

employing barrage firings. When one considers that one cubic mile of airspace contains 5,500,000,000 yards and the effectiveness of one anti-aircraft shell is only a few thousand cubic yards and exists for less than 1/50th of a second, the effectiveness of barrage fire was nil. It was estimated that 3000 rounds were required to shoot down one aircraft. The ratio of rounds per aircraft downed was considerably higher during World War II when sight and radar tracking was used to aim the Luftwaffe flak batteries.

The usual practice during that period was to mount batteries of anti-aircraft guns behind the front in such a manner that when approaching aircraft were detected by sound ranging equipment, gun crews were alerted and then could concentrate their fire on the aircraft. To protect cities or vital military targets, guns were positioned along the lines of approach. As navigational devices were quite crude, pilots often followed roads, rivers and rail lines leading to the cities and vital targets so gun batteries were sited along these same natural barriers and man made features.

According to the strict terms of the Versailles Treaty (that Hitler was to blame as the cause of World War II), Krupps was forbidden to manufacture the 8.8 in Germany after World War I. To overcome this restriction, Krupps came to an agreement with Bofors of Sweden, whereby Bofors acquired the foreign rights for all Krupps designs in exchange for granting design and research rights to the Krupps team working at Bofors. In 1928 Krupps developed a new design for a high velocity 88mm gun with a semi-automatic breech which re-cocked the striker on ejection of the cartridge case. A Krupps representative took the design back to Essen in 1931 where manufacture began in 1933, when the Versailles Treaty provisions were being openly violated by the Nazi Government which took power when Hitler became Chancellor.

*The defense of the Reich was given to the Luftwaffe, the German air force. It employed in excess of a million men and auxiliaries to defend the country.*

The new gun, the 8.8 Flak 18 was mounted on a cross shaped carriage with dual wheeled bogies that could be turned in pairs for positioning on the ground. The fore and aft legs of the cross were mounted over the wheels with the side legs swiveling up for storage. This was a great improvement over the 1916 model. This design proved rather clumsy from the experience the German Condor Legion gained during the Spanish Civil War, as it was found that the gun platform was somewhat unstable. To overcome this restriction, before firing, the gun had to be lowered from the bogies

to the ground. When the gun barrel was elevated to fire at aircraft the strain on the center of the star shaped cruciform carriage was greatest after the projectile was fired. Battle experience in Spain dictated a need for a reduction in time to bring the gun into a

battle ready state. It was evident also that provision had to be made to facilitate quick changing of the gun barrel in the field if the weapon was to reach its full potential. This necessitated that the manufacture of the barrel would have to be accomplished in sections so that worn parts could be replaced individually instead of a whole barrel assembly. The butt end of the outer barrel where the rifling began was threaded so a new barrel section could be easily screwed on. This extended the gun's service life and allowed assembly line manufacture without the need for specialized machinery. In 1936-37 the gun platform was improved by the installation of winches to the bogies which allowed the platform to be lowered to the ground eliminating the bending force on the carriage support. The bogies/limbers could then be wheeled away and the side arms were lowered. The mounting was then levelled by screw jacks at the end of each arm.

For quick firing when used on ground targets or as an anti-tank weapon the gun could be used from the wheeled position by applying hand brakes and chocking the wheels. With the barrel set almost parallel to the ground the recoil forces would be to the rear and the need to lower the weapon was not as great. The side arms were then dropped and secured readying the gun for action. From 1940 onwards the Flak 18 and Flak 36 were mounted on a Sonderonhaenger type trailer. Later improvements included the installation of twin wheeled bogies and protective shielding for the gun crew. The gun was designed to be towed by a half track vehicle, the Sd. Kfz7 tractor built by Krauss-Maffei. It had seating for the gun crew, and ammunition lockers, making the tractor-gun trailer self contained. When equipped for battle the gun & trailer weighed 7 tons.

The earlier models of the Flak 18 used a data transmission system whereby information on bearing, elevation and fuse setting was sent from the gun computer (predictor) via electric signals that illuminated three rings of colored lamps. The gunners merely turned his hand controls until all of the lights were put out. This system was replaced by a dual pointer system in the Flak 37 model so that the gunners then just turned the control wheels until both pointers matched up. Later improvement of the basic 88mm design consisted of the use of a turntable instead of the usual pedestal mount allowing a lower profile. But with the advent of high altitude bombing during the World War II, higher muzzle velocities were required to lift the shells to the operating altitudes. This was obtained partly by increasing the length of the barrel. This led to the model 41, a new design that led to a host of teeth-



**Flak tower in Vienna. Double mount 12.5 cm cannons were mounted on top. 3.7 cm and 2.cm guns were mounted on the lower ring for defense of low flying aircraft.**