by flak increased as a result of this measure, but the solution itself was not effective enough. A short time later, i.e., in the spring of 1942, the HAMBURG and BERLIN flak defenses combined three four-gun batteries into one battery. This creation was called a "super battery." [Grossbatterie.]

I shall discuss the advantages and disadvantages of this battery system later. First, we must examine the problem of how it was technically possible to combine three firing units, heretofore independent to one another, into a single firing unit. Aside from connection difficulties which first became acute when several guns were to be

connected to one junction box, one of the most important purposes of the super battery was to insure the synchronized firing of its component sub-batteries. This difficulty was surmounted through employment of the "Wuerzburg" radar in conjunction with the super battery. This battery, in existence since about the middle of 1942, was arranged with one radar set in the center. Grouped around it within earshot, in a triangular pattern, were the three directors for the sub-batteries. In order to compensate for deviations due to different locations of radar and directors, and to keep these deviations as low as possible, the directors were moved so close to the radar that parapets placed around each director for protection against bomb hits and fragmentation almost touched. Since the directors contained a device which eliminated deviation between their own locations and the center of the sub-batteries for a distance of up to 500 meters (after 1944, up to 1000 meters) it was possible to group these three sub-batteries around the central fire direction set-up in such a manner that a certain degree of dispersion became possible after all.



DIAGRAMMATIC SKETCH OF

A SUPER BATTERY.

(no scale)

The above sketch shows that, depending upon the nature of the terrain, it was possible for the three sub-batteries to make the most of space -- even if only to a small extent -- so that the threat to the batteries resulting from bombings could still be kept within moderate bounds. On the other hand, the center of the super battery, its four sensitive devices massed at that point, was exposed to great danger from the air. However, this risk had to be taken for the sake of complete target detection, or rather, target data transmission from radar to the three fire directors.

The super batteries proved very satisfactory during the ensuing period, i.e., starting during the latter half of 1942 and extending almost into the middle of 1943, when enemy raids were constantly becoming heavier and more concentrated. Radar, which at this time suffered from only little interference, constantly reported almost the exact distance and altitude of enemy planes, and furnished a running report on the azimuth of the plane's course. This radar data was passed on continuously to the three directors by telephone or by word of mouth. Since it was a question of getting matching sets of data on each of the the three directors for use as initial data in ballistic computation, the procedure had to be practiced constantly, It had to be supervised by officers and carried out with scrupulous exactness. Otherwise, the fire of the super battery became de-synchronized, offsetting the advantage to be gained by delivering concentrated fire on one target through introduction of the super battery. All batteries therefore daily practiced dry runs with and without simulated targets. The following factors are mentioned merely in passing, as special

attention had to be given them also: The three directors had to be oriented, synchronized, and leveled for unity of action. The battery had to be composed of guns in as uniform condition as possible, allowing '1 plus' in velocity error variation. Ammunition had to be stored under uniform conditions in order to obtain uniform powder temperatures. There had to be constant checking to maintain parallelism of guns and proper adjustment of the data transmission system.

In the summer of 1943, during the almost incessant large-scale raids on HAMBURG, advance flying formations dropped large quantities of chaff in the vicinity of and over the target. The chaff, cut to the right frequency, jammed the radar of the batteries to such an extent that the data first became inaccurate and then completely incorrect. The result was a dispersion of the flak volume, and any hits scored were more or less accidental. The consequences to the city of HAMBURG were catastrophic. They were a foretaste of the mass raids against the most vital objectives which one could then certainly expect to occur in the future.

It was therefore important:

1. To counteract as much as possible the radar interference caused by chaff floating down as small dipoles.

2. To maintain and increase the effect of super battery fire.

The brave officers and men experienced the most severe hardships during the ensuing period. Their technical apparatus jammed, they remained at their guns amid a hail of bombs and phosphorus, all the while standing by and watching as the installations, intrusted to them for protection crumbled into rubble and ruin. In addition, the terrified populace adopted

an unfriendly attitude toward flak crews. Everything possible had to be done to make up for this severe air defense setback, not only for reasons of target protection, but also for reasons of troop morale.

The German fighter defenses -- likewise controlled from the ground by means of high frequency equipment -- suffered from the same serious interference as flak. German fighters thus neutralized were unable to close the breach in German air defenses.

The German research and development agencies were well aware of the possibility of dipole interference at the time high frequency equipment was introduced into German air defenses. The counter-interference equipment, however, remained wrapped in secrecy for fear that its existence might be revealed to the troops too soon, creating the chance of a possible leakage of information and data to the enemy. When the enemy finally employed this interference device completely by surprise, the flak units lacked the necessary additional parts to install in their apparatus. After several weeks of laborious organizational work and equipment distribution, the situation was brought under control to a certain extent at least. So-called remoted stations were installed in advance of radar, and the latter was once more in a position to provide data that were at least half-way useable.

At the same time, an effort was made further to reinforce the super battery and increase the number of guns. A second junction box was inserted into each sub-battery. It thereby became possible to increase the number of guns of the sub-battery from four to six and finally even to eight. Thus the total number of guns of the super battery during the

[-6-] winter of 1943-44 and in 1944 rose to three times six, equalling eighteen, and finally to three times eight, totalling 24 guns in one super battery.

It is obvious that an increase in the number of guns to this extent, was bound to increase the volume of fire placed upon the target, which, in turn, was bound to increase the probability of hits. On the other hand, however, the technical apparatus of this battery became so sensitive, particularly in the electrical connections, and breakdowns created so many complications, that the advantages and disadvantages counterbalanced each other. The operation of a complicated instrument, such as the 24-gun super battery was, demanded first-rate training for the entire crew, and this in turn required first-class personnel. It was also found necessary to install a second radar set next to the first set in order to avoid paralyzing the entire fire power of 24 guns in case one of the sets failed. In most instances a data converter was installed in addition to both of the radar sets. This converter was used to relay radar data to adjacent super batteries in the event the radar sets, of these batteries jammed or failed. Because of the very valuable equipment grouped in its center and because of the large number of guns, the super battery turned out to be a target particularly vulnerable to air attacks.

It must be mentioned, however, that super battery scores during the heavy air raids of the winter of 1943-44 and 1944 were quite considerable.

In summarizing the advantages and disadvantages of the super battery, the following picture will result.

Advantages: 1. The superbattery of the type described, manned by well-trained personnel, is in a position to focus the fire of twelve,

[-6-] eighteen, or twenty-four guns with lightening speed upon one target. The target area will be covered by a triple layer of bursts from four, six or even eight guns. With as heavy a barrage as this, flak is bound to score.

[-7-] Fire control may be returned to the several sub-batteries at any time the air situation should require it. In this connection two of the sub-batteries can open fire with electrically computed data, while the third sub-battery can enter action with its own optically-computed figures. This distribution of fire is technically possible. It was, however, rarely put into actual operation because enemy raids were carried out in such rapid succession that the time available -- a matter of mere minutes and seconds in the case of air warfare -- offered no opportunity to order a target change of one or more sub-batteries once a super battery was delivering concentrated fire on a target.

2. The employment of a super battery will result in a saving of administrative and service personnel.

3. Technical supervision of weapons and equipment can be improved and accomplished with less personnel.

On the other hand, there are the following disadvantages:

1. The super battery, particularly the one made up of twenty-four guns, was extremely vulnerable to air attacks.

2. The technical and equipment set-up was more complicated. Certain unavoidable electrical failures (short circuit, ground short, cable breaks, and influence of moisture could not be repaired fast enough.

3. Super batteries, especially those of twenty-four guns, require

[-7-] so much space that they are difficult to emplace in the peripheral areas of large objectives to be screened.

4. Super batteries because of their technically complicated set-up, and especially those of eighteen and twenty-four guns, require first-class, highly-skilled personnel and continuous additional training during commitment. Otherwise the entire fire power of the battery might be lost even for quite insignificant reasons, resulting in a considerable breach in air defenses.

5. Friendly fighter formations can operate within the firing zone of single flak batteries, since the fire volume of a single battery is not as heavy and since the commander of a single battery exercises greater control over the fire volume of his battery. Friendly fighters can not operate in the firing zone of a super battery without suffering losses through friendly flak fire.

In conclusion, it may be stated that the installation of super batteries of up to eighteen guns can be recommended, depending upon the anticipated enemy air activity. Considerable success can be realized if the technical and personnel requirements described previously can be met. The 24-gun super battery is not recommended because of its extreme complexity and its great vulnerability to air attacks.

[-8-] During 1944 efforts were made to set up 36-gun "Mammoth" batteries. Such flak units are both tactically and technically utterly impracticable.

[signed] v. Axthelm