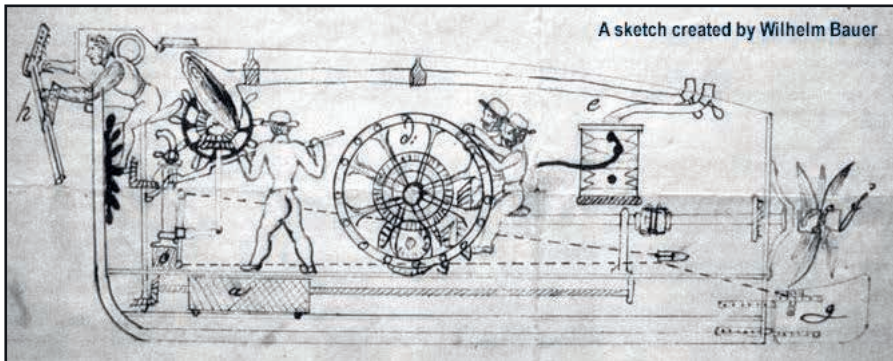




A CENTURY OF GERMAN SUBMARINES

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During both World Wars, U-boats bore the main burden of German warfare against the Western naval forces, and the submariners paid the heaviest toll of lives. Originally, the admiralty and the German Naval War Staff respectively had by no means planned to assign this role to the submarines. But the way the wars developed forced them to do exactly this. The U-boats of the German Emperor had sunk 12 million gross register tons of merchant ships, while his “Schimmern-de Wehr”, the High Seas Fleet, was gently riding at anchor in the Jade Bight. At the time of Hitler's invasion of Poland, 32 submarines were at sea, which is slightly more than the number of units the force had available in 1914 when it was still in its infancy. After two wars, there was no other means of naval warfare that the Germans knew to employ better. For this reason, submarines also were platforms of choice for the new Federal German Navy. However, no longer for the purpose of an oceanic *guerre de course* but as assets for the maritime forward defense in alliance with the enemies of yesterday. Since the end of the Cold War, German submarines have again been involved in operations in remote maritime areas.

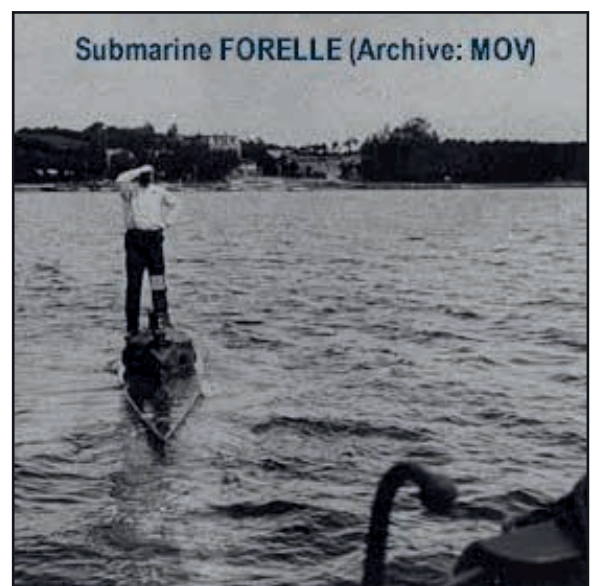
1. THE BEGINNINGS

Taking the construction of the first U-boat as the criterion for the beginning of a national submarine history, it is certainly justified to regard 18 December 1850 as the decisive date for Germany. On this day, the Bavarian artillery NCO Wilhelm Bauer had completed the construction of his *BRANDTAUCHER* for the Schleswig-Holstein Army and conducted surface trials in the Kiel Firth. After he and his companions had nearly paid with their lives for their first (failed) diving attempt, Bauer started to look for customers in Prussia, England and Russia, where in 1855 he finally was able to build the submersible *SEETEUFEL* and to successfully test it in more than one hundred dives.

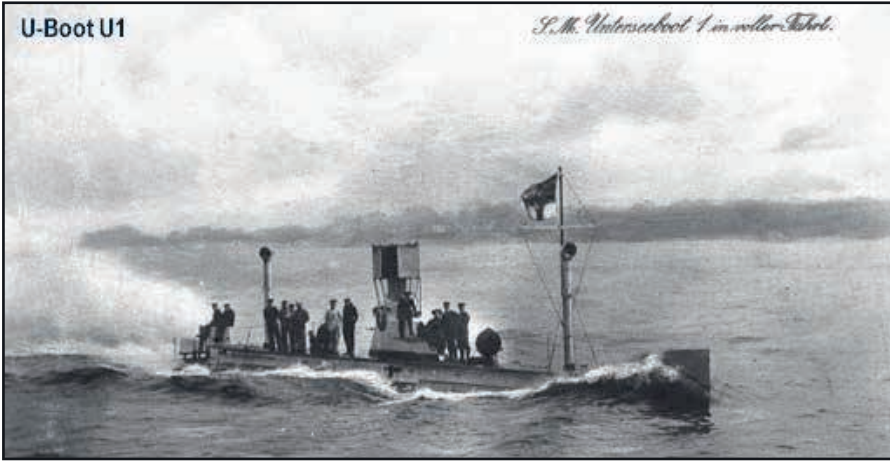
As much as the submarine would be associated with German maritime warfare in later years – at the time when this new platform was being introduced elsewhere, Germany's Imperial Navy was still hesitant. In his memoirs “*Erinnerungen*”, Grand Admiral Alfred v. Tirpitz, who had develo-

ped the Emperor's favorite military force – the fleet – into an instrument to exercise sea power, later explained this by his seasoned method of waiting until a new invention has proven its suitability for warfare before he would implement it. He wrote that he had refused to “waste” money for submarines as long as they were only capable of operating in coastal waters. As soon as seaworthy boats had been built, however, he had been the first to promote them on a large scale, going up to the limits “of our technological capabilities”, in spite of the budgetary restrictions.

Eberhard Rössler, the tireless chronicler of German submarine construction, counted 181 submarine designs which were offered to the Prussian and Imperial Navies respectively for realization between 1861 and 1900. Only construction no. 333 was actually built in 1897 at the Howaldt shipyard in Kiel, but never got beyond the experimental stage. The Spanish engineer d'Equivilley, whose submarine design had been



U-Boot U1

S.M. U-Booteboot 1 in voller Fahrt.

rejected by the French navy department, turned to Krupp in Essen at the beginning of the year 1902. Thus, the nucleus of the German submarine force was – so to speak – “proliferated” across the Rhine by a frustrated engineer looking for a job. The Germania shipyard in Kiel built the submersible FORELLE, a prototype which was offered for sale to different navies. The Imperial Prince Heinrich himself operated the diving plane during a submerged demonstration run in December 1903, the German Emperor inspected the boat and so did Russian navy officers. Even before the Imperial Navy could place an order, the Germania yard was awarded a contract for three large submarines for the navy of the Tsar in June 1904, and Saint Petersburg received the FORELLE as give-away.

2. THE BIRTH OF THE GERMAN SUBMARINE FORCE

It was this export success and the pressure of public opinion that made Tirpitz change his mind. Already in December 1904, the Imperial Naval Office ordered a submersible similar to the Russian boats. Due to additional modifications, this boat was commissioned with a delay of one year on 14 December 1906 under the name U 1. The hoisting of flag and pennant on U 1 marked the birthday of the German submarines.

The cruise of 587 nautical miles from Wilhelmshaven around Skagen to Kiel in heavy weather, which was regarded as a top performance, gives an idea of the limited capabilities of U1 with her displacement of 238 tons. The Imperial Shipyard Danzig was awarded the contract for larger follow-on submarines, while the Ger-

mania yard had to make do with exports to Austria and Norway. It was not until the foreigner d'Equieville was replaced by Techel as the chief designer that the yard in Kiel was able to get through with its design of a 500 ton boat with which both yards were then contracted in 1908 for U 5 to U 12. The boats had a design diving depth of 50 meters and reached a surface speed of approximately 15 knots. They were said to have already reached a speed of 10 knots submerged, however. They could carry six torpedoes to be launched from two bow and two stern tubes. With their latest units, the Imperial Navy had reached a level of capability clearly superior to that of foreign submarines with respect to endurance and combat power.

These boats were already provided with lead batteries, hydraulic and pneumatic systems, electric propulsion motors also serving as generators to charge the batteries, with torpedoes, periscopes, radio masts and gyro-compasses - all of these major components still representing the technology of today's submarines. According to Tirpitz, the kerosene engine was the only component which made these boats unsuitable for long-distance operations because this engine had a poor efficiency and made the boats easily detectable due to the development of smoke at day and a fire-like glow at night. And indeed, most of the kerosene-fuelled boats were lost already shortly after the beginning of the war. It was not before 1911 that a matured Diesel engine could eventually be installed in U 19, but it took until 1913 to overcome its teething troubles..

3. THE FIRST WORLD WAR

Eight years after its birth, the German submarine force had made it to the top by international comparison with respect to quality. In July 1914, it already had 28 units available, 10 of them provided with Diesel propulsion; further 17 Diesel boats were under construction. Germany had outstripped its major opponent England, which had just 7 Diesel submarines, and France, which possessed not even a single functional unit of that kind. But there were also shortcomings. The most advanced 685 tons series – U 31 to U 41 – was planned to be delivered by 1 August 1914. However, technical problems with the two-cycle Diesel engine caused a delay of nearly one and a half years. The blame for this delay – as Tirpitz writes in his “Erinnerungen” – was to be ascribed to the companies involved in the construction which were not able to keep what they had promised. As rapidly as technology developed leading to astonishing results, as vague were the ideas regarding the submarines' potential for the war, the tactics and the operational approach. To Fleet Command, the primary purpose of the submarines was to support the High Seas Fleet by performing static tasks like the formation of security zones and taking up engagement positions. With regard to the physical stress of the crews, the prevailing conviction until 1912 was that human beings could not endure more than three days in the narrow steel tubes. This opinion, however, had to be corrected in the winter of 1912/1913. The complete flotilla had been dispatched to the North Sea with the task to remain, ready for attack, near the English coast - they staid out for as long as eleven days. On the basis of this experience, the respective technical adaptations were immediately implemented and proved themselves in the war to follow.

The type U 31 boats ordered before the war and the slightly larger boats from U 43 onwards bore the main burden of the submarine war for many years, until larger submarines - up to the sub-cruisers of the U 139 type with approximately 2,000 tons - could be introduced from 1918. The-

se units were especially designed for long-distance operations. The keels of more than 800 boats were laid during the war; 380 of them were actually commissioned, just under 300 of those were suitable for front line operations. By autumn of 1914, the development of the land war opened the possibility to engage Britain from bases in Flanders with small U-boats used as torpedo and mine carriers. Up to 1916, 147 of these UB and UC-type boats, characterized by extremely short construction times, were delivered. The smallest UB I boats were even de-ployed in the Mediterranean and the Black Sea after their components had been brought to Pola at the Adriatic Sea by rail to be assembled there.

The first really spectacular successes were scored by the Lieutenants Otto Hersing with U21 and Otto Weddigen with U 9, for which they were awarded the order of Pour le Mérite. On 5 September 1914, Hersing was the first submarine skipper in history to sink a ship with a torpedo. A British light cruiser off the Scottish coast was the victim. Only 17 days later Weddigen torpedoed three British armored cruisers near the Dutch coast with his kerosene U-boat, outdated already a few years after it had been commissioned. Within little more than one hour, 1,500 men went down with their ships. With another great coup Hersing entered the books of history and proved the suitability of the Diesel boats for long-distance operations: Following a request for help by Turkey, the German naval staff dispatched U 21 on 25 April 1915 to a 4,000 nautical-mile cruise from Wilhelmshaven to the Dardanelles. After just one intermediate stop at the Austrian Adriatic base Cattaro, the U-boat arrived at Gallipoli one month later, where a British-French fleet supported the Battle of the Dardanelles with naval gunfire and landing operations. Hersing sank two British ships of the line in two days, before the very eyes of the Turkish defenders; for tactical reasons he then had to remain submerged for 29 hours – an incredible accomplishment. The land war had claimed the lives of 250,000 allied soldiers; four major combatants had

already been destroyed by Turkish artillery and mines. Hersing's torpedoes, however, tipped the scales towards the abandonment of the Dardanelles Offensive. His operation was credited with a strategic dimension because Russia remained cut off from the vital arms transfer via the Black Sea, which accelerated the collapse of the tsarist empire.

Right at the beginning of the war, the new naval asset had proven its unpredictability and threat to warships. Now it was intended to be employed also in the *guerre de course*, because on 2 November 1914 Great Britain had established a sea blockade and declared the North Sea a theater of war. However, only actions in compliance with the London Declaration of 1909 - which had also been signed by Germany - were covered by international law, especially by the Naval Prize Act; this denied submarines the option of surprise submerged attack against merchant ships. Surfacing, forcing a ship to stop, boarding and search, release the crew into the lifeboats in case contraband goods were found, and only then weapon employment - for the complete duration of this sequence of actions the U-boat was exposed on the surface as a vulnerable platform. Aiming at this vulnerability was the "U-boat trap" or "Q-ship", merchant ships equipped with covert artillery. Their success-rate, however, was moderate. No more than 12 U-boats fell victim to this British countermeasure.

When the "hunger blockade" impacted its economy, Germany declared the waters around Great Britain a theater of war in February 1915. Any enemy merchant vessel in this area was allowed to be destroyed. The Imperial Government had entered a gray area of international law. The number of ships sunk increased only marginally. When on 7 May 1915 U 20 sank the passenger liner LUSITANIA off the Irish south coast with 1200 passengers on board, among them many Americans, the political damage was immense. Since the neutral United States threatened to join the war, the German Emperor eventually decided to cease submarine warfare in the waters around the British Isles for the time being. It was not until March 1916 that it was resumed with increased intensity. Now, even neutral vessels were allowed to be treated as hostile if they were not clearly identifiable. However, the sinking of a ship still had to be in compliance with the Naval Prize Act. When, under this regime UB 29 torpedoed the French passenger steam ship SUSSEX on 26 March, which again led to 25 Americans being injured and entailed the danger of America entering war, the trade war with U-boats was suspended once again. The supporter of unlimited submarine warfare, Grand Admiral Alfred v. Tirpitz, a few days after he had resigned from office as a state secretary of the Imperial Naval Office, wrote the following: "The Sussex Note marked a decisive turning point in the war, the beginning of our surrender.



B 3 Boot 1917 (Foto: Archiv MOV)

The entire world could see that we were giving in to America.”

The Battle of Jutland, declared victorious, the failed offensives at the army fronts in the course of the year 1916, and the rejection of the German peace offer by the Entente in December 1916 resulted in a mood in Germany which stimulated the supporters of submarine war and increased their influence on the wavering emperor. The U-boats – provided that they were allowed to bring their full potential to bear against the enemy – were believed to be capable of cutting off Great Britain from supplies, thus enforcing peace. On 9 January 1917, Emperor Wilhelm II decided in favor of unlimited submarine warfare from 1 February. This meant the sinking of ships – even of neutral ones – without prior warning in the waters declared exclusion areas, i.e. around the British Isles, adjacent to France and Italy and in the eastern Mediterranean. This measure made Lieutenant Lothar v. Arnauld de la Perrière with his U 35 the “ace of aces”. He had already fought outstandingly between Malta and Crete in 1916 (still under the Naval Prize Act): On his most successful war cruise alone, he had managed to sink 90,000 tons. Nothing could stop him now to become the “King of Tonnage” among all submarine skippers of all time. As many as 453,000 tons of allied tonnage fell victim to him who later, in October 1918, also was tasked to carry the submarine war to the American east coast with the sub-cruiser U 139. And his U 35, commissioned only 8 years after the formation of the German submarine force, will remain at the top of the submarine war statistics for all times with a total of 536,000 gross register tons sunk.

Some sources state more than 9 million tons of allied shipping sunk in 1917. In spite of this immense success, which was not even reached in the “year of horror” 1942, Germany did not manage to force Great Britain to the negotiating table within one year, as this had been anticipated. On the contrary: On 6 April 1917, President Wilson had declared war on Germany. This intervention of the U.S.A. into the maritime war – espe-

cially by providing transportation space and escorts for the new convoy system, and from 1918 on the massive reinforcement of the land front with one million U.S. soldiers – led to the decisive turning point in the war. Then Commander in Chief of the Fleet Admiral Scheer remembered in 1920 that as few as 57 U-boats were operating in the North Sea and the eastern Atlantic, when unlimited submarine warfare began on 1 February 1917. Later that year, a total of more than 150 U-boats were available for front deployment; the loss of less than 10 boats per month could be more than compensated by the new builds. Still, the U-boats were not able to seriously endanger the Atlantic supply routes – hardly any vessel under convoy protection was sunk. Successes like the ones of U 35 were mainly achieved in the Mediterranean. Admiral Scheer summarized how the Entente had managed to gain control over the U-boat threat: By reproducing the tonnage losses, by blocking the North Sea with mines, by employing destroyers with depth charges, by using nets and wire obstacles, by Q-ship operations and, most decisively, by convoys. What he did not write: The declaration of the unlimited submarine war was the actual cause for America to join the war, which finally sealed the fate of the Central Powers.

On 21 October 1918, the German government complied with President Wilson’s demand to terminate the submarine war against passenger ships. Following this, Admiral Scheer completely stopped the guerre de course with U-boats. In the language of his ancestors Lieutenant v. Arnauld de la Perrière called his sub-cruiser U139 the “dernier cri” of German armament. On 1 October he had left Kiel; Scheer’s order reached him, halfway to his assigned area off the American east coast. On 14 November, U 139 was back in Kiel, severely damaged. Ten years later, the “King of Tonnage” told American author Lowell Thomas for his book “Raiders of the Deep”: “When we entered port, we saw the red flag of revolution flying.” In 1920, Admiral Scheer resumes bitterly in his book “Germany’s High Seas Fleet during

the World War”: “In the Navy, the submarine force had to sustain the worst losses... In total, 360 U-boats ... were employed during the submarine war; 184 of them were lost on their war patrols.” 5,249 out of 12,500 men had perished.

4. THE TIME BETWEEN THE WARS

According to the Treaty of Versailles, Germany had to hand over all submarines; their construction and procurement was prohibited. 176 U-boats and sub-cruisers got into British hands and were then distributed among the allied nations U.S.A., France, Italy and Japan, sea-unworthy and unfinished boats were scrapped – finis submarinae. The design documents had not to be handed over. German influences nevertheless proliferated into the submarine developments of the victors through re-engineering, as we would call it today. In Argentina, Sweden and Spain, too, reproduction projects of German U-boats were planned, and three former German submarine yards established the “Ingenieurskaantor voor Scheepsbouw” (IvS) in the Dutch Hague to support such programs. Budgetary resources of the post war German Navy (Reichsmarine) were transferred to a secret fund, the Reichsmarine even became the principal shareholder of the IvS. German officers maintained close contacts with the office in The Hague via a covert submarine section in the fleet department.

When in 1925 Turkey ordered two 500 ton boats to be built in Rotterdam, this offered an opportunity to gain experience for future German submarines by participating in this program. In the small Finnish port of Abo, three further boats of the 500 ton Vetehinen class were built for the Finnish Navy according to IvS plans and delivered in 1930. With the help of Spain but completely financed from the secret funds of the Reichsmarine, the E1, an IvS design of 745 tons could be constructed in Cadiz. The trials for this boat were finished in 1931 and in 1934 it was sold to Turkey.

When the National Socialists seized power, Germany started with

planning a secret submarine program with initially six 250 ton boats of the II A type and two boats of the modified E1 class (I A type) to be built by German yards, in spite of the prohibition still in force. On 1 October 1933 the training of submarine officers began in Kiel under the code name "Ubootabwehrschule" (ASW School: ASW = Anti Submarine Warfare), the construction of the boats started in February 1935. Simultaneously, several drafts for follow-on programs were developed which resulted in the 500 ton type VII and later in the legendary 750 ton type VII C. Shortly after the German-British Naval Treaty had been concluded, which allowed the German Navy only 35 % of the Royal Navy's total tonnage, but a balance with respect to submarines, a total of 24 small boats of the II A and II B types were commissioned in rapid succession from June 1935 until 1937. Further 17 boats of the larger I A and VII types and the 1000 ton type IX (for sub-cruiser tasks) were under construction.

In June 1935, the Commander in Chief of the Navy, Admiral Raeder, had entrusted to Captain Karl Dönitz the operational command and the training of the U-boats, and thus the task to shape a powerful submarine force from the incoming platforms. In fall 1936, Dönitz became "Führer der Uboote" (FdU, Senior Officer Submarines). Raeder's vision of powerful surface forces suitable to form a so-called "risk fleet", the high dedication of resources inevitable for their

construction, Germany's joining the London Submarine Protocol of 1936 which meant compliance with the Naval Prize Act, and the widespread belief that new means of detection like Asdic (Anti Submarine Detection Investigation Committee, which examined the use of sound for underwater detection; later referred to as "sonar" = sound navigation and ranging) could neutralize the effectiveness of submarines, all of this spoke against a one-sided preference of the U-boat in the fleet construction program. In addition, Raeder still had Hitler's promise that England would not be the enemy in a future war.

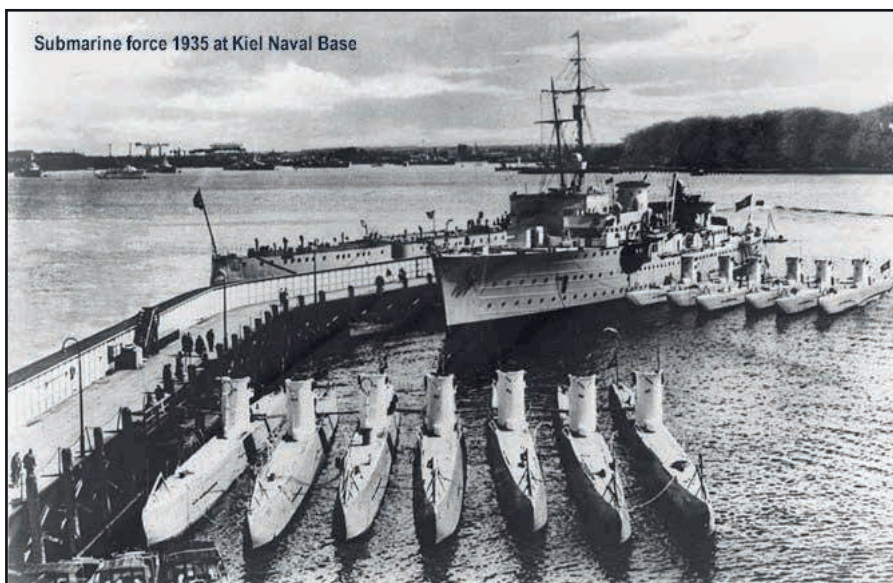
Dönitz' training was extremely successful. He freed the skippers and their crews from the inferiority complex that the submarine was an outdated weapon. He did not believe in Asdic as the panacea, least of all in light of his doctrine to prioritize the surfaced close-in attack at night. As a result of a war game in the winter of 1938/39 during which the guerre de course against England had already been exercised, he had requested 300 frontline submarines (100 boats in overhaul, 100 on transit, and 100 in the area of operation) for the convoy battle because the convoy system, which had been so successful since 1917, would undoubtedly be applied right from the start of a future war. In response to this anticipation, he followed a basically new approach which discarded the idea of the submarine as a lone wolf. With his "wolf-pack tactics" Dönitz revived

Tirpitz' idea of massing small torpedo boats combined with adequate tactical control and co-operation, and transferred it to the U-boats. Following the initial detection of the convoy, groups of U-boats directed via radio were to report and maintain contact beyond their victims' visual range, then surface in the dark and penetrate the screen to torpedo as much transportation space as possible. The risk caused by breaking radio silence had to be accepted.

After those tactics had proven successful in an exercise in the Bay of Biscay conducted in spring of 1939, when 20 U-boats attacked a convoy, Dönitz had also convinced the Naval High Command. The FdU therefore urgently insisted to increase the quantities. One quarter of the total of 300 boats was to be made up of the type IX boats optimized for long-distance operations, while the majority was to consist of type VII boats which to his opinion were most feasible for the Atlantic convoy battle. These boats had a slim silhouette, a relatively high surface speed of 17 knots, and, in the case of the type VII C which was not delivered until 1940, an increased cruising range of almost 9,000 nautical miles.

5. THE SECOND WORLD WAR

On 3 September 1939, however, when Great Britain and France reacted to Hitler's invasion into Poland with their declaration of war, only 51 U-boats had been commissioned and a further 78 were still under construction. Since the end of August already, 18 boats of the I, VII and IX types were patrolling their grid squares from the north of Scotland to the approaches of Gibraltar, while 14 U-boats of the smaller type II were stationed in the southern North Sea and the English Channel. On this same 3 September, mistaking her for a troop transport ship 250 nautical miles west of the Hebrides, Lieutenant Lemp sank the passenger liner ATHENIA with his U 30. The German Government denied the sinking, the Naval Operations Staff ordered Dönitz to keep the circumstances secret – the respective page disappeared from Lemp's war diary. 128 of the 1,400 passengers of the



Submarine force 1935 at Kiel Naval Base



ATHENIA lost their lives. The international press accused the Germans of inhumane warfare. On 5 September, U 48 sank the ROYAL SCPTRE in accordance with the Naval Prize Act. This was the first of nearly 2,500 merchant ships to fall victim to German submarines in the course of the Second World War. After several incidents in which merchant ships stopped in compliance with the Naval Prize Act had radioed emergency calls to land-based stations stating their position and in one case even had opened fire at U38, the German government nullified the Naval Prize Act on 30 September and by mid November declared unlimited submarine war against British and French merchant shipping. In World War I, by comparison, 29 months had elapsed before the similar enactment.ä

On 17 September, U 29 had her first success against a warship. The torpedoed British aircraft carrier COURAGEOUS went down with nearly half of her complement of more than 1,200 and with 52 aircraft. Asdic of the escorts had been unable to detect U 29. This seemed to confirm Dönitz' expectations. The most effective coup with respect to propaganda was achieved by Lieutenant Prien with his U47 who penetrated into the heavily protected anchorage of the British Home Fleet at Scapa Flow and managed to sink the old battleship Royal Oak – 833 men lost their lives. Prien – from now on with the nom de guerre “Bull of Scapa Flow” – was decorated with the Knight's Cross and his whole crew with the Iron Cross. Dönitz who had already been promoted to rear admiral on

1 October 1939, became “Befehlshaber der Uboote” (BdU, Flag Officer Submarines).

Relieved of the restrictions of the Naval Prize Act, the U-boats now fought a merciless battle (in spite of numerous humane actions of commanding officers) against a just as merciless an enemy determined to persevere. The year of 1939 ended with 800,000 tons sunk, while 9 U-boats were lost. In February 1940,



the handful of U-boats (due to the slow build-up, more U-boats could not yet be deployed to the front) scored a monthly success of 170,000 tons. According to the statistics of the British admiralty, however, only 7 of the 164 ships sunk since the outbreak of war had been sailing in protected convoys. With the small number of boats available, Dönitz' “wolf-pack tactics” could not yet come into effect. Then, almost simultaneously with the Norwegian Campaign between April and June 1940, the torpedo crisis struck. None of the

aces, neither Prien nor Kretschmer nor Schultze could score a success. The magnetic proximity firing pistol of the new torpedoes failed. In their firing positions off the Norwegian coast, the U-boats had to watch impotently as British battleships, cruisers, destroyers and troop transports steamed along after their “fish” had either detonated prematurely or passed their targets without effect.

After the German invasion of Norway and the Wehrmacht's victory over France in the summer of 1940, the chain of bases along the occupied coastline reaching from Drontheim to La Rochelle put an end to the unfavorable situation in the “wet triangle” of the German Bight, in particular for the submarines. However, Dönitz still only had 29 operational boats, while the losses were balanced by new deliveries. After the torpedo crisis had been overcome, the BdU kicked off his wolfpack tactics with these few boats. There was no long-range aerial reconnaissance by Reichsmarschall Göring's Luftwaffe

at his disposal to facilitate the most severe problem, i.e. the initial detection of a convoy. It was the German cryptanalysis service (B-Dienst) that provided the information for the première of a headquarters-controlled group operation of 4 U-boats on 28 August. Although they only managed to sink 5 of Convoy SC 2's 53 ships, the procedure of keeping in touch, reporting and vectoring in other boats, as well as the surface attacks at night, had been successfully demonstrated. The foundations for the major convoy battles of the



coming two years had been laid. Coldblooded warriors like Prien as well as skilled and dashing tacticians like Schultze, Schepke, Kretschmer, Lüth and Topp became “U-boat Aces” and, not least, heroes of the Nazi propaganda. In the years 1940 and 1941, 4.4 million tons of allied merchant shipping could be sunk, 22 and 35 submarines, respectively, were lost. Prien and Schepke both died with their crews in March 1941. Kretschmer was taken prisoner by the Canadians. With 263,000 tons sunk he remained the most successful submarine skipper of the Second World War.

However tragic each individual U-boat loss was, an incident of much greater significance was the capture of the German cipher machine known as the “Enigma”, the so-called “Schlüssel-M”, and the grid charts of the Atlantic, when on 9 May 1941 the British had bombed U 110 to the surface. From then on the legendary cryptanalysis service “Bletchley-Park” was able to decipher German messages in near real time. When a fourth rotor ring was added to the Enigma in February 1942, Bletchley-Park lost contact for ten months. The capture of U 559, however, secured transparency for the rest of the war. The more the group tactics of the BdU relied on radio traffic, the larger grew the danger not only of being “huff-duffed” (High Frequency Direction Finding = HF-DF), but also of revealing message contents, i.e. the positions of the U-boats, and the easier it became for the allied convoys to evade the now known U-boat barriers. In spite of numerous indi-

cations, Dönitz refused to concede this fact until the end of the war and beyond.

The United States, still neutral in this war, deployed destroyers to escort British convoys beyond Germany’s declared war zone before these convoys were handed over to the Royal Navy. Their mission was to detect and report German U-boats, but not to attack. Under such rules of engagement, the sinking of the US destroyer “Reuben James” by Lieutenant Topp’s U522 in late October of 1941 was an inevitable incident. The loss of more than 100 American sailors helped President Roosevelt to win public opinion for his plan of a direct intervention against Hitler. From now on, the Congress permitted U.S. merchant ships to enter the war zone, and eventually – by mid-November – also approved the arming of those vessels. By the end of 1941, 35 of the “Liberty Ships” that were manufactured from prefabricated sections had been delivered. The American construction program for these simple 10,000 ton cargo ships, which from 1942 on were delivered at a monthly rate of 60 units, made it impossible for the U-boats to decisively decimate the available transportation space, in spite of ever increasing successes. In addition there was Hitler’s order to withdraw U-boats from the *guerre de course* for strategic reasons, i.e. to deploy them to the Mediterranean and to northern Norway, where they could not contribute to impair the Atlantic supply.

Immediately after Germany had declared war on America following

the Japanese attack on Pearl Harbor, Dönitz initiated “Operation Drumbeat”, the blow against shipping off the American east coast. In mid-January 1942, U 123 under Lieutenant Hardegen stood at the approaches to New York. He and further boats that followed saw a coast illuminated like in times of peace, providing a background against which individual ships, neither darkened nor escorted, were an easy prey. In the first six months of 1942, the U-boats in these waters, including the Caribbean Sea, succeeded in the sinking of 400 freighters, while only 4 own boats were lost. Boosted by these successes, the monthly tonnage destroyed for the first time exceeded the mark of 700,000 in June – more than the Allies were able to rebuild. In this year, they lost a total of 8.3 million gross register tons; the stranglehold of the *guerre de course* against Great Britain became tighter and tighter, and the supply situation seemed seriously endangered; the convoy system could apparently no longer cope with group tactics.

In March 1943, the Battle of the Atlantic reached its peak. For the first time, Admiral Dönitz’ de-sired number of 100 submarines was deployed in the areas of operations. During this month, the Allies lost a total of 105 ships with approximately 600,000 tons in all theaters, compared to 15 U-boats sunk. The German submarine command stated to have scored its “greatest success so far” in the convoy battle, however, as a critical evaluation revealed, the initial surprise attacks on the convoys were followed by an increasingly stiffened defense, most of the U-boats were forced to crash-dive by aircraft and were then harassed by escorts with extended depth charging.

In April 1943, 16 U-boats were lost, in May the immense number of 41 – i.e. one boat per merchantman sunk. In late May, Admiral Dönitz for the first time withdrew all U-boats from the North Atlantic. The Battle of the Atlantic was lost for the rest of the war. How did it get this far? The reasons for this are manifold: After Dönitz had been appointed Commander in Chief of the Navy and been promoted to Grand Admiral on

30 January, U-boat construction was given absolute priority. However, the number of allied new-built ships – particularly the Liberty Ships – started to outnumber the vessels sunk by U-boats. The rate of submarines lost increased in proportion to the production of replacements, because now the technological backwardness in comparison to allied ASW became drastically noticeable. The enemy was still engaged with submarines optimized for high surface cruising speed, with a design status of the nineteen-thirties. Under water, the maximum speed of 7 knots could be sustained for 30 minutes at best. Because these U-boats were capable of submerging for a couple of hours only and else were dependent on the surface, they were almost helpless in the face of modern electromagnetic detection devices such as high-frequency radar. Their communication doctrine exposed them to HF direction find-ers and the cryptanalytic breakthroughs of the enemy; under water, advanced Asdic/Sonar equipment, improved tactics and new weapons (e.g. catapult depth charges like the British “Squid” and the American “Hedgehog”) made escape ever more unlikely. In the air, the Allies had managed to close the “Atlantic Gap”. In the opinion of British historian Roskill, the success was mainly to be attributed to the few aircraft on escort carriers sailing with the convoys in combination with the approximately 15 long-range aircraft of Coastal Command, efficiently employed with the help of science, i.e. new operations research methods. The “Monsoon U-boats” in the Indian Ocean, operating from Indonesian bases occupied by the Japanese, could push overall successes beyond 200,000 tons one last time in July 1943. In November 1943, Dönitz withdrew the U-boats from the North Atlantic convoy routes for the rest of the war – the “Grey Wolves” had switched sides from the hunters to the hunted.

Now it turned out to be fatal that little had been done to gradually enhance the battle tested designs. The first measure really worth mentioning, the upgrading of the VII C standard type with the snorkel, was

introduced to the front not until February 1944, and it took until November to retrofit all boats. When, on 6 June, Dönitz ordered the “Landwirt” group to attack the invasion fleet, only 8 of the group’s 26 were snorkel-boats; 13 were lost during this operation. For the next U-boat generation, a technological quantum leap was planned: the “total submarine”, driven by a Walter turbine with a maximum submerged speed of up to 25 knots. Only when it became apparent that such a boat would not become operational within an acceptable time frame, Dönitz would shift to an interim solution. By using the hydrodynamically optimized hull of a pre-series Walter submarine (Type XVIII) and installing large-capacity batteries, the ocean-going type XXI with a maximum underwater speed of 17 knots emerged, and – as the smaller derivative – the coastal type XXIII. In an unparalleled construction program, 170 of these boats were completed between June 1944 and April 1945 and for a large part underwent sea-acceptance testing. For the

gether clean war with no more brutal exceptions than those which also marred the annals of their British or American counterparts.

On 4 May 1945, when Lieutenant Commander Adalbert Schnee with his Type XXI U 2511 fully exploited her 17 knots submerged and penetrated the screen of a Royal Navy cruiser task group without having been detected, he could no longer engage the enemy. Dönitz, succeeding Hitler as head of state had called off hostilities on that very day. As many as 30,246 of the 40,600 submariners trained between 1934 and the end of the war had lost their lives at sea. 790 of the 1,162 U-boats built for the Kriegsmarine became their “iron coffins”. No other warfare community had had to pay such a heavy toll. Very few of those men lucky enough to survive this apocalypse are still among us. I consider it an honor to have made the acquaintance of one or the other.



front, however, they came too late.

During the last two years of the war, the old boats carried the burden of a hopeless battle with an unwavering fighting spirit in spite of immense losses, thus substantiating the myth of the “Grey Wolves” down to the bitter end. Irrespective of his criticism of the overall German conduct of war, British historian Peter Padfield expressed his appreciation for the German submariners in his book “War Beneath the Sea” that they fought an incredibly stoical, brave and alto-

6. THE POST-WAR GERMAN NAVY

The U-boats had shouldered the main burden of the war at sea, there was no other naval asset the Germans knew to employ more effectively. For this reason, the submarine was included in the planning for the navy of the Federal Republic of Germany at an early stage. The year of 1957 saw the salvage and refurbishment of a type XXI ocean-going submarine sunk by the Germans themselves as well as of two type XXIII

coastal submarines (The “WILHELM BAUER”, “HAI” and “HECHT”). Thus the nascent Federal German Navy benefited from the ingenuity of the last submarine types of World War II and could become familiar with their technology and handling. Against the background of the completely new strategic situation of West Germany as a frontline nation of NATO, the submarine could no longer be a platform for an oceanic *guerre de course*.



U HAI and
U HECHT 1957

In the case of an attack by the Warsaw Pact, the task of the Navy now would have been to deny the enemy the unhindered use of the Baltic Sea as a taxiway in support of its land front and to prevent landing operations. In sea areas with a clear enemy superiority like the central and eastern Baltic, small compact submarines with high combat power were an appropriate means for maritime forward defense. In the North Sea and adjacent waters, the mission of the submarines was to contribute to area defense by engaging enemy submarines and surface forces. In the typical mission profile of the Cold War it U-Boot WILHELM BAUER was important to maintain the advantage of invisibility and covertness of a submarine until and beyond weapon release and to take the enemy by surprise.

The establishment of a new German submarine force was characterized by the restriction to 500 tons imposed by the West European Union, the build-up of an industrial base, and the search for a submarine type which could meet the tremendous challenge of the mission

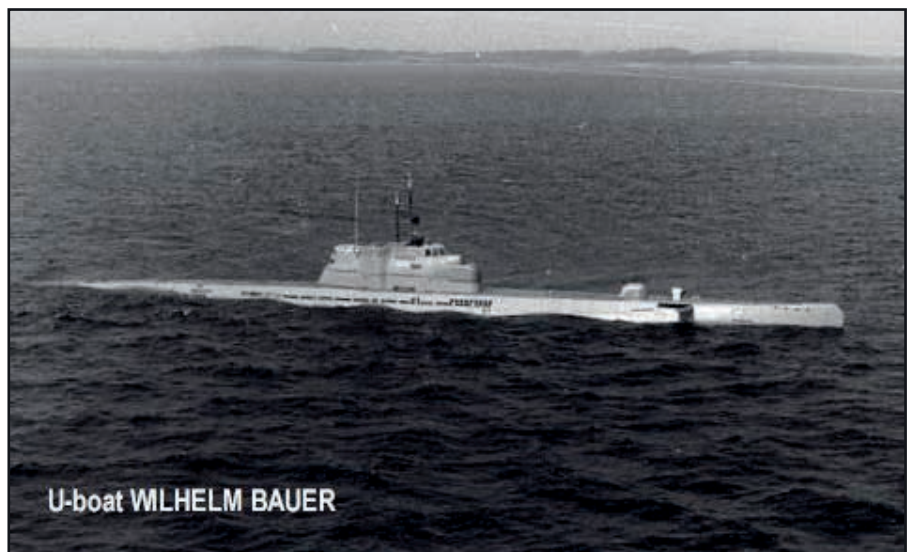
requirements. In the Baltic Sea with its shallow waters and its limited extent, the navies of the Warsaw Pact had the complete southern coast at their disposal, from the Gulf of Finland to Lübeck Bight; ASW forces were capable to be in theater within just a few hours, land-based airborne ASW even within a few minutes. German submarines therefore had to meet special requirements for operations under these conditions, which to this extent were not applicable to most other navies.

With his Ingenieurkontor Lübeck (IKL), Professor Ulrich Gabler, in the Second World War chief engineer on Lieutenant Commander “Teddy” Suhren’s U 564, found a design solution based on the wartime type XXIII coastal submarine. The 206 class, developed from the previous designs of the sixties (U201 and 205), was commissioned between 1973 and 1975 with 18 units. With the six class 205 boats, this brought the submarine force level of the gradually phased out. The six remaining boats of these upgrades adapted to the state-of-the-art of that time by providing them with new sonar, as well as command and weapon control systems were decommissioned as late as 2010 and had formed the backbone of the German submarine service. Up-

graded and tropicalized two of the class, U 23 and U 24, were sold to the Colombian Navy and delivered in November 2015. The rest of the U206As was scrapped.

The class 206A submarines were conventional single-hull boats optimized for missions in the Baltic Sea. The main battery which was massive relative to the displacement of the boat allowed a maximum submerged speed of 18 knots that could be maintained over several hours. The boat has excellent maneuvering and depth-keeping capabilities, enabling submerged operation in water depths of less than 20 m. The end of the Cold War, so to speak, opened the window towards new horizons for this unique design. While up to then their training area was limited to the North Sea and the Baltic, the Norwegian Sea, the Bay of Biscay, and the waters around the British Isles, since the third decade of their in-service time the boats operated routinely in the entire Mediterranean. Several times they had faced the U.S. Navy as demanding exercise partners in the littorals from New England to the Caribbean. Since the beginning of the 21st century German submarines were deployed to the eastern Mediterranean, where they participated in “Operation Active Endeavor” as a contribution to the war against terrorism. Long since they have proved to be not just coastal submarines.

Further special features of the U206A submarines were their non-magnetic construction of austenitic steel and their U 30 S 179 KI 206A



U-boat WILHELM BAUER

low own-noise characteristics. This resulted in a high insusceptibility to sea mines with magnetic and acoustic fuzes as well as to airborne magnetic anomaly detection (MAD). Their small size of only 500 tons presented a small target strength to active sonar detection. With their wire-guided dual-purpose heavyweight DM 2 A3 torpedoes in 8 torpedo tubes, the boats could carry a relatively high weapon load. The German submarine industry with their yards HDW in Kiel and Nordseewerke in Emden transferred these features to larger IKL export designs, such as the Type 209. Ever since, far more than 100 submarines of German origin were delivered to numerous navies. The capabilities of these submarines are obviously so convincing that the only remaining Kiel submarine yard, meanwhile taken over by the ThyssenKrupp Corporation industry with its Type 209 and the AIP Type 214 managed to rise to world market leader for non-nuclear submarines, although for more than 30 years – between the delivery of the last class 206 boat and 2005 – no new submarine had been commissioned by the own navy.

Since the 1980s, a successor model was being considered for the time when the class U206 boats would reach the end of their life cycle. The fact that the resulting 1,500 ton design of the U212 in its beginnings was still a child of the Cold War becomes obvious from the Staff Target of December 1987. It requires that the boat can be deployed flexibly and without limitations in all parts of the area of operations, with the priority on the Baltic Sea. This implied the capability for submerged shallow-water passage from the base at Eckernförde through the just 17 m deep Kadet Fairway south of the Danish isle of Falster, combat against landing forces in the Gulf of Gdansk as well as maritime interdiction operations in the Norwegian Sea up to ASW in the Arctic Ocean. Above all, however, this involved the requirement for air-independence and low acoustic, magnetic, hydrodynamic and thermal signatures. The U212 components with the greatest development risk were the propulsion



motor (Permasyn motor by Siemens, Erlangen) with permanent magnet excitation and the solid electrolyte fuel cell module to ensure air independence. Since the early eighties already, industry, supported by government funding had been working on the development of a fuel cell feasible for submarine propulsion systems; the operational suitability of this fuel cell had been extensively tested ashore and on board of a submarine using a liquid electrolyte version.

Since 1987 the world had undergone fundamental changes: the security environment, the strategic situation of the reunified Germany, the

mission and strength of the forces, the focus of armaments, the defense budget - nothing was as it used to be. In combination with the technological problems of the development, these framework conditions complicated the realization of a demanding project like the U212. They required adaptive and corrective measures which resulted in a delay of two and a half years, until finally the construction contract for a first batch of initially 4 units was signed in 1994; Italy joined the contract with two further boats in 1996. Ever since an „A“ was added to the class designator. Now, the Baltic Sea is no longer specifically mentioned in the mission need document of May 1994; instead, “the European maritime areas and the North Atlantic” are defined as the focus of the operational theater. For the U212A, the following main tasks are stated: sustained presence in the area of operation without regional restrictions, the undetected reconnaissance and surveillance of maritime areas, the containment of enemy naval forces, the securing of maritime areas and key positions as well as the denial of unhindered enemy use of maritime areas and sea lines of communication by engaging surface and submarine forces either alone or in cooperation with other sea-borne or air-borne ASW platforms.

Nine fuel cell modules of 34 kW



each provide the boat with its most outstanding capability: submerged operation over several weeks with air independent propulsion (AIP). The fact that the design combines fuel cell technology with a Diesel generator and a conventional main battery, still required for the maximum speed, makes the U212A a “hybrid boat”. To reduce signature, the proven non-magnetic design was maintained. Enhanced non-acoustic reconnaissance capabilities implemented with modern periscopes, a modern command and weapons control system, several high-performance sonar systems as well as novel communications systems enable the U212 to accomplish its mission efficiently. With its fiber optic-guided DM 2 A4 heavy-weight torpedo, it has an engagement range far beyond the horizon. Between October 2005 and May 2007, four boats of the first batch, U 31 to U 34, were commissioned.

Throughout the more than fifteen years since the start of the fight against terrorism, also with submarines, the German Navy has been continuously operating with allied and coalition partners in remote theaters. The “Concept of the Bundeswehr” of 2004 specified a force level of 8 submarines to be able to cover the underwater spectrum of maritime warfare. The capability of network centric warfare (NCW) is indispensable for interoperability with own and allied forces of all services. In September 2006, the building contract for the second batch of the class 212A boats with two more units was signed; the boats were scheduled to be delivered from 2013 on. Features distinguishing the new boats from those of the first batch are greater endurance, NCW capability, the integration of additional systems and technically improved components; in terms of their structural design, however, they will be largely identical. Delayed by two years, the first boat of the second batch, U 35, was commissioned on 24 March 2015, U 36 followed suit on 10 October 2016. For the foreseeable future this was the last of class 212A. The operational demand of 8 submarines, however, was reduced to just 6 by the German Navy in 2011, i.e. that level can

now be considered accomplished. In terms of platform numbers, the once formidable post-war submarine force has shrunk to one quarter of its Cold War size. Since September 2015, however, media reported that in light of the deteriorated strategic situation a moderate increase of the German submarine force is again considered by 2030. If a cooperation with Norway’s planned replacement program for its ULA-class materializes, Germany might embark and could procure another two of that yet to be jointly developed class.

7. CONCLUDING REMARKS

Even after more than 100 years, the strength of the submarine still lies in its invisibility. More than ever the detection of a submarine alone requires an enormous employment of ASW assets in all three dimensions, not to mention its classification or even its engagement. Just a handful of navies are able to chase a submarine with such distinct stealth characteristics as the U212 A. Equipped with air-independent propulsion, our “real submarines” of the 21st can exploit the advantage of their invisibility much better than the units of the last century, that actually were only little more than “dive boats”.

What Otto Weddigen initiated in 1914 with his spectacular sinkings is true today to an even greater extent: A submarine already begins to have an effect as soon as its presence in theater is not more than suspicion. It denies the enemy the unimpeded use of maritime areas and sea lines of communication and is capable to launch devastating strikes against enemy surface and submarine for-

ces. The submarine represents an enormous force multiplier because it can tie up a multitude of ASW platforms or even neutralize whole fleets. Especially relatively small air-independent submarines with high combat power and excellent stealth characteristics, like the U212A, can successfully assume this role in enemy littorals where own or allied surface forces - due to enemy superiority, or other submarines due to their size - cannot be employed. In addition, the role of covert reconnaissance and intelligence gathering increasingly gains importance for submarines like the surveillance of sea areas, especially when a secure environment is required for follow-on operations, contributions to the early detection of crises, observation of military and mission-relevant non-military activities, the reconnaissance of objects near the coast and in harbors etc. This list of tasks could be continued in any order.

Taking the capabilities of German submarines of all epochs into account, it becomes obvious that their excellent technical and operational features, in particular, however, the professionalism and moral of their crews, have for more than a century extended the military options of the political leaders in a unique way - both for the good and for the bad. Most of our predecessors on U-boats did not have the privilege to serve and fight for freedom and democracy, nor did they have much opportunity to pursue the most interesting pastime in the world: submarining in times of peace. I sincerely do wish this for the successors of the sorely afflicted submariners of two World



Wars who rest in the depths of the oceans in such great numbers.

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