

code in spring 1940 and the naval code in spring 1941 but were unable to read codes produced by the M4 until the end of 1942.

B. DOCTRINE

1. Surface Warfare

Although, in the aftermath of the First World War, Germany was reduced to the size of a minor navy, tactical training still followed the traditional idea of a fleet encounter between lines of battleships. The heavy guns were to open up in a fast series of rounds, a so-called fork. The first round was only to warm up the gun and was not spotted. The following rounds were shot very quickly with small variations in the actual measured range. At greater ranges three salvos were in the air before the first reached the target area. Most often one of the salvos would straddle, which meant that its shells would splash in front of and beyond the target, and shooting at the identified range would start. To get quicker results, the battery was often split in two and alternated fire. It was also considered easier to spot the fall of shot from four splashes rather than eight.

The traditional idea of torpedo boat attacks at night or from the battle line's unengaged side predominated before the war. In an effort to improve nocturnal torpedo boat attacks, the *Marinenachrichtendienst*, or signals service, developed a radar in cooperation with the GEMA Company in 1933. This radar operated on the 50-cm wavelength and could detect vessels up to 10 km away. A pre-war doctrine called for shore-based radar stations to guide torpedo boats to their targets. This concept worked well on the night of 23 October 1943 when a British cruiser and six destroyers tried to intercept a German convoy off the French channel coast. Five radar-directed torpedo boats surprised them and torpedoed and sank the cruiser *Charybdis* and one destroyer without loss to themselves.

2. Aviation

At the end of the First World War, the Kaiserliche Marine possessed 1,400 planes distributed between thirty-two seaplane stations along the North Sea, English Channel, Baltic, Black Sea, and Mediterranean as well as seventeen airports. The Treaty of Versailles prohibited German air forces. In spite of this the army and navy trained pilots and developed aircraft. The Reichsmarine used civilian organizations like "Aerosport GmbH" at Warnemünde as a disguised naval air force. In 1925 the navy established a civil aircraft company *Severa*, and in 1926 purchased the aircraft factory *Caspar-Werke AG* Lübeck-Travemünde, which was later developed as the trial base for seaplanes. From 1933, however, when the NSDAP party took power and Hermann Göring became the minister of air, the still camouflaged *Luftwaffe* assumed the development of all military aviation, which frustrated the navy because