



1939-1945

GRIPPING U-BOAT
COMBAT IN THE ICY
NORTH ATLANTIC



ACES of the DEEP™



ENGLISH

Dynamix
PART OF THE SIERRA FAMILY



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ACES of the DEEP

SECRETARY OF THE NAVY

Courtesy National Archives

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Getting Started

Using this Manual

This manual helps you get the most out of *Aces of the Deep* quickly:

Getting Started shows you how to install and start the game.

The **Historical Overview** describes the U-boat's role in the Battle of the Atlantic, and highlights the dramatic incidents and shifts in technology that took place as the war progressed.

The **Reference** section provides important background information on the vessels, weapons, and tactics you'll need to know to succeed.

Game Play provides a Tutorial of a convoy attack mission, and a complete screen-by-screen reference of the game's set-up menus and simulation controls.

The **Appendices** offer troubleshooting, memory configuration, and customer service information, as well as a bibliography, glossary, and index.

Changes to the Manual

Any changes made to *Aces of the Deep* after the manual was printed will be outlined in the README file. To view the file, simply change to the drive and directory where the game is installed, type **README**, and press [ENTER].

System Requirements

Minimum

To run *Aces of the Deep*, you will need the following minimum software and hardware:

- IBM® PC® compatible computer with an 80386 DX 33 or better processor, and at least 4 megabytes (MB) of random access memory (RAM).
- Microsoft® MS-DOS® version 5.0 or above.
- Extended memory manager (EMM386 [included with MS-DOS 5.0 and above], QEMM-386™, or equivalent).
- Hard disk. *Aces of the Deep* takes about 10 megabytes (MB) of space on your hard drive. If your system uses some type of disk compression utility, such as Stacker™, you will need approximately double the indicated hard drive space (since the game files will not compress as much as your compression software will estimate).
- VGA graphics card and VGA color monitor.
- Microsoft compatible mouse.
- 1.44 Mb, 3.5" floppy drive.

Recommended

- Sound Blaster™ or 100% compatible sound card. See "Changing Sound Settings" for other sound cards supported.
- SmartDrive disk caching software (included with Microsoft MS-DOS 5.0 and above), if you have more than the minimum 4 MB of RAM.



Courtesy National Archives

The S.S. F.W. Abrahams goes down off the American east coast, 1942.

Memory Requirements

Even if you have the minimum 4 MB of RAM, *Aces of the Deep* may not run correctly unless the RAM is configured (set up) correctly for the game. If *Aces of the Deep* DOES NOT start correctly, use the MS-DOS MEM command to see if you need to free up some of your computer's memory. From MS-DOS, type **mem** and press [ENTER].

You need approximately 3,320 kilobytes (KB) of free memory to run *Aces of the Deep*. MS-DOS 6.0 or later shows this as "Total Free Memory." If you have MS-DOS 5.0, add "Largest executable program size" (free conventional memory), "bytes free EMS" (free expanded memory,) and "bytes available XMS" (free extended memory). Together, they must add up to at least 3,400,000 bytes (3,320 KB) total free memory. If you do not have enough free memory, you probably have resident or "background" programs and device drivers taking up memory that the game needs.

The simplest way to set up your system's memory correctly is to use the INSTALL program to create a "boot disk." For more information, please see Appendix B, "Configuring Memory."

Changing Sound Settings

After installation, you can change the sound card or settings the game will use for sound effects and music. Follow these steps:

1. Change to the directory in which you installed *Aces of the Deep*.
2. In the *Aces of the Deep* directory, type **soundset** [ENTER].
3. Use the menu selections to change the sound card and settings, save the settings, and exit to MS-DOS.

Running *Aces of the Deep*

1. Change to the directory where you installed *Aces of the Deep*.
2. To run the game, type **aod** and press [Enter]. To move past the title screen, click the mouse or press [ENTER] or [SPACE].

Controls

All you need to get around in *Aces of the Deep* is a mouse, although most commands also have keyboard shortcuts. Use the mouse to control the pointer, or "cursor," on the screen, and click on buttons, menus, controls, and arrows to select items or perform an action. For most commands, just point to the item and click the left mouse button once, or "click." A few actions require you to "drag" the mouse (hold the left button down while moving the mouse) or use the right mouse button "right-click." Keys are shown in brackets: [ENTER], [F1], [CTRL]+[X] are examples.



Courtesy National Archives

In this famous image, the captain of a Type VII checks the periscope view while the control room crew looks on. This photo was widely distributed in Germany and was even placed on a postage stamp.

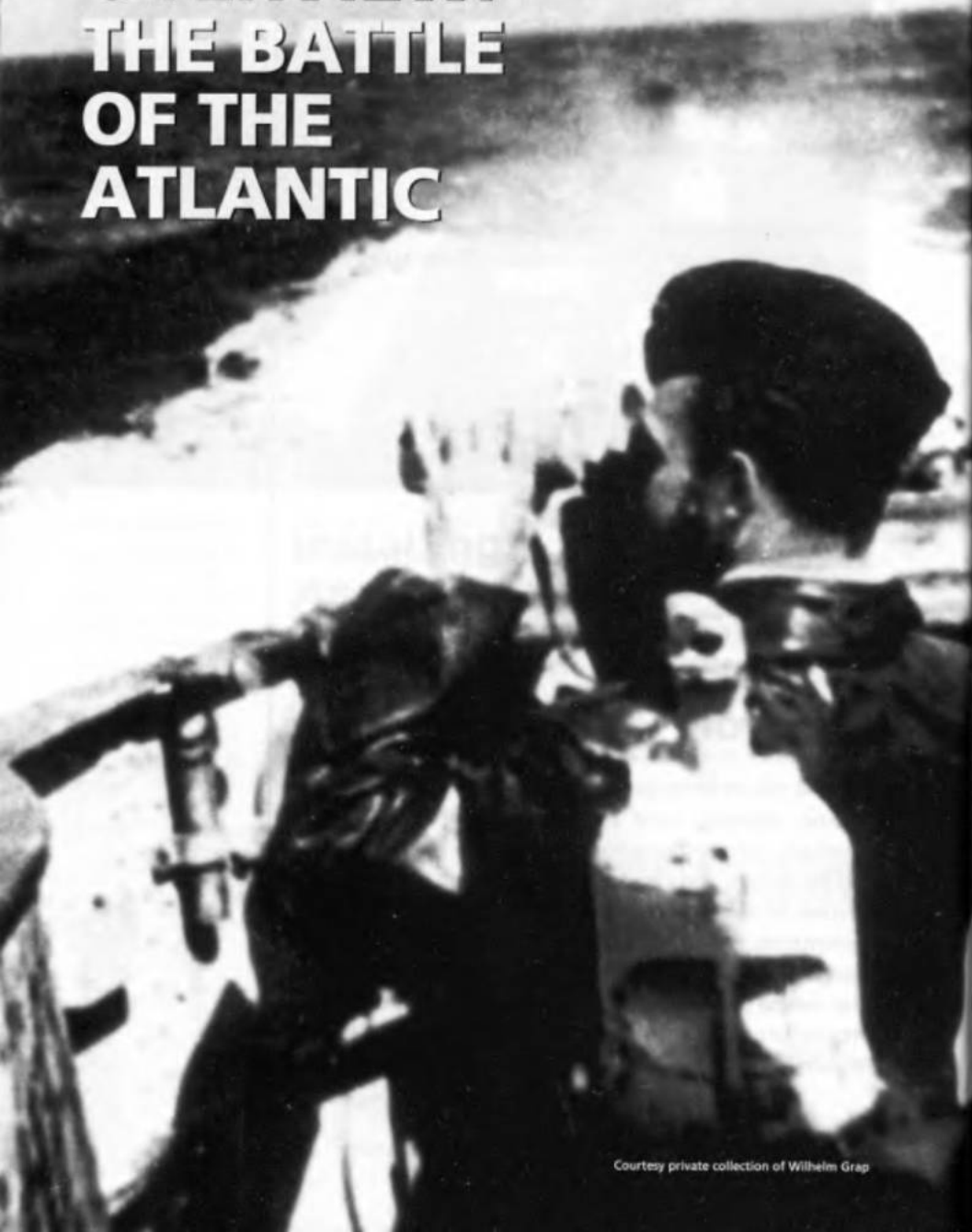
Installing *Aces of the Deep*

The *Aces of the Deep* Install software automatically optimizes the game settings according to your computer's speed, graphics, sound board, and input devices. You can use Install to specify the game's default location on the hard drive, change preferences, and make a boot disk.

These instructions assume that you are using floppy drive A: and hard drive C:. If not, please substitute as appropriate.

1. After booting your machine, insert the *Aces of the Deep* Disk #1 into drive A:.
2. Type the appropriate drive letter and press [ENTER].
3. Type **install** [ENTER].
4. Follow the on-screen instructions.

HISTORICAL OVERVIEW: THE BATTLE OF THE ATLANTIC



Courtesy private collection of Wilhelm Grap

Introduction

ACES of the DEEP

September 3, 1939. The low cry of a lookout brought *Oberleutnant* (OL) Lemp to the bridge of the *U-30*, a Type VIIA *Unterseeboot* ("undersea boat"), or U-boat, on patrol in the fading light of a late-summer evening 250 miles northwest of Ireland. *U-30* had sailed from Germany with other U-boats in the middle of August when the Polish Crisis seemed likely to lead to war with the Western Powers. Only a few hours ago that likelihood had become reality—Germany was now at war with Britain and France. The captain's attention was drawn to the dark shape his lookout had spotted. A blacked-out ship large enough to be a passenger liner was zigzagging at high speed across the horizon in front of the submarine.

The U-boats were operating under strict rules about what could and could not be attacked. It was forbidden to attack passenger liners. Passenger liners were not supposed to travel darkened, however, or zigzag as if they were combatant vessels. Lemp decided that the ship was an Armed Merchant Cruiser, a converted passenger liner fitted with naval guns to guard merchant ships. By 2100 hours, *U-30* was in position, and Lemp fired two torpedoes into the target. Explosions lit the nighttime sky, and the ship went down with a hiss of overheated steel. Unfortunately, the ship turned out to be the 13,851-ton passenger liner *Athenia* enroute from Liverpool to Montreal, carrying over 1,100 passengers, including several hundred Americans. One hundred and twelve passengers lost their lives.

The sinking of *Athenia* caused an immediate furor in both Allied and neutral circles. It appeared as if Germany intended to wage the same kind of unrestricted submarine warfare that had come so close to cutting the sea lanes to Britain during the First World War. (In fact, the U-boats were under strict orders to operate according to existing maritime law, and those orders would remain more or less in force until the end of 1939.)



A Type VII U-Boat on patrol in the Atlantic, 1942.

Courtesy National Archives

Both Germany and the Allies launched immediate propaganda campaigns about the incident. The German naval staff went so far as to falsify the log of *U-30* to “prove” that the *Athenia* had been sunk as part of a British plot to lure the United States into the war. The Allies accused Germany of a deliberate campaign of terror and a complete disregard of civilized law. Only one thing was absolutely clear—Britain would once again have to fight for the sea lanes of the Atlantic.

Between the Wars

During the First World War, German submarines sent over 11 million tons of Allied shipping to the bottom, nearly cutting off the strategic flow of food, fuel, and raw materials that the Allies required to keep on fighting. This “commerce war” faltered only when the British introduced the convoy system. Suddenly, the U-boats could no longer find isolated merchant ship targets scattered all over the ocean. The few submarines able to find convoy concentrations faced agile and heavily-armed escort vessels. The number of sinkings dropped dramatically. The U-boats had been defeated, for the moment.

After the war, German submarine officers developed new theories and tactics about how to wage a commerce war against shipping. First, they developed a method of looking at the shipping war as a whole. Second, they worked out new tactics to deal with the convoy system. Finally, they designed and developed new submarines and submarine equipment which would allow them to put the new tactics into practice. By 1939, Germany had a submarine warfare doctrine that would allow it to fight a sea power like Britain—and win.

This theoretical basis was founded on the innovations of the U-boat organization, and particularly on the work of Admiral Karl Dönitz. Dönitz, who had commanded a U-boat for two years during the First World War, became the commander of the U-boat force (*Befehlshaber der U-boote—BdU*) in 1935. This was the same year that Hitler denounced the Versailles restrictions, and the year that Germany revealed the existence of a new U-boat force.

Unlike almost all other naval commanders, Admiral Dönitz saw the submarine as a weapon with a war-winning potential of its own. Dönitz considered all of the ships of a sea-going nation to be a single pooled



Commissioning ceremony for the 1st U-Boat Flotilla, November 7, 1935. This unit was named the "Weddigen" Flotilla after a famous WWI U-Boat commander.

resource, a single target. It didn't matter where the ships were sunk, or whether the ships were full or empty—all tonnage removed from the shipping pool was a net loss to a nation dependent on the sea. Using this concept, U-boat staff calculated how much tonnage needed to be sunk to seriously affect the British economy and war-waging potential. They also developed efficiency standards for the U-boats in terms of tons sunk per U-boat day at sea. Such measurements could help determine the success or failure of operations in a particular zone, and give clues as to when the focus of operations should be shifted. Alternatively, this calculation could be used to evaluate relative crew performance, or discover weaknesses in training and operational doctrine.

The tactical doctrine that the German U-boat service developed to deal with convoys became one of the



Courtesy National Archives

most famous elements of the Battle of the Atlantic. They called this method "*Rudeltaktik*," or pack tactics. The technique called for a number of U-boats to confront a convoy, delaying the attack until a sufficient number of boats had gathered to make a massed attack. It took many months of warfare before the tactic was finally worked out in practice, but the theoretical elements were worked out long before.

The German submarine force staff were very definite about the desirable performance characteristics for the new Atlantic U-boat. They recognized that, given the technology of the day, it was a mistake to think of a U-boat as a true submarine. Rather, it should be considered a torpedo boat with the special capacity to submerge when threatened. The most effective attack would be to launch torpedoes from the



Admiral Karl
Dönitz.

Courtesy National Archives

surface, preferably at night, when the U-boat's low silhouette made detection by convoy lookouts difficult. Accordingly, the most important offensive characteristics for a U-boat would be surface speed and maneuverability. Since submerging was considered the primary escape method, dive speed and depth were to be the most important defensive characteristics. Great strides in electrical and optical technology also would permit far better communications capacity and torpedo firing procedures than the World War I boats.

But new theories, new tactics, and new design possibilities did not make a U-boat force. For that, actual boats would have to be constructed. Unfortunately for the German Navy, the Treaty of Versailles, which formalized the terms of surrender of the German Armed Forces at the end of the First World War, forbade Germany to build or operate submarines. From 1919 until 1935, when Hitler repudiated the terms of the Versailles

treaty, the German Navy was forced to keep its submarine program entirely secret.

To study submarine operations, Germany used the cover of an "Anti-Submarine Warfare School." This installation investigated many questions of submarine deployment and tactics, as well as U-boat organization and design requirements. A whole generation of future submarine staff officers was trained here, ostensibly in the tactics to be used against submarines, but actually in the techniques which U-boats might use in a future war.

To maintain the technological capability to build U-boats and to conduct actual construction of submarines, the German Navy financed several submarine design, development, and construction firms abroad, notably in the Netherlands. These operations were subsidized and directed by the staff of the German Navy, but acted as independent contractors for other governments, especially Finland, Spain, and Turkey. The basis for the U-boats of World War II came largely from the experience and expertise developed in these foreign firms.

1935 marked the turning point for German submarine rearmament. A clandestine program of U-boat construction had begun the previous year, and parts for twelve small U-boats were awaiting assembly by the end of 1934. On February 1, 1935, Hitler ordered that construction of these vessels be undertaken openly, and on March 16, denounced the military clauses of the Treaty of Versailles.

June saw the signing of the Anglo-German Naval Accord, which allowed Germany to legally construct submarine tonnage up to 45 percent of that of Britain. This figure could be raised to 100 percent if Germany thought it necessary. Finally, in July, Karl Dönitz was appointed commander of the fledgling submarine force (see "Uncle Karl").

Dönitz recognized that it would take more than high-quality submarines and submariners alone to defeat a great naval power like Britain. It would also take

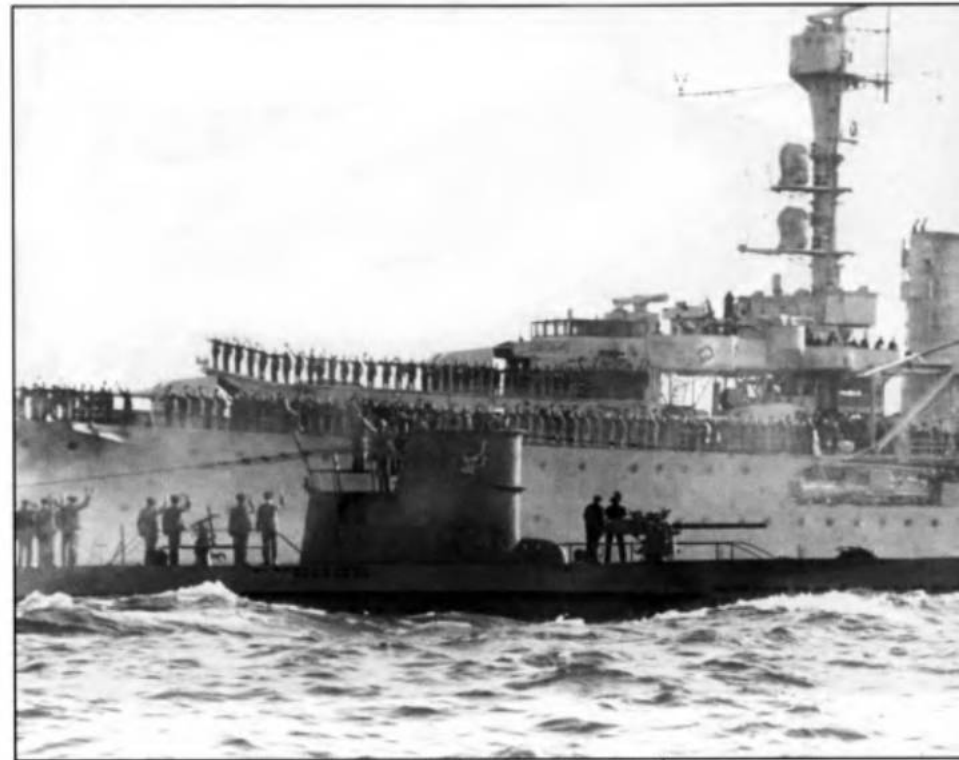
Admiral Dönitz finishing an inspection tour.



Courtesy National Archives

a great number of submarines—at least 300 Atlantic boats. Unfortunately for the German submarine forces, this vision was not shared by the Navy high command. Like all naval staffs in the world at the time, the Germans were infatuated with the potential of the battleship, and “big gun” admirals were in firm control of the naval construction budget. Naval construction plans between 1935 and the outbreak of war in 1939 therefore emphasized large ships and their supporting vessels. A long-term project for the construction of a balanced German fleet, the “Z” plan, called for the construction of almost 100 larger ships and 162 U-boats suitable for commerce war. This plan was not scheduled to be complete until 1948, however, and construction priorities for submarines were well below those for battleships and cruisers.

The emphasis on large ships was not the only point of difference between the U-boat arm and the rest of the Navy. Dönitz wanted medium-sized boats—fast, nimble, and swift-diving—to undertake the kind of war he envisioned. The higher staff of the Navy, on the other hand, was more interested in larger boats, with long



Courtesy United States Naval Institute

ranges and larger torpedo capacities. This difference came to a head when tonnage allocations for U-boat construction were being decided. The Naval staff insisted that a significant proportion of the boats built be of the larger types. Not only did Dönitz consider these less effective for fighting a commerce war, but their larger size meant that fewer could be constructed with the available supplies of steel and other raw materials. In addition, the larger boats took longer to build and required more dockyard space and labor than the smaller boats. All of this meant that Germany would continue to possess an inadequate number of U-boats. When war began in September 1939, Germany had only 57 operational U-boats, and only 38 of these were capable of operations in the Atlantic.

U-47, a Type VII B boat, receives a salute from the crew of the cruiser *Emden*. In the German Navy, tension ran high between those who advocated a submarine-based navy and those who wanted a more traditional surface fleet.



Courtesy National Archives

Admiral Dönitz congratulates U-Boat crewman at an awards ceremony. He was famous for his memory for details of the lives of his men.

Uncle Karl

Karl Dönitz's submarine experience began during World War I. With the complete elimination of the German U-boat arm mandated by the Treaty of Versailles, however, he transferred to the regular Navy. In July 1935, Dönitz, now the commanding officer of the cruiser Emden, was offered command of the newly emerging submarine force (U-bootwaffe). Dönitz was hesitant.

There was no guarantee that the fledgling U-boat arm would ever be an important part of a German Navy dominated by "big ship" admirals. But Karl Dönitz was a submariner at heart, and he accepted the command.

In charge of a small flotilla of U-boats, Dönitz trained his crews under the most realistic conditions possible—in all weather, at all times. Previously, crews had been instructed to attack a target from over 3,000 meters away. Dönitz had them fire at 600

meters. He pushed for an increase in allocations for U-boats, and began to develop coordinated pack tactics. In spite of all the preparation and his pride in the skill of his men, however, he was not optimistic when war broke out. He was heard to exclaim "My God! So it's war with England again!" when the news first broke. After the first British air raid, he said to the officers standing with him "Make no mistake about it—it [the war] may well last for seven years, and we shall probably be only too happy to see it end then in peace by negotiation."

Although Dönitz was known as a brilliant naval tactician, his main contribution would eventually be as a leader. Under him, the U-boat arm would eventually achieve the highest standards of combat efficiency and seamanship. He enjoyed greeting a boat personally when it returned from patrol and speaking frankly with its crew, officers and enlisted men alike, to draw the proper lessons from the patrol. Dönitz minimized red tape in order to present awards as soon as a boat docked, or even while the boat was still at sea. With the fall of France, Dönitz moved his headquarters to Kernevel near Lorient to be closer to his men. He made certain the crews had high pay and the best rations. He even had a special express train placed at his disposal to ferry U-boat men on leave back to Germany—while Allied planes bombed the French ports, U-boat crews relaxed in far-away resorts. The Admiral also facilitated communications to boost morale. BdU would often send messages to U-boats at sea with news from home. One man was informed of the birth of a son with the message "Arrived, one sailor. With periscope." Radio weddings were even performed at sea; the captain officiated for the groom on board the U-boat

while in radio contact with the bride and minister ashore.

Admiral Dönitz's affection for his men was returned in full measure by the U-boat crews. They had great confidence in their Admiral, and felt a deep respect for the lonely figure who so often greeted them on their return from the Atlantic. The U-boat crews nicknamed him "Uncle Karl," and sometimes referred to him as "The Big Lion." So closely tied were the personal loyalties of the U-boat crews to the Admiral that the branch jokingly referred to itself as "Freikorps Dönitz." This loyalty was a key factor in the U-boats' continuing high morale and unflinching efforts even in the desperate closing months of the war.

The Admiral paid a high personal price for his command of the U-boats: Both of his sons were U-boat officers, and both died at sea. After the war, Admiral Dönitz was convicted by the Nuremberg Tribunal for "violating the laws or customs of war" and sentenced to 10 years in prison, despite testimony by U.S. officers that he waged submarine war under the same rules governing the American submarine campaign in the Pacific. He was released from prison in 1956, and died peacefully in late December 1980. To the end of his life he retained the respect and affection of the men who had served under him.

Opening Moves

As the Polish crisis deepened during the summer of 1939, U-boat Headquarters made plans for a precautionary deployment of the U-boat force. On August 19, 14 Type VII and Type IX U-boats left German bases for the Atlantic. Two more boats soon followed. On August 25, 14 of the smaller Type II boats left for stations in the North Sea. Despite these measures, neither the German Naval High Command nor the staff and commander of the U-boat fleet truly believed that a war with Britain was imminent. Hitler had personally assured the Naval staff in July that war with Britain would not be allowed to happen. Besides, the U-boat force was far from ready to undertake its mission. Dönitz had only about one-sixth of the operational U-boats he felt would be needed for war, and given the production schedules for U-boats over the course of the next few years, this already inadequate number of boats was bound to decrease because of operational losses. Even a crash program of submarine construction would not significantly affect the number of U-boats available for more than a year. Nonetheless, Germany was soon at war, with the U-boat arm woefully ill-equipped to sink the amount of shipping it knew would be necessary. The U-boats, however, were prepared to try.

With so few boats available, it would clearly be difficult to maintain much of a U-boat presence in the Atlantic. Once operations began in earnest, about one-third of the operational U-boats could be expected to be in port, refitting and resupplying. Another third would be on their way to or from their operational zones. This meant that fewer than a dozen boats would be operating in their patrol areas at any given time.

Even with such a small number of boats in action, the first months of the war were not without some success. In September, U-boats sank 41 Allied merchant vessels, totaling over 150,000 tons. By May 1940, the end of the first phase of the Battle of the Atlantic, U-boats had sunk over 750,000 tons of Allied shipping.



Courtesy National Archives

A U-Boat aids survivors of its attack.

The U-boats also recorded some spectacular achievements against British warships during this time. On September 17, 1939, near the end of his patrol, OL Schuhart in *U-29* spotted a large aircraft carrier. This was the 22,500-ton fleet carrier *Courageous* on anti-submarine patrol about 200 miles southeast of Ireland. It was an accident that Schuhart spotted the carrier at all, since he was actually looking for a convoy suspected to be in the area. Fortunately for *U-29*, two of the carrier's normal escort of four destroyers had been detached to assist a merchantman. Even so, *U-29* still might not have been able to mount an attack had the carrier not turned into the wind to launch aircraft, inadvertently placing the ship in perfect position for a torpedo attack. Schuhart fired a spread of three torpedoes from less than 3,000 yards. Two hit the target, sinking it in less than 15 minutes with the loss of 518 lives.



Courtesy National Archives

U-47 accepts a salute from the crew of the battleship *Scharnhorst*. *U-47* has just returned from Scapa Flow.

An even more notable success soon followed. Admiral Dönitz had long wanted to penetrate the main British fleet anchorage at Scapa Flow in the Orkneys. On September 26, the Luftwaffe managed to obtain excellent aerial photographs of the base. Dönitz called in one of his most aggressive and capable officers, Gunther Prien of *U-47*, and offered him the task of slipping through the sunken blockships which clogged the narrow channel, and attacking the warships sure to be inside. Prien studied the photographs and operational plans overnight, and then confidently accepted the assignment.

Late in the evening of October 13, Prien began his run into the anchorage. The tidal currents through the channels into Scapa Flow were fierce, so the penetration phase of the operation was scheduled for slack water. As *U-47* moved cautiously past the ships sunk to block the harbor entrance, the crew could see activity along the shoreline only a few dozen meters away. At one point, the boat was illuminated by the headlights of a passing

automobile, which turned around and raced away. Prien continued his operation nonetheless. Just after midnight on October 14, *U-47* was inside the northern fleet base of the British Navy.

After a search, Prien spotted two large ships to the north of his position and fired three torpedoes at the overlapping targets. After a run of three and a half minutes, one small explosion was heard. The explosion seemed to attract no attention from the targets or the base. Quickly reloading *U-47*'s torpedo tubes, Prien moved again to the attack, firing one torpedo from his stern tube and three more from the bow. Three minutes later, explosions tore through the anchored battleship *Royal Oak*. The ship sank in thirteen minutes, taking 333 officers and men with her. Despite very strong currents now running through the channel entrance, Prien and his crew managed to escape the British base and return to Germany. It was the most spectacular U-boat exploit of the war (see "Celebrity Skippers").

Meanwhile, the political restraints which required U-boats to adhere to the pre-war maritime Prize Regulations were gradually being lifted. These regulations required U-boats to stop and search merchant vessels and allow their crews to escape in life boats before sinking the ship. The commanders of the German submarine forces felt that following the Prize Rules unnecessarily endangered the attacking boats, and were eager to move towards unrestricted submarine warfare. As early as September 23, U-boats were given permission to sink immediately any vessel using its radio after being stopped by a submarine. By October 2, U-boats were allowed to attack any darkened ship off the British or French coasts without warning. By October 17, U-boats were granted permission "to attack without warning all ships identified as hostile," and on October 19, to attack any darkened ship as far as 20 degrees West. Even the restriction against attacking liners was largely withdrawn by November 17. For all practical purposes, the official policy against British and French shipping was unrestricted submarine warfare, with restrictions only on attacking neutral vessels.



Courtesy National Archives

Hitler decorates the crew of U-47 for the Scapa Flow operation.

Celebrity Skippers

After the Royal Oak victory, Gunther Prien and the crew of U-47 were greeted as heroes, and were flown to Berlin to meet Hitler. Later on, Prien was asked to speak at dozens of gatherings, including interviews with the foreign and domestic press, and treated almost as a movie star. Like many of the other successful U-boat commanders to follow him, Prien was

uncomfortable with the attention. But Germany needed heroes, and the U-boat skippers and crews fit the bill. As the war lengthened, their exploits were followed by millions of Germans in the newspapers and on radio. Books, magazine articles, films, and even popular songs were written about the most successful skippers, and their achievements were known to everyone in Germany.

Despite their small numbers, the U-boats had already made their presence felt by the spring of 1940. However, problems bedeviled the U-boat force. Submarine support of the Norway invasion turned into a fiasco due to faulty torpedo detonators (see "Wooden Rifles"), and the shortage of operational boats continued. When war began, the pre-war construction program was scrapped to place a greater emphasis on submarine building. But it still took over a year to construct each boat, and it was clear that the U-boat shortage would not be overcome soon.

This dismal picture was worsened by bureaucratic wrangling and mismanagement. Admiral Dönitz had demanded that the U-boat Command be given full authority over the construction program, but was told that he would have to work through Hermann Göring, the head of the Luftwaffe and the man responsible for the German economy. Göring's organization set the U-boat production level much lower than Dönitz felt was necessary to overcome the crippling shortage with which he had started the war. A mere 29 boats per month were promised (a figure later reduced to 25). Given the requirements for training new crews, the inevitable operational losses and the long lead time that any construction program would require, the number of U-boats at sea would not grow significantly for many months. In fact, the low point for U-boat numbers occurred in February 1941, when only 22 Atlantic U-boats were capable of putting to sea. Thereafter the number rose slowly, but not until the middle of 1943 would the number of U-boats finally reach the figure necessary for decisive attacks on the convoy system.

During this first phase of the Battle of the Atlantic, the British Navy was aggressively attempting to choke off the menace of the U-boats. Due to inadequate research and development efforts, and a series of mistaken tactical and strategic assumptions, their efforts were, like those of their enemy, less than totally successful.

Wooden Rifles — The German Torpedo Crisis

"For the lessons one fails to learn in peace, one pays a high price in war."

— Karl Dönitz

The World War II submarine was designed to perform one main mission: to torpedo enemy ships. If the torpedo failed, then the mission failed, and all the hardships and difficulties of the mission served no purpose. A submarine fleet with ineffective torpedoes was ineffective as a force.

The Kriegsmarine's U-boat arm found itself with precisely that problem at the outbreak of World War II. Word began to trickle back to U-boat headquarters that the torpedoes ("eels" in U-boat jargon) were unreliable. In fact, one source reports that the torpedoes loaded on some boats for their first war patrol had mistakenly been fitted with non-steerable fins. When Dönitz was notified of this problem on the evening of September 13, 1939, he was not pleased. In fact, he was to get little satisfaction from the Navy Torpedo Directorate during the next two years.

Refitting torpedoes with the fins they were designed to use revealed other problems. During World War I, most torpedoes were equipped with contact detonators only. Between the wars, a sophisticated magnetic detonator ("pistol") had been developed, but had been tested only twice, and with mixed results. Even the simple contact detonator had been redesigned—the force of impact was no longer directed straight back, but was now redirected 180 degrees forward by a complicated system of levers.

Not surprisingly, once operations began in 1939, returning captains began relating accounts of torpedo failure. The Torpedo Directorate dismissed the initial reports as cases of inexperienced captains not correctly setting the torpedoes before firing. But even the best captains began complaining. For example, when Gunther Prien returned from his famous attack on the great British fleet base at Scapa Flow, he stated that his first salvo of three torpedoes from the bow and one from the stern resulted in only one explosion on the battleship Royal Oak, and an ineffective one at that. In another instance, U-56, a Type IIC under the command of Kapitänleutnant Zahn, attacked the battleship HMS Nelson. Zahn fired three torpedoes, and heard two of them thump harmlessly against the target's side. Worse yet, the third eel detonated at the end of its run and alerted the escorts. Zahn was so demoralized by this result that Admiral Dönitz had him transferred to a training flotilla upon his return.

By the end of 1939, it was apparent that something was very wrong with the torpedoes. In response, Konter Admiral (Rear Admiral) Kummetz was appointed Inspector of the Torpedo Directorate on December 21. However, the winter of 1939-1940 was exceptionally harsh and thick ice prevented any testing.

Even when spring came, Kummetz had little chance to investigate. Germany invaded Norway on April 9, 1940, and every available U-boat was thrown into the battle. Their tasks were to protect the German landing

forces, attack any Allied landings, and prevent interference by the Royal Navy against German sea communications.

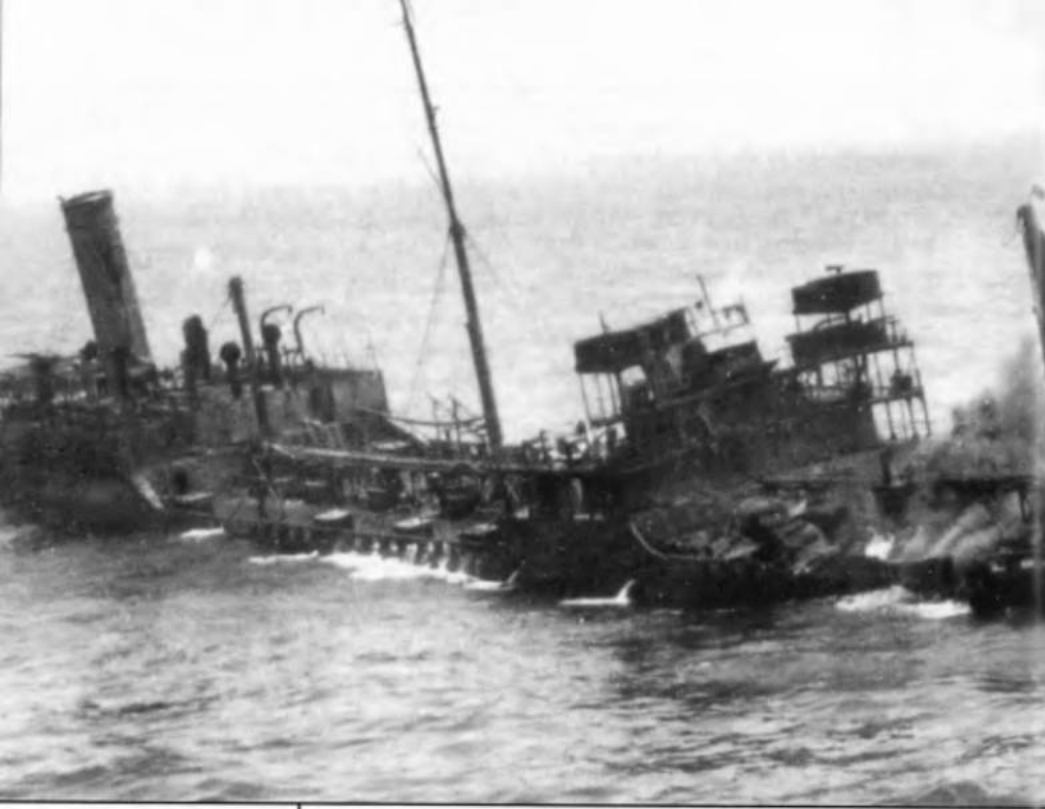
Dönitz ordered boats to radio in their results each day. As the reports came in over the next week, the gloom at U-boat headquarters deepened. Four attacks were launched on the battleship HMS Warsprite, 14 on cruisers, ten on destroyers, and a further ten on transports—yet in all of these attacks, only a single transport was sunk. Exasperated, Dönitz ordered the U-boats to withdraw from the campaign on April 17.

The returning crews were completely demoralized by the torpedo failures. Prien told Dönitz that he could hardly be expected to fight with a wooden rifle. It is to Dönitz's credit that he was even able to get the U-boats to put to sea again. Meanwhile, the Torpedo Directorate began to discover design flaws. Each time a problem was found and corrected, it was assumed that the problems had all been eliminated. As often as not, however, each fix only uncovered other flaws.

Problems fell into three main categories: contact detonator, magnetic detonator, and depth-keeping ability. The contact detonator was supposed to explode if it struck an object within 69 degrees of a right angle; in practice, it would explode only if the angle was closer than 40 degrees to perpendicular. The contact pistol was replaced with a simpler design, one influenced by a device that was captured from the British sub HMS Seal. The magnetic detonator proved to be immune to simple fixes. Only when the completely redesigned Pi2 pistol was introduced in December 1942 was Dönitz confident that the problems had been eliminated. But even if the detonators

had been working flawlessly, the torpedoes were running two to three meters too deep. This problem was caused by the torpedo balance chamber (which controlled the running depth using atmospheric pressure as the standard). Since the air inside a U-boat was often much higher than atmospheric pressure, especially after firing torpedoes or prolonged underwater activity, air would leak into the balance chamber, effectively recalibrating the depth sensor. Years would elapse before a fairly reliable torpedo was designed. By this time, delivering torpedoes to target had become far more difficult.

"It is my belief," wrote Dönitz, "that never before in military history has a force been sent into battle with such a useless weapon." It might have come as cold comfort to know that the U.S. Navy would face almost exactly the same problem.



A stricken freighter wallows in the Atlantic swell.



Courtesy National Archives

The British focused on three main strategies to defeat the U-boats. First, a series of mine barrages was laid across the likely U-boat routes through British coastal waters. These mining operations did not sink many submarines. However, three U-boats were sunk in the Straits of Dover early in the war, and U-boats avoided the Straits for a long time thereafter. This forced U-boats from the Baltic to circle almost all the way around the British Isles to reach the convoy approaches south and southwest of England.

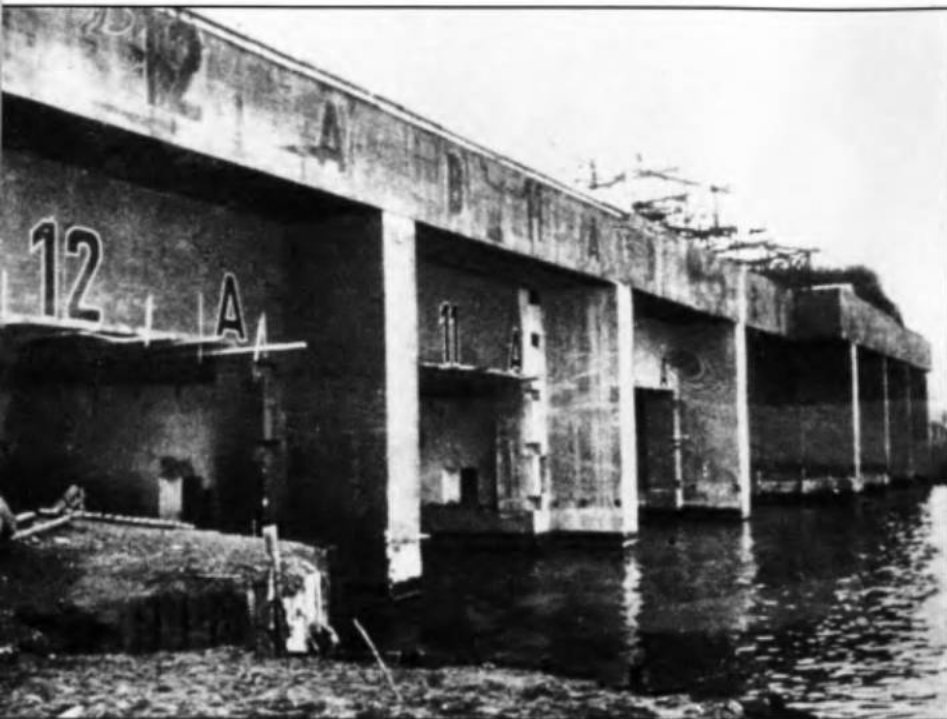
The second strategy was the organization and deployment of anti-submarine vessels into "hunter groups" to take the offensive against the U-boats. Here the British made a serious error, one which would be repeated by the Americans a few years later. Although sounding good in theory, and satisfying the Navy's psychological need for offensive action, hunter groups took escort vessels from the one place where submarines were sure to be found—around the convoys—and set

them to prowling empty reaches of the Atlantic. U-boats were seldom found away from the convoys, and when they were, their small size and low silhouettes virtually guaranteed that the submarines would spot their hunters long before the British ships spotted them. More importantly, the formation of these hunter groups left some convoys with no escorts, and many with just one or two. Despite their small numbers, convoy escorts accounted for nine U-boats during this first phase of the battle, while the patrolling groups sank only three.

The third British strategy was the use of aircraft to hunt and attack submarines. Here again, the lack of research between the wars left Britain with no effective anti-submarine aircraft or airborne weapon in 1939. For example, the standard depth setting for air-dropped depth charges was fifty feet, far too deep to cripple a surprised U-boat just beginning a dive. Many well-conducted surprise attacks against submarines failed because of this simple error. It was not until the winter

The Happy Time

ACES of the DEEP



Courtesy National Archives

U-boat bunkers on the coast of France. These massive concrete constructions kept the submarines safe from allied bombardment.

of 1942 that an effective air-dropped depth charge became available, and it was some time until enough capable anti-submarine aircraft were produced to have a decisive effect.

Meanwhile, a “war in the ether” was being conducted on the airwaves by the British and German radio intercept and code-breaking services, a battle in which the Germans had the early advantage. At the opening of the war, the German radio intercept service (B-Dienst) had broken the Royal Navy Administrative Code. Until August 1940, when the British Navy switched codes, B-Dienst was able to provide the U-boat Command with good information on convoy departures and routes, and sometimes the operating areas of the hunter groups as well. Since convoys observed strict radio silence and could change their course independently based on the tactical situation, however, B-Dienst was seldom able to provide exact convoy locations.

The German U-boat successes against the British before May 1940 were remarkable, considering how few U-boats were actually on patrol during this period. But the total tonnage sunk did not significantly reduce the shipping available to Britain. In fact, vessels captured at the outbreak of the war and new construction had already made up for most of the losses. Also, the convoy system in the North Atlantic began operating more smoothly by March, which reduced the number of easy, isolated targets. Also in March, Admiral Dönitz shifted U-boats to the shipping lanes near Gibraltar, holding to his belief that it did not matter where British ships were sunk. These operations were disappointing, since there turned out to be fewer ships using this route, and they tended to be smaller than the North Atlantic ships as well. However, the situation was about to change dramatically.

On May 10, 1940, the German army opened its long-awaited offensive in the west against French and British armies. Within a few days, it was clear that the combination of armor and air power called “Blitzkrieg” was too much for the old-fashioned and unprepared forces of the Western Allies. By the end of June, France had been completely defeated, and British forces driven from the continent at Dunkirk. Despite the sparse numbers of U-boats, Admiral Dönitz was suddenly confident that the next phase of the war would be very successful for his fleet. He was to be proven absolutely right.

The most important result of the fall of France for the U-boats was the acquisition of new bases on the Atlantic coast of France. Brest, Lorient, and St. Nazaire were rapidly occupied by U-boat support units and turned into fully equipped U-boat bases capable of refueling, rearming, and even making major repairs and renovations to the boats. BdU itself was moved to the French coast. Possession of these bases was decisive. No longer would U-boats have to make long journeys through the heavily-patrolled seas surrounding Britain

just to reach their patrol areas. Decreasing the days spent in transit increased the days each boat could stay on patrol. In effect, the French bases greatly increased the number of boats present in the operational area. By July, the first U-boat was resupplied from a French base: Lemp's *U-30*, of *Athenia* fame.

Another important effect of the conquest of France was the elimination of the French Navy from the battle. Although most of the escorts had been provided by Britain, the French contribution was significant, particularly in the Mediterranean. Other than a few French escort vessels that declared for De Gaulle and the Free French, the bulk of the French fleet, including many destroyers, was no longer available. In turn, British units were forced to extend their coverage, which significantly reduced the average number of escorts available for convoy duty. Furthermore, the collapse of France had exposed Britain itself to fear of invasion. Many more destroyers were held in Home Waters to counter the invasion threat.

Finally, the French bases permitted the theory of "Rudeltaktik"—pack tactics—to be put to the test. Dönitz and the U-boat staff had long wanted to begin massed attacks by several U-boats against a single convoy, but had been thwarted by the shortage of boats and communications problems. Admiral Dönitz realized, however, that the extensive communications and close tactical control necessary to coordinate such attacks would now be possible from his new headquarters. The U-boat radios were perfectly capable of exchanging messages with powerful radio transmitters in France.

Introduced in June, 1940, pack tactics brought immediate and dramatic results.

The first boat to contact a convoy was designated the "shadower." Its job was to maintain contact with the convoy and provide regular reports about the convoy's size, location, course, speed, and composition. This information was then relayed to other boats in the area, who would then converge on the convoy and report when they too had made contact. When enough boats



Courtesy National Archives

were gathered, they would be ordered to attack. As each boat started its attack run, usually on the surface and at night, it radioed its intention to BdU. If another U-boat was already attacking, BdU could order a boat to delay its attack to avoid collisions or mistakes. Thus, BdU exercised close control over the U-boats until an attack approach began—but the final attack procedure was always in the hands of the U-boat captain.

By carrying out coordinated surface attacks at night, the U-boats exploited several vital weaknesses in the convoy defenses. The underwater echo-ranging device known as ASDIC, developed at the end of the First World War, allowed British escorts to locate and attack submerged submarines. Now the U-boats were coming in on the surface, where ASDIC was useless, and at night,

(continued page 40)

U-48 returns to its French home port after another Atlantic patrol. *U-48* was the most successful boat of the war.



Courtesy National Archives

Inside the captain's "cabin" on board U-505.

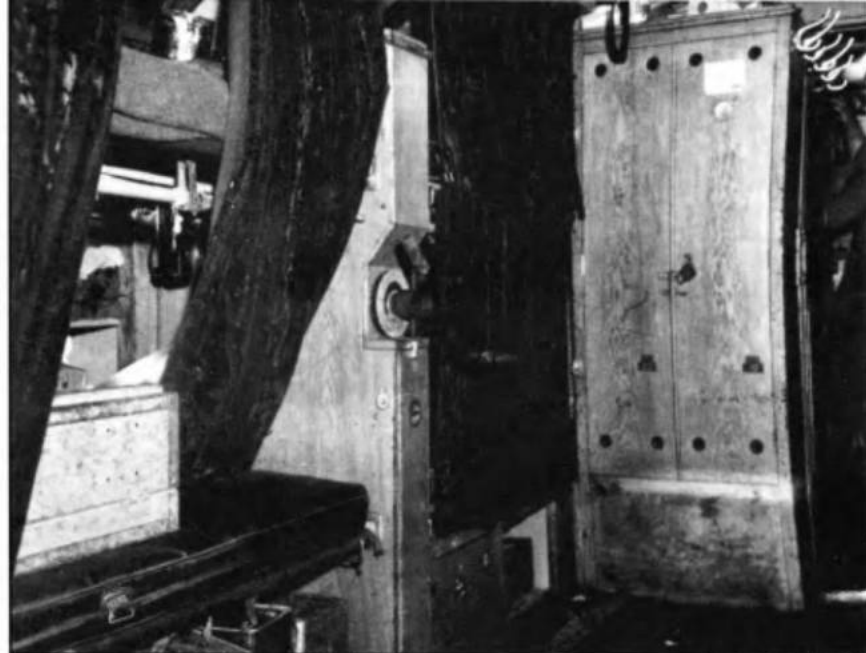
Life Aboard a U-boat

While each U-boat crew member was important to the operation of the boat, the captain of the vessel was essential, for he routinely made life or death decisions affecting the entire crew. Consequently, it was not surprising that the captain's personality had a great effect on daily life aboard the boat. U-boat life was very intimate, and the captain, or "old man" as he was usually called, was often an object of superstition, especially if he was considered lucky or was known to be particularly skilled. The crew identified closely with their captain, especially on successful boats, and they were very proud if their commander was awarded a medal.

Two types of crew manned the vessel: the seamen and the technicians. The seamen (or

"sea lords") stood watch on the bridge, loaded torpedoes, manned the guns, and took care of most of the everyday housekeeping activities aboard the boat. Their day was organized around three eight-hour shifts—one for regular duties, one for sleeping, and the third for miscellaneous tasks such as four-hour watches on the bridge. The technical division (or "black gang") maintained the diesel engines and electrical motors, as well as other mechanical systems. They also stood watches, six hours on, four off, every twelve hours, rotating positions. The two radiomen, also on the technical team, operated under an alternating schedule of three four-hour shifts between 8:00 a.m. and 8:00 p.m., and two six-hour shifts during the night.

Deck watches in stormy weather were a misery. Broken bones were not uncommon as



Courtesy National Archives

U-505 Petty Officers' quarters.

violent waves frequently broke over the top of the conning tower, completely submerging the watch in icy Atlantic water and throwing them against the deck and bridge gear. Leather and steel safety lines were mandatory to keep the crew from being washed overboard. The watch wore heavy weatherized suits, but water pooled inside the sleeves and trouser legs, soaking them anyway. Crewmen rarely got a chance to dry their clothes while on patrol.

Bunk space on a U-boat was limited. Crewmen often had to resort to "warm bunking," in which two were assigned to the same bunk. As soon as one person crawled out, another crawled in. The Type VII boats were particularly crowded, since two extra torpedoes were kept in the forward torpedo compartment where the enlisted men slept. Six

bunks had to be folded up to make room for them. These bunks were unavailable until the boat had fired its first two torpedoes and the extras could be loaded into the now-empty torpedo tubes. With space extremely limited, personal possessions were frequently restricted to the clothes on one's back and a single change of underwear and socks.

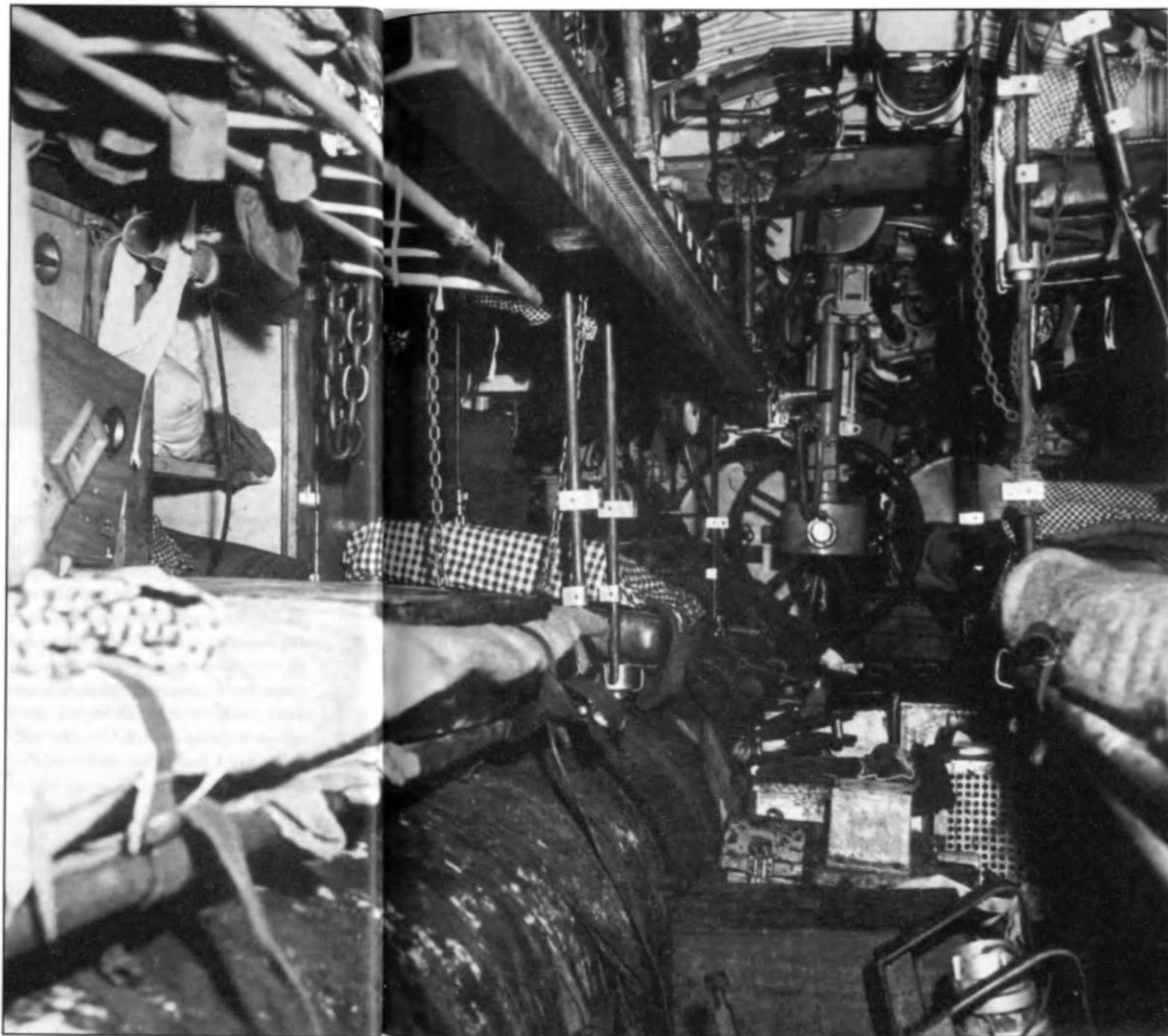
U-boat food was both the best and worst the German military offered. At the beginning of a voyage, salamis, sausages, fresh fruits and vegetables, and loaves of fresh-baked bread complemented the canned stores. Limited refrigerator space, however, meant that food spoiled quickly in the constantly damp environment. Moldy loaves of bread were called "rabbits" because of their fuzzy white exteriors. Furthermore, all food soon took on the flavor of diesel exhaust. Before long, the

fresh food was eaten or spoiled. Meals then consisted of canned goods supplemented by the soy-based filler called *Bratlingspulver*.

Fresh water was strictly rationed, especially when U-boats opted to fill one of the fresh water bunkers with extra diesel fuel to extend their operational range. With fresh water scarce, washing, shaving, bathing, and laundering were all postponed for the duration of the journey. The *Kriegsmarine* had a saltwater soap, but this item was universally unpopular as it didn't lather well, and left a scummy film. A special cologne was used to try to remove salt from the skin.

Even using the toilet was a complicated procedure on board a U-boat. Two toilets were on board, but one was usually unavailable because it was used as a pantry for part of the voyage. The toilet's contents had to be hand-pumped into a holding tank, then pumped into the ocean after each use. Using the toilet was frequently forbidden while stalking enemy ships, for fear that the noise and floating debris might signal the U-boat's presence. At least one boat, U-1206, was forced to the surface when its captain's error caused the head to flood and dump saltwater into the battery compartment, generating a cloud of poisonous chlorine gas. When the U-boat surfaced to vent the gas, it was attacked by aircraft and had to be abandoned.

Bunks in the aft torpedo room of U-505.





Courtesy National Archives

Broken in two by a torpedo, this burning tanker will soon be gone.

(continued from page 35)

when they were almost invisible to convoy lookouts. Furthermore, surfaced U-boats were faster than many of the escort vessels, which had been designed primarily to counter the threat of slow, submerged submarines. Finally, there were simply too few escort vessels available. Coinciding with a decline in torpedo failures, pack tactics began to overwhelm the escort screens, and the percentage of ships lost in convoys rose dramatically. For the U-boat crews, the period from June 1940 to March 1941 was known as the "Happy Time."

This phase of the Battle of the Atlantic climaxed during the autumn of 1940. The first mass sinking occurred on the night of September 21, about 350 miles west of Britain. Four U-boats made repeated attacks on the fast convoy HX72, sinking eleven ships and damaging two more. Kapitanleutnant (KL) Otto Kretschmer in *U-99*, who became the supreme submarine ace of the Second World War, sank three ships. His friend and rival

Joachim Schepke in *U-100* sank seven ships in a series of attacks lasting over three hours. Another ship was sunk and yet another damaged by KL Bleichrodt in *U-48*, while *U-32* attacked and damaged one more. The weak escort screen was unable to prevent or even impede the attacks.

From October 16th to the 19th, seven U-boats concentrated on the slow convoy SC7 off Rockall Bank. Composed of 34 merchant ships deployed in eight columns, the convoy was guarded by an escort of three sloops and two corvettes. Twenty ships went down, including six torpedoed by Kretschmer in *U-99*. The very next night, four U-boats attacked convoy HX79, sinking 12 ships. The attacks mounted against these two convoys became known as "The Night of the Long Knives." Finally, on the night of December 1, six boats caught convoy HX90 and torpedoed 13 ships, of which ten were sunk and the remaining three severely damaged. In these four great convoy battles, the U-boats sank 53 ships and damaged five. Thereafter a series of severe winter storms curtailed anti-convoy operations in the North Atlantic.

The British Admiralty realized that if sinkings continued at this pace, the Battle of the Atlantic would be lost, along with Britain's ability to continue fighting. A sustained effort began to increase the number of available escorts. Many destroyers on invasion watch in Britain were released to the convoys. Newly constructed ships, especially corvettes, were beginning to enter service. Further, many ships which had been damaged during the previous year were now repaired and returning to service. Finally, Britain negotiated the loan of 50 old model destroyers from the United States, making more and more convoy escorts available.

Significant changes also took place in the organization and equipment of the escorts. Prior to this period, the escorts assigned to a particular convoy were gathered from any ships available at the time, which did not allow them the opportunity to train or work together as a team. Now permanent escort groups were formed and

new training given to all vessels. This allowed a much closer coordination among the escorts of a convoy. Escort vessels were now also equipped with improved high-frequency, short-range radios for communications with other escorts and aircraft. New and better anti-submarine aircraft were also starting to reach the battlefield. Many of these planes, and some escort vessels as well, were now equipped with crude radars. Though the shipboard sets were largely ineffective as submarine-spotters, they did allow ships to have a much clearer picture of the locations of convoy and escort ships, which was of great benefit in keeping the convoy together. Finally, the Royal Navy switched codes, replacing the old Administrative Code, which the Germans had broken, with the new "Naval Code No. 1."

By March 1941, the new techniques and technology were beginning to have some effect. That month, three of Germany's leading U-boat aces were eliminated from the battle. On March 7, Gunther Prien and *U-47* disappeared near Rockall, perhaps victims of one of their own torpedoes. Ten days later, northwest of the Hebrides, both Joachim Schepke in *U-100* and Otto Kretschmer in *U-99* were attacked by escorts and sunk. Schepke was killed when his U-boat was rammed by the destroyer *Vanoc* after having been located by radar, the first time this had happened in the war. Only a few minutes later, KL Kretschmer was discovered trying to exit a convoy and attacked by the destroyer *Walker*. *U-99* went down, but most of the crew were rescued and sent to POW camps. The balance had been restored.

Stalemate

The period from April to December 1941 was a time of relative equilibrium on the Atlantic battlefield. The number of U-boats was rapidly increasing, but three new Allied technological developments offset the gain.

The first of these was the development of High Frequency Direction Finding receivers (HF/DF, or "huff-duff") for shipboard use. In the hands of skilled operators, this equipment could detect a U-boat's radio messages and reveal its bearing and approximate range from the convoy. In many instances, this allowed a convoy to send out an escort to intercept the sub before it was able to attack. These subs were often the "shadowers," whose task it was to report the convoy's location and direction. Even if the escort was unable to sink or damage the U-boat, it could often force it to submerge, which usually caused the shadower to lose contact with the convoy, and therefore helped keep packs from forming against it.

Another development was the installation of adequate radars on land-based patrol aircraft. Some aircraft were also now equipped with massive searchlights (called "Leigh Lights," after their inventor) which, when coupled with radar, allowed the planes to find and attack surfaced submarines at night. This new threat forced U-boats to dive and travel submerged much more while moving to and from the battle zone, especially from the French Atlantic bases. In turn, it effectively decreased the number of U-boats on patrol. New radars were also installed on escort vessels to help remove the invisibility which U-boats had enjoyed when attacking on the surface at night.

But the most important development was the success of the Government Codes and Ciphers School (GCCS—the British code-breaking organization) in penetrating the German naval code system. While some progress had been made earlier in the war, decoding usually took too long for the information to be tactically useful. The



Courtesy National Archives

A Type VII boat of the 7th U-Flotilla returns to St. Nazaire with victory pennants flying.

determination to crack the German code system grew. Several German weather and supply vessels were captured, and valuable information seized. But the greatest break came on May 9, 1941. KL Lemp, now commanding *U-110*, was attacking convoy OB318 when the corvette *Aubretia* and the destroyers *Broadway* and *Bulldog* forced him to the surface with a well-conducted series of depth-charge attacks. As *Bulldog* bore down, intending to ram the crippled submarine, the crew of *U-110* abandoned ship. Seeing his opportunity, the captain of *Bulldog* reduced speed and sent a boarding party to seize the submarine. Not only did the boarding party capture several loads of confidential papers, they seized an ENIGMA coding/decoding machine, on which the entire German cipher system was founded. Captain Lemp, who had opened the U-boat war with the sinking

of the *Athenia*, died trying to re-board his boat and scuttle it. The *U-110* sank two days later, but the damage was already done.

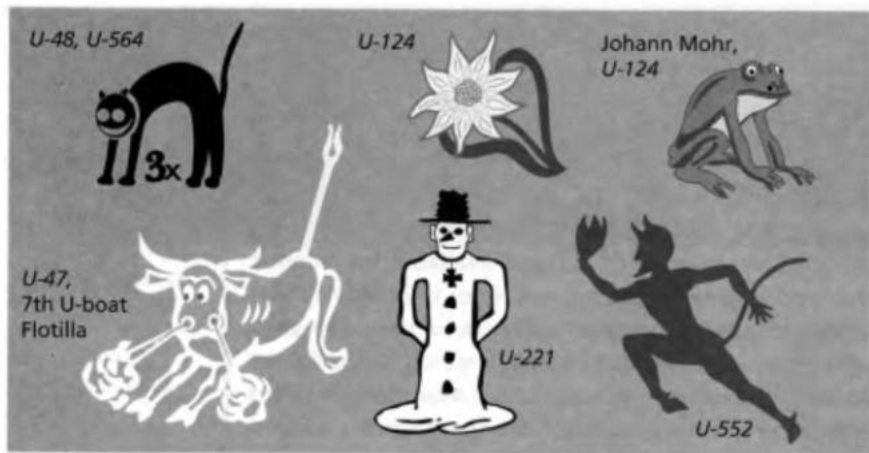
The new information provided GCCS with what it needed to crack the German cipher system. Soon, many messages from U-boats were being decoded and read in real time, and most German radio traffic was open to the British by August, 1941. This was of decisive importance in the Atlantic War. The Allies now had a clear picture of U-boat dispositions, allowing them to re-route convoys away from concentrations of submarines. Convoy sightings became rarer and rarer, and the monthly tonnage total began to drop significantly.

Admiral Dönitz, disappointed by the meager results of this phase of the campaign, tried several remedies. U-boats were formed into groups rather than being deployed in long patrol lines so that any convoy spotted could be attacked more rapidly. Dönitz also changed the zone of operations several times, hoping to find a way through the ring of darkness which now surrounded the convoys. Nothing seemed to help. Finally a higher power took a hand. In mid-November 1941, Hitler ordered a significant U-boat presence in the Mediterranean, which reduced the number of U-boats available for Atlantic operations. Later in the month, Hitler directed Admiral Dönitz to form a large group of boats for operations out of Norway against supply convoys going to the Soviet Union. With so few boats available, Atlantic operations were suspended in December. But new opportunities on this ocean were about to arise, this time far to the west.



Courtesy National Archives

U-664 shows the "Laughing Sawfish" emblem of the 9th U-Flotilla, Aug. 9, 1943.



U-Boat Insignia

Before the war, U-boat numbers were painted on the conning tower in letters 1.5 m high, as well as on a plaque on the bow. Once the war began, however, all U-boats were painted an overall neutral gray to keep the enemy guessing about the deployment of the U-boat fleet.

It wasn't long before the U-boat crews began to assert their individuality and started adding symbols representative of some special feature of their boat or captain. Maritime emblems were popular, and octopi, sharks, and lobsters soon populated conning towers. Superstitious motifs also were common. Otto Kretschmer went so far as to have horseshoes

welded onto his tower. (Ironically, the emblem of the destroyer that sank his U-boat was also a horseshoe.) Some captains painted less-auspicious emblems on their towers. Herbert Schultze had "Black Cat Times Three" on the tower of U-48, along with his personal emblem, a white witch. His first officer, Reinhart Suhren, became commander of U-564 and took the black cat insignia with him.

Each graduating class from the German Naval Academy chose an emblem, and these were frequently used on the U-boat tower. The classes of 1938, the year of the Olympic Games in Munich, chose the Olympic rings. The symbol for one of the classes of 1937 was an upright dagger through a wedding ring, and this emblem duly appeared on several boats.

Pure whimsy also came to play. One early emblem was the snorting bull, used by Gunther Prien on U-47. The figure was borrowed from the comic papers on board, and was painted on the tower by the First Watch Officer, Engelbert Endrass, while returning from sinking the Royal Oak. Peter "Ali" Cremer, captain of U-333, had "three little fishies" on the conning tower, after an American pop song of that title. One U-boat (perhaps temporarily) boasted an Easter bunny with a basket of eggs on its back with "Frohe Ostern" (Happy Easter) painted above. Word play on the captain's name also provided emblems. Löwe ("lion") had his namesake for an emblem. Captain Adalbert Schnee ("snow" in German) had a snowman on the tower, and when Schnee got a Knight's Cross, so did the snowman.

Flotillas also chose insignia. The 7th Flotilla, based out of St. Nazaire, was Gunther

Prien's old unit and it adopted his snorting bull after his death. The 9th Flotilla took a laughing sawfish as its emblem. Training flotillas would often paint large geometric designs on the towers of their training boats. Sometimes a city would "adopt" a U-boat, and the crew would put the city's heraldic symbol on the front of the conning tower.

The U-boat's own history could also suggest an emblem. U-338 broke free while being launched, ramming and sinking a barge—its emblem was a wild donkey. After U-123 was damaged for the third time, its crew painted the German "Wounded" badge on its side.

When U-64 was sunk in a fjord by British aircraft, captain Wilhelm Schulz and most of his crew were rescued from the icy waters by members of the German Alpine Corps. The Corps insignia, an Edelweiss (a white alpine flower) became the insignia for Schulz's next command, U-124.

When a new captain took over command of an already-famous boat, he would usually just add his own insignia, rather than remove the old one and risk losing the old luck. Hence, when Johann Mohr became captain of U-124, he added his own green frog to the front of the tower and left the Edelweiss on the tower side.

With the coming of the "true" submarines like the Types XXI and XXIII, with their snorkels and great underwater endurance, U-boats no longer spent much time on the surface displaying their emblems. As a result, the colorful tradition of insignia became yet another casualty of the war.

Drumbeat

German U-boats had been sparring with U.S. forces in the Western Atlantic for some time. The U.S. had established a Neutrality Zone within which American escorts guarded both British and neutral merchants, and gradually extended it over much of the Atlantic. As a result, American destroyers and German submarines had come into conflict several times, though neither side was eager to initiate hostilities. American destroyers did not generally attack the U-boats they discovered, but usually broadcast their locations to warn British units. It was difficult, especially at night or in bad weather, for the U-boats to clearly distinguish an American destroyer from a British or Canadian vessel. Accidents were bound to happen. On October 31, 1941, for example, KL Erich Topp, commanding *U-552*, attacked and sank the American destroyer *Reuben James* in the mid-Atlantic. Other American naval vessels had been attacked previously, and the situation between the two nations at sea was tense. But actual operations against the United States did not commence until December, when the Japanese attack on Pearl Harbor and the subsequent German declaration of war opened up a whole new hunting ground for the U-boats.

German plans for a U-boat assault on the American coast were complicated by several factors. The extreme distance to the target area meant that only the larger Type IX boats were considered capable of operating there effectively. Also, Hitler was unwilling to divert boats from the Mediterranean or the Arctic. In fact, he ordered a whole new concentration in Norwegian waters to foil a suspected Allied invasion attempt. Nonetheless, a campaign was planned with as many subs as possible to exploit the total unpreparedness for submarine warfare on the American coast. Five Type IX boats were dispatched in an operation named *Paukensschlag*—Drumbeat.

Beginning on January 13, 1942, the attacks were an immediate success. Indeed, the main problem was



Courtesy United States Naval Institute

choosing the best target, for there were so many unescorted ships that it was impossible to attack them all. American air cover was weak or nonexistent, and the escorts were operating under the outmoded doctrine of hunter groups. The Americans had not even instituted black-out procedures along the coast, so merchant shipping near shore was conveniently illuminated for the U-boats. Tonnage figures skyrocketed, soon to reach an all-time high.

Over the next six months, wave after wave of U-boats sailed to American waters, including a growing number of the smaller Type VII boats. By filling one of their auxiliary water tanks with diesel fuel, the Type VIIs gave themselves enough range to participate in the slaughter. Later, this procedure would become unnecessary, as BdU began stationing submarine tankers—"milk cows"—in the central and western Atlantic. U-Boats could refuel and resupply from these vessels and stay on active operations much

The "Edelweiss Boat" (*U-124*) comes home, victory pennants flying. The personal emblem of captain Johann Mohr (a green frog) can just be made out in the front of the conning tower.



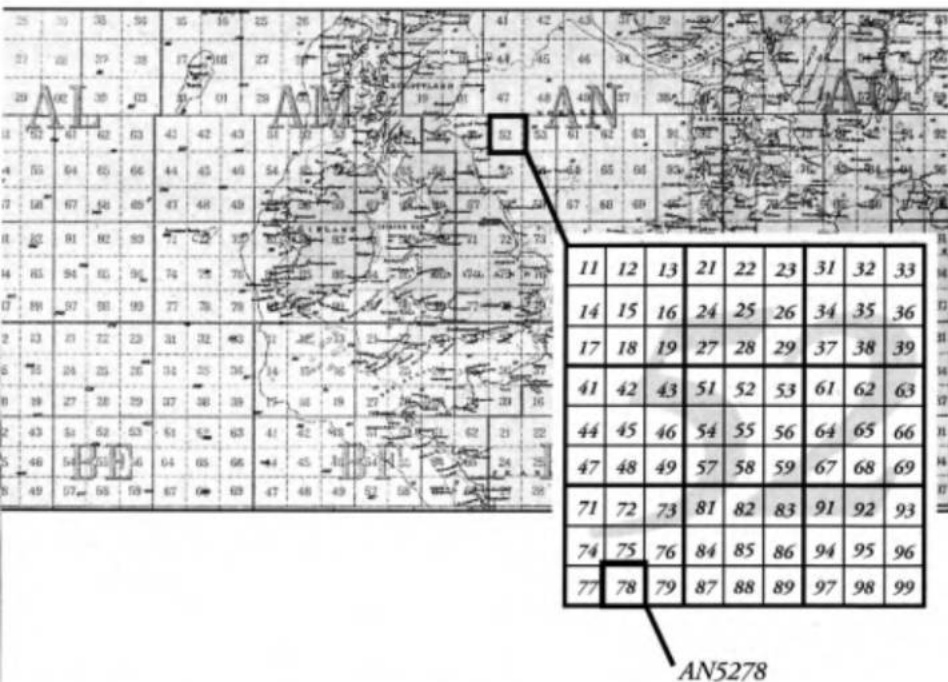
S.S. Robert C.
Tuttle on fire off
Cape Henry, June
22, 1942.

Courtesy National Archives

longer. Until the U.S. Navy began to employ the organization and technology already developed by the British and their allies, there was nothing to stop the U-boats.

The American naval response to the crisis was painfully slow. For six months, the naval staff in Washington resisted the formation of convoys and the consequent release of destroyers from ineffective "offensive" sweeps. Despite so many recent examples of the efficiency of convoys as a method of avoiding submarines, it was believed that "convoys without escorts are worse than no convoys at all" —a patent absurdity. Hundreds of ships and thousands of merchant sailors would pay the price before the U.S. Navy learned its lessons.

As the Americans slowly acquired some knowledge of anti-submarine warfare and began instituting coastal convoys for at least the more exposed sections of their coastline, Admiral Dönitz and BdU switched the focus of the campaign from zone to zone, constantly seeking areas that were not yet fully organized for submarine defense. At various times the attacks were directed into the Caribbean, the Florida Coast, or into the Gulf of Mexico, wherever the defenses were weakest. Gradually, the American anti-submarine forces began to learn from the U-boats, and the yield began to drop. Besides, with ongoing construction, there were now enough submarines to begin an all-out campaign against the North Atlantic convoy routes: it was time to return to the main arena.



AN5278

The German Naval Grid Chart

Rather than use latitude and longitude to describe ocean locations, the Kriegsmarine staff created their own system. They divided the ocean surface of the globe into large square areas, and gave each a two-letter designation. These large areas were then subdivided into a three-by-three grid of nine medium-size squares, numbered 1-9. Each medium square was further divided into nine small squares and again numbered. The small squares in medium square number three, for example, were numbered 31-39. These small squares were subdivided by nine twice more into 81 squares, each covering a patch of ocean about six nautical miles across. With this system, a

German naval vessel or U-boat could report its location using only six characters: two letters for the large ocean square and four digits to fix the location to within six nautical miles inside that large square. A U-boat at CA2764, for example, was in the middle of New York Harbor.

Some of the large lettered areas were of irregular shape, for tactical reasons. England, for example, was divided between sectors AM and AN, so that sector AN covered the North Sea and the east coast of Britain, while AM spanned the western approaches. Similarly, square CH was slightly distorted to cover the south coast of France as well as the western end of the Mediterranean sea. A single two-letter designation could therefore describe an entire zone of operations.

The German return to the North Atlantic was favored by several new developments, including two in the code-breaking battle. In February 1942, the Germans added a fourth code wheel to ENIGMA, their mechanical ciphering apparatus, greatly complicating the British code-breaking effort. The Allies were unable to read any German coded messages until December, and the following months would yield only a little progress. As a result, the Allies were unable to route the convoys away from the U-boat packs for most of this period.

That same month, B-Dienst broke the British "Naval Cipher No. 3," and became able to read significant amounts of Allied naval traffic, including advance information on convoy movements and even the Allied daily estimate of U-boat positions. These decrypts were of great use to BdU. Between August and October 1942, for example, ten out of 23 convoy interceptions were a direct result of evidence provided by B-Dienst. By January 1943, virtually all U-boat dispositions were based on decrypted data.

Another German advantage was the introduction of gear for detecting Allied radar signals. The first radar warning receiver was Metox, named after its French manufacturer. Introduced in August 1942, it gave the U-boats enough warning against radar-equipped ships and aircraft to enable the subs to dive safely. This made a great difference in the Bay of Biscay, on the routes to and from the bases in France. The U-boats could once again navigate on the surface at night with relative safety, and get to their patrol areas much more quickly.

Finally, a new magnetic exploder and the first pattern-running torpedoes improved the U-boats' firepower, and the new network of U-tankers made possible a very wide-ranging campaign against shipping in the far corners of the Atlantic and around the world. Sustained operations could be carried out as far away as

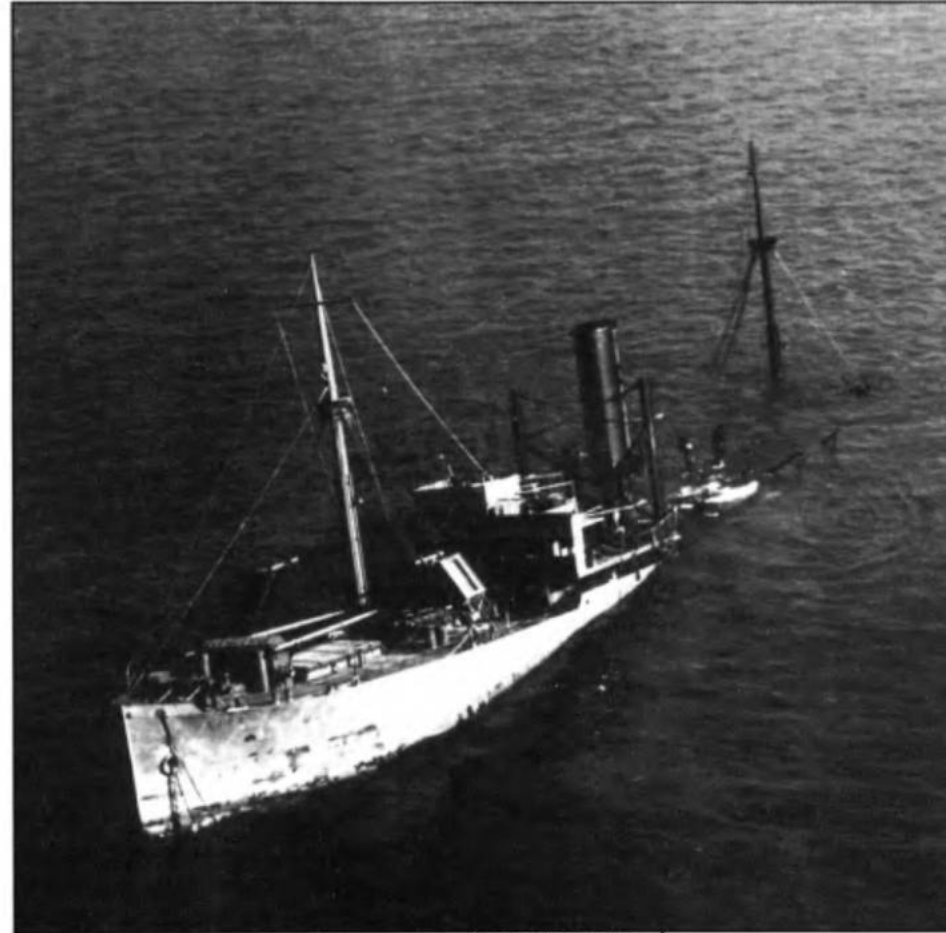


Courtesy National Archives

Tanker *S.S. Dixie Arrow* burning off of Cape Hatteras, March 26, 1942.

Capetown at the southern tip of Africa and even into the Indian Ocean. The U-tankers could also be deployed in support of the packs in the North Atlantic, greatly extending the time that the pack boats could stay on station.

On the other hand, the Allies had several new advantages of their own. The number of escorts available was now large enough to provide every convoy with an adequate guard. This meant that more escorts could be spared from the convoy to chase down HF/DF bearings, for example, with a consequent reduction in the number of submarines shadowing the convoy. HF/DF itself was improved, and with more ships carrying the apparatus, escort commanders could often get cross bearings from several ships and pinpoint the location of a lurking U-boat. Improved radar sets were now available to help thwart U-boat night-surface attacks. The



Courtesy National Archives

S.S. Tiger sinking after attack by *U-754*, April 1, 1942.

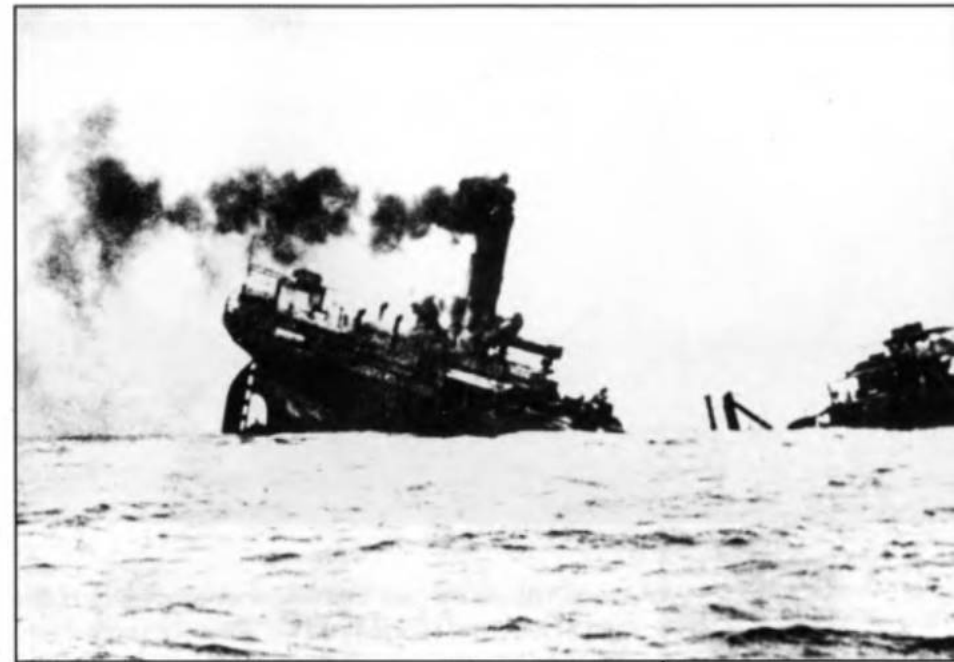
Allies were also deploying a new ship-borne weapon, a forward-throwing mortar called "Hedgehog" which fired a pattern of small bombs in a dense pattern ahead of the attacking ship. This new weapon allowed escorts to attack more quickly and accurately than with depth charges, although escort captains still preferred depth charges because of their greater punch. Finally, Allied air power was beginning to play an increasingly important role in the anti-submarine system. Aircraft were quite effective U-boat killers by now, and even when they missed, they still forced U-boats under the surface. Submerged U-boats were virtually blind and

very slow, and could not keep up with a fast-moving convoy battle.

When the Battle of the Atlantic reopened in the summer of 1942, it became clear to both sides that the crucial phase was at hand. The technical balance was almost even, and both sides were well-equipped for the coming struggle. But when the convoy attacks resumed, the results were disappointing for the U-boat forces. Between August and October, 23 convoys were intercepted by groups of U-boats. Of these, eight contacts were lost because the shadowing boats were driven off or destroyed, and only three of the convoys lost more than four ships to pack attacks. The U-boats were clearly having problems with the escort's new capabilities, and the number of U-boats damaged or sunk by escort or air action rose significantly.

The frustration continued into the autumn months. In November, when the Allies invaded North Africa, Hitler ordered a maximum effort against the sea supply lines of the invasion force. This shift of U-boat strength crippled the North Atlantic campaign, and the number of ships sunk off the African shore did not justify the diversion of effort away from the main theater. The weather again intervened later that winter with a series of Atlantic hurricanes that prevented the U-boats from making many intercepts or exploiting the contacts they had.

Not until January 29, 1943 did a real pack attack develop. *U-456*, commanded by KL Tiechert, spotted convoy HX224 and shadowed it for three days before a pack of five boats could be assembled. Tiechert sank two ships, and a straggler was picked off by *U-632*. However, a survivor of *U-632*'s attack revealed that another large convoy, SC118, was close behind. Twenty boats were gathered to attack this convoy. From February 4 to February 9, a series of attacks sank eleven ships, three of them stragglers, and one other vessel was damaged. SC118 was a heavily-protected convoy, however, and the U-boats paid a high price. Three U-boats were sunk by the convoy escorts. Another four were seriously



Courtesy National Archives

Another freighter goes down in the Atlantic.

damaged, two by escorts and two by air attack. This was clearly not a favorable exchange rate for the U-boats.

An even more distressing factor came to light when the action against SC118 was analyzed back at BdU. Of the twenty U-boats around the convoy, only three executed successful attacks. Furthermore, of the eight ships sunk inside the convoy, six were torpedoed by *U-402* under KL Siegfried Freiherr von Forstner, who also accounted for the damaged merchant. It was apparent that only the most experienced and skillful skippers could successfully operate in the new defensive environment. The problem was that such captains were becoming quite rare, and the new crews were not as carefully trained as the older ones had been.

As 1943 wore on, the intensity of the battle for the convoy routes in the North Atlantic increased. The U-boats encountered five more convoys during the rest of February, but only one encounter resulted in a pack



Courtesy National Archives

This remarkable series of photographs documents the sinking of the American freighters *Edward Rutledge*, *Tasker H. Bliss* and *Hugh L. Scott* by KL Kals in *U-156* at Fedala Roads, Nov. 12, 1942.

attack. The attack took place against west-bound convoy ON166 from February 21-25. Thirteen submarines gathered for the assault, but only seven actually managed to attack, sinking seven ships and damaging another four. West of Gibraltar, four convoys were intercepted during the first two months of the year. However, only one of these attacks was successful—seven tankers out of nine sunk from a special convoy (TM1).

Other attacks were broken up by strong escorts and heavy air cover, which forced the U-boats to remain submerged and prevented them from assuming an attack position.

March, 1943 was the crisis month in the U-boat war. Between March 7 and March 10, convoy SC121 was attacked by nine U-boats. Twelve ships were sunk, five

Courtesy National Archives





Courtesy National Archives

in the convoy and seven that had become separated from the convoy due to heavy seas. On March 9, four U-boats concentrated against HX228 and sank four ships. Three more were damaged. These struggles were the preliminary to the biggest convoy battle of the war.

On the evening of March 13, a U-boat spotted a destroyer headed northeast, but a search of the area produced no convoy sightings. The following morning,

however, another U-boat, this one heading for a tanker to refuel, came across convoy HX229. All available boats were routed to intercept. Firm contact was finally established on the morning of March 16. For the next four days, a running battle developed between over 40 U-boats and two convoys, the original HX229 and another convoy only a few miles ahead, SC122. The two convoys were so close that the battle merged into one

Courtesy National Archives





Laconia survivors being assisted by U-506.

Courtesy private collection of Wilhelm Grap

The Laconia Incident

One of the most peculiar events of the war occurred on September 12, 1942. Just after 10:00 p.m., Captain Hartenstein in U-156 torpedoed a large target in the South Atlantic. In the fading light, a number of men

struggled for survival, some in lifeboats, but many in the sea. The crew of U-156 were astonished to hear the sound of Italian voices in the water. Their victim was the British liner Laconia, carrying civilians, military dependents, and more than 1,500 Italian prisoners of war. Hartenstein immediately



Courtesy private collection of Wilhelm Grap

Some of the civilians picked up by U-boats after the sinking of the Laconia.

began rescue operations and called for assistance from nearby U-boats. He also broadcast an uncoded radio message requesting aid from any vessel available and promising a suspension of hostilities while rescue operations were under way. For two days, U-156 and several other U-boats shepherded the survivors, many of whom were forced to stand on the decks of the U-boats, while others were towed behind in lifeboats. Before any Allied or neutral ships could reach the scene, an American patrol bomber operating out of Ascension Island appeared. The pilot radioed back to base for instructions and was told to attack, which he did. The U-boats were forced to submerge, leaving hundreds of victims struggling in the water. Fortunately, neutral ships showed up soon after, so the loss of life from the American action was small. In

fact, many survivors already had been taken aboard the already-crowded U-boats. But as a result of this incident, Admiral Dönitz forbade U-boats from attempting any rescues and, furthermore, from providing any assistance whatsoever to survivors of submarine attack. The "Laconia Order" became the basis for an indictment against the Admiral after the war. Despite evidence that his order substantially reflected Allied practice, Dönitz was convicted of war crimes by the Nuremberg Tribunal and sentenced to a long prison term. The veterans of the U-boat service, proud of the professionalism with which they had fought a long and difficult war, deeply resented this action, and felt that the entire U-boat service was being punished for their skill and for the threat they had posed to the Allies, rather than for war crimes.

Italian ex-POWs
being fed on the
deck of U-506.



Courtesy private collection of Wilhelm Grap

gigantic melee. Despite heavy air cover and a strong escort, 22 ships were sunk. Of these, 13 were sunk in the convoys and the other nine damaged so badly that they fell behind and were eliminated one by one. All this had been achieved with one U-boat lost and three severely damaged. It was the greatest U-boat victory of the war—and almost the last.

The following months showed that the attacks on HX229 and SC122 were not the opening of a new round of German submarine success, but rather the high-water mark of a campaign on the verge of failure. For example, in the last convoy battle in March, against HX230, only one ship was sunk despite the presence of many stragglers. Four convoys were attacked in April, but a combination of air cover and aggressive escort action

frustrated attacks on three of these, and only eleven ships were lost, five of them stragglers. The last April convoy interception failed because of strong storms which stymied the efforts of many of the inexperienced U-boats to reach favorable attacking positions. Only two U-boats out of 19 arrayed against the convoy managed to attack, sinking two vessels and damaging one.

The final proof that the escorts were establishing mastery over the attackers came during the first week of May. Sixty U-boats from four different packs were involved in a mass assault on convoy OBS5, which was guarded by 18 escorts. In the course of three nights, 13 ships went down and another was damaged. But in return, the escorts sank six U-boats and damaged four. Two more U-boats sank after colliding during the night actions. Even worse, of the 60 U-boats who managed to approach the convoy, only nine had actually executed their attacks. Four other convoy attacks were defeated that month, with the Allies losing only three ships total. In all, 41 U-boats were lost during May 1943, a horrendous rate of loss which could not be sustained. The escort system had defeated the U-boats. On May 24, Admiral Dönitz reluctantly ordered a suspension of the convoy battles and a withdrawal to safer waters. He had not conceded defeat, but recognized that until new technological innovations could restore the power balance, the U-boats would have to concentrate on peripheral areas.

The triumph of the convoy escorts was due to several factors. Beginning in February, the Allies had started deploying new radar systems in both escorts and aircraft that could not be detected by the U-boats' Metox gear. U-boat losses due to aircraft suddenly started to mount, and the boats began to have a difficult time getting past the convoy escorts on the surface.

Another major problem for the U-boats was the entry of VLR (Very Long Range) aircraft into the battle. The farthest reaches of the North Atlantic routes were now covered by aircraft, which meant that the U-boats

The End

The situation for the U-boats grew steadily worse. The Allied and British forces kept adding new escorts, and Allied shipbuilding capacity was easily outstripping the ability of the U-boats to sink ships. The crowning blow came in June, 1943. B-Dienst, which had been reading much of the Allied naval traffic since February, 1942, suddenly lost this ability when the Allies changed codes again. From now until the end of the war, the German interception service would only be able to provide partial and sporadic decrypts of Allied coded material. At the same time, the GCCS at Bletchley Park finally penetrated the four-wheel ENIGMA code variations. For the rest of the war, German naval communications were open to Allied observers, including all the daily position reports. Any German submarine which communicated with its base was now closely tracked and its location monitored on a daily basis.

This development brought about a new American anti-submarine operation in the Central Atlantic. From intercepted communications, the Allies were able to determine the locations of all the German U-tankers at sea. The Americans devised a scheme to rapidly locate and eliminate the U-tankers using anti-submarine groups consisting of escort carriers and destroyers. The British were very leery of this operation, fearing that the sudden disappearance of all the U-tankers would alert the Germans that their communications were no longer secure. But the Americans insisted, and in the summer of 1943 a series of operations was conducted against the U-tankers that virtually eliminated them from the seas. The loss of the tankers severely decreased the amount of time that the long-range boats could spend far afield, and put some once-lucrative hunting grounds forever out of reach.

The Germans pinned their hopes for the remainder of the war on the development of several new technical advances. To escape the punishment dealt out from the



Courtesy National Archives

A U-boat under air attack. Note the falling depth charge at lower right.

were subject to aircraft attack and harassment anywhere in the battle zone. Now, too, the Allied surplus of escorts allowed the formation of support groups, often including a small aircraft carrier, which could be rushed in to reinforce threatened convoys. These groups were not assigned to individual convoys, but would take over the hunt for submarines discovered near a convoy and finish it off while the convoy moved on. They were willing to hunt a target for days, and make dozens of attacks, if that's what it took to insure the destruction of a U-boat. The escort system had clearly demonstrated that it was a match for anything the U-boats could bring against the convoys.

planes, the U-boats' anti-aircraft armament was significantly increased. However, the large increase in the number of Allied aircraft, the sophistication of their weapons, and the excellence of their tactics and communications still left the U-boats terribly vulnerable to air attack, especially with no effective radar warning receivers. It was not until quite late in the war that the U-boats once again acquired the ability to detect and react to Allied radar signals.

Another significant U-boat improvement was the development of an efficient "snorkeling" device. Originally developed by the Dutch Navy before the war, the snorkel provided a means of drawing air from the surface while the submarine was safely submerged. No longer was the U-boat forced to surface to use diesels or recharge the electric batteries, and this made travel under hostile air cover much safer. However, a submerged U-boat was a blind U-boat—the snorkel did little to improve a U-boat's ability to attack.

The greatest effort was in the area of new U-boat designs. For some time, the Germans had been researching a new propulsion system that broke down hydrogen peroxide to produce oxygen fuel, potentially allowing very long-range submerged missions. Early experimental results were promising enough to justify the building of combat prototypes. But the research failed to solve the safety problems of handling such volatile materials, and there were too many problems producing and delivering sufficient hydrogen peroxide to justify building boats that used it.

However, as the research was being phased out, one of the engineers working on an advanced prototype noted that its hull could hold large banks of storage batteries, diesel engines, and fuel. From this, a new project began that resulted in designs for two new U-boat types capable of revolutionary underwater speeds and endurance. So promising were these designs that on August 13, 1943, the order was given to halt new construction efforts on most of the older types. All available dockyard and shipbuilding space was to be



Courtesy National Archives

given over to production of the large Type XXI Atlantic boat and its smaller cousin, the Type XXIII. Concurrently, new construction methods decreased building time by pre-fabricating the boats in sections at widely-dispersed yards, and then bringing the various parts together for final welding and fitting out.

But even with the faster construction, the delivery of the new boats would be too late. Germany did not have that much time left. Very few of the new boats actually made operational sorties, and only the type XXIII executed actual attacks. Given their limited deployment, the new boats were quite successful, and might have caused the Allies serious problems. However, the first mission was carried out only five months before the end of the war, and there were never enough of the new weapons to make any real difference.

Air attack on *U-66* (left) and *U-117*, August 1943. *U-117* sank after this attack.



Courtesy National Archives

Guarded by Allied ASW aircraft, a convoy sails undisturbed, carrying vital war *matériel* to Europe.

The Germans tried to renew the attacks on the convoys in September 1943, but the entire effort collapsed under massive numbers of Allied escort vessels and aircraft. For the rest of that winter and into the spring of 1944, very few convoys were intercepted and none successfully attacked. Additionally, the losses taken by the U-boat forces were approaching calamitous proportions. In June 1944, the Allies invaded France. By the end of August, the last remaining U-boats were forced to flee their French bases as the Allies broke out of the beachhead and drove down the coast. The few U-boats that survived the flight from France and the defensive efforts of the previous few months were sent to Norway or the German North Sea coast. From there they still sortied, but the situation was hopeless.

No matter how heroic their efforts, the U-boat crews could do little to stave off the inevitable end. The enemy was far too strong, and there were insufficient resources and time to produce the new weapons which

might have redressed the balance. Years of sacrifice had been in vain. Over 39,000 German sailors put to sea in the U-boats of World War II. Of the more than 30,000 who did not return, 27,000 were killed in action—the highest percentage of losses to any arm of any service in any armed force in the history of modern war. Yet morale remained unbroken until the very end, and until that end the men of the U-boat service were willing to put to sea, even for a battle they knew was hopeless. No nation could ask more of its fighting men than this.

The Final Hours

As more and more U-boats were destroyed while under construction or repairs, many sailors found themselves armed with rifles. Captain Peter Cremer, who had been promised one of the new Type XXI electro-boats, was instead handed a Panzerfaust (a primitive bazooka) and told to stop British tanks. Seizing some three-wheeled delivery vehicles, Cremer led his anti-tank squad on an 80-km journey from Hamburg to defend U-boat headquarters at Ploen. As soon as Cremer arrived, Admiral Dönitz, anticipating an imminent crisis, put him in charge of his personal bodyguard. A message had just arrived from Berlin: in the event of Hitler's death, Dönitz would become head of state. Meanwhile, Heinrich Himmler, the ambitious leader of the SS, arrived at Ploen with a heavily armed personal guard, and Dönitz feared that Himmler might try to seize power. Cremer and his men hid on base with machine guns, and Dönitz concealed a loaded pistol under some papers on his desk. The Admiral told Himmler that there could be no place in the new government for anyone as closely connected to the old regime as Himmler. After arguing with the Admiral until the early hours, Himmler finally departed with his guard.

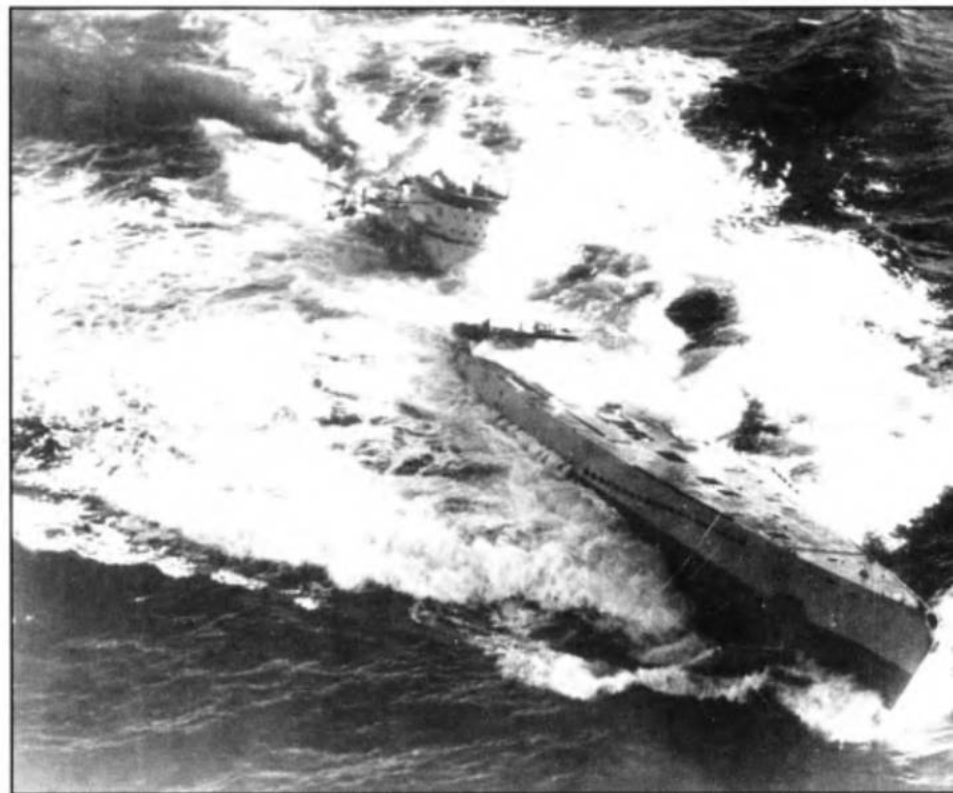
For most U-boat captains still at sea, the situation had already become nearly hopeless. KK (Korvetten Kapitän) Adalbert Schmee, however, was pleased with his new command. Of the two brand-new Type XXI's on patrol, he had one of them—U-2511. Schmee had scored his first victory in August of 1940, been awarded the Knight's Cross, and had become Dönitz's operations officer. Now

he was back at sea, and at the helm of a boat that once again made hunting as easy as it had been during the "Happy Time." He was under orders to make no attacks on his outbound trip to Panama. Detecting an antisubmarine patrol, he easily outran it, travelling faster underwater than the corvettes could on the surface. Then came the unthinkable, but inevitable, message from BdU: all U-boats were ordered to cease hostilities. Nevertheless, after spotting the cruiser HMS Norfolk, Schmee carefully threaded the sub through the heavy escort, closed to within attack range of the cruiser, and raised the periscope. But in the end, he obeyed orders—instead of giving the order to fire, Schmee simply cursed, lowered the scope, and slipped away.

When the actual surrender came, the U-boats were ordered to proceed to the nearest Allied port under a black flag. Forty-three were still on patrol. Most sailed to England, but two were beached off Portugal, and two made the long journey to neutral Argentina, hoping to get better treatment than what was expected from the Allies.

After Germany surrendered, there was a brief period when the German Armed Forces no longer existed as an organization, but during which the Allies had yet to assert control over them. Gunfire echoed in the night as nervous sentries on both sides fired at shadows. One German sentry fired a single warning shot that killed Wolfgang Lüth, the most highly decorated captain in the Kriegsmarine.

After a few tense days, the defeated soldiers were ordered to turn over their weapons and submit to internment. As Cremer's



Courtesy National Archives

A badly damaged Type IX U-boat struggles to stay afloat.

comrades were marched to POW camps, Captain G. H. Roberts of the Royal Navy interviewed the submarine commander. Their talk so impressed the British officer that he granted Cremer's request to go free.

Others did not fare as well. Herbert Werner, captain of U-953, was transported from Norway to Germany by the British, who then turned him over to the Americans. They, in turn, relinquished him to the French, who confined him to a detainment camp where the internees had neither shelter nor food. He spent the next six months in POW

camps, jails, and cattle cars. Finally, he was given the choice of either joining the French Foreign Legion or spending the rest of his life behind bars. He agreed to join the Legion, but took the first opportunity to escape. Over half a year after the war ended, he finally returned home.

Those operational U-boats that had survived against all odds were held briefly by the Allies and ultimately sunk. More than 1,000 U-boats were launched during World War II; only two of the combat boats remain today.

REFERENCE



Courtesy private collection of Wilhelm Grap

How a U-boat Works

ACES of the DEEP

A submarine is defined as any vessel that can submerge and navigate underwater using its own power. Unlike nuclear subs—"true" submarines which can stay submerged for months on patrols covering thousands of miles—the U-boat can operate submerged for only brief periods. Even so, it is an incredibly sophisticated piece of machinery.

The U-boat's core is a strong steel cylinder, called the pressure hull, that protects the crew and vital machinery against the tremendous pressures of the ocean depths. The pressure hull is surrounded by a much thinner external hull that streamlines the boat for movement through the water and provides control surfaces for navigation.

On the surface, the U-boat operates much as any other ship does. When driven forward by its engines, it turns using a vertically mounted rudder at the rear of the boat. When the rudder is turned right, for example, onrushing water pushes against it, swinging the stern of the boat to the left, and thus the bow to the right. The boat must be moving to turn, and is subject to the effects of wind, wave, and current like any other surface vessel.

Unlike surface ships, submarines can also adjust their buoyancy, or ability to float, so as to submerge and maneuver beneath the surface. Surface ships float (have positive buoyancy) because the weight of the water displaced by the hull is greater than the weight of the boat. Submarines use a complex system of tanks and valves to take water into the hull as ballast to the point that the boat has neutral or negative buoyancy (is sinking). To rise to the surface again, the ballast water is blown out with compressed air until the boat regains positive buoyancy again. Thus, a sub can sink or rise through the depths solely by manipulating buoyancy with ballast water and compressed air.



Courtesy National Archives

Water streams from beneath the outer hull of a Type VII.

U-boat commanders prefer to keep their boats at neutral buoyancy. This allows the boat to dive quickly and operate submerged without constant dependence on compressed air. With electric motors pushing the sub, it can maneuver through the water in three dimensions using the rudder and the “dive planes”—pairs of wings on the external hull that can lift the boat or push it down. Buoyancy changes with the boat’s weight and depth, and has to be carefully monitored and kept in balance, or trim. For example, firing a torpedo instantly creates more than a ton of positive buoyancy that must be offset by ballast quickly to prevent the sub from popping to the surface.

The Simulation Model

While the basic physics of the submarine may seem simple, controlling them in an ocean-going vessel of war is not. Real U-boats, after all, require hundreds of precision systems, years of training, and a 45-man crew to operate. As a simulation, *AOD* recreates the challenge and sensation of commanding a U-boat while avoiding the myriad details and complexity. The North Atlantic ocean surface and weather may in fact be too realistic for some. Time is modeled accurately: day follow night in a cycle marked by accurate sunrise/sunset times, lunar cycles, and star charts. Crush depth will vary, even between boats of the same type and model. When you raise the periscope, water sheets off of the lens. It takes time to clear the deck and start a dive, regardless of the urgency. Your rate of turn and of climb changes with your speed. You may have a crash dive go out of control, taking you to crush depth.

On the less realistic side, the TDC calculates your firing solutions, and the Tactical and Strategic charts can give you an animated sky-eye that actual U-boat commanders would have given their favorite toe for. For the most part, the intricate chore of maintaining trim is handled automatically by the simulation. Many aspects of the model are adjustable to your preferences (see *Realism Settings*, page 139). If you play *Aces of the Deep* on the “Expert” level, rest assured that there is no fuller realism available. Enjoy.

U-boat Types

The German Navy designed more than 30 types of U-boats, several with various subclasses. Many designs either were never deployed for various reasons or were purely experimental. In addition to Types II, VII and IX, two advanced classes (Types XXI and XXIII) put to sea before the war's end, but were commissioned too late to have any significant impact. One class (Type X) was designed to lay mines, but it served along with the Type XIV U-tanker as a resupply ship.

A pair of late war Type VII boats. Note the absence of deck guns and the slot to the left-front of the conning towers for the folding snorkel mast.



Courtesy National Archives



Courtesy United States Naval Institute

Type II A U-Boats of the 1st U-Flotilla, 1935.

Type II

(Statistics for the Type II D)

- Crew: 25
- Length: 44.0 m
- Displacement: 314 tons surfaced, 460 tons submerged
- Top Speed: 12.7 kt surfaced, 7.4 kt submerged
- Range: 5,650 nm at 8 kt surfaced, 56 nm at 4 kt submerged
- Dive Depth: 100 m (test depth)
- Torpedo Tubes: 3 (bow)
- Torpedo Capacity: 6
- Guns: 1 x 2 cm antiaircraft gun

The small Type II boats, known to their crews as "Dugout Canoes," were the first U-boats built in German yards after the repudiation of the Treaty of Versailles in 1935. Earlier models of this U-boat had limited range because of their small fuel capacity, but later variants were lengthened to allow more fuel. The boats could carry enough provisions for three to four weeks, but frequently returned to port earlier after exhausting their supply of torpedoes. Although the Type II boats were small and cramped, they earned the respect and affection of their crews because of their maneuverability, rapid diving capability, and toughness.

A Type VII boat, on the left, lies next to a much larger Type XIV "Milk Cow."



Courtesy United States Naval Institute

Type VII

(Statistics for the Type VII C)

- Crew: 44
- Length: 66.0 m
- Displacement: 769 tons surfaced, 865 tons submerged.
- Top Speed: 17 kt surfaced, 8.0 kt submerged.
- Range: 8,500 nm at 10 kt surfaced, 80 nm at 4 kt submerged.
- Dive Depth: 150 m (test depth)
- Torpedo Tubes: 5 (4 bow, 1 stern)
- Torpedo Capacity: 12 (14 with external storage)
- Guns: 1 x 8.8 cm gun, 1-4 x 2 cm antiaircraft guns

The first of the Type VII series was launched in June 1936, and variants of this type were used throughout the war. More Type VIIs were built than any other submarine by any other nation. The original Type VII design was quickly modified to provide longer range, more maneuverability, and better torpedo arrangements (Type VII B). Additional minor design changes resulted in the Type VII C, the workhorse of the U-boat force. One variant of the VII C, the VII C/41, was constructed of thicker steel than usual, giving it the deepest diving depth of any operational submarine of World War II. Other Type VII variants were used as mine-laying boats (VII D) and as torpedo-supply vessels (VII F).



Courtesy United States Naval Institute

Type IX

(Statistics for the Type IX C)

- Crew: 48
- Length: 76.8 m
- Displacement: 1,120 tons surfaced, 1,232 tons submerged
- Top Speed: 18.0 kt surfaced, 7.0 kt submerged
- Range: 13,450 nm at 10 kt surfaced, 63 nm at 4 kt submerged.
- Dive Depth: 150 m (test depth)
- Torpedo Tubes: 6 (4 bow, 2 stern)
- Torpedo Capacity: 22 (10 in external storage)
- Guns: 1 x 10.5 cm gun, 1-4 x 2 cm antiaircraft guns

Nicknamed *Seekuh* (Sea Cow), the Type IX was designed to accommodate two separate requirements: to be a long-range submarine, and a tactical command post for the leader of a wolf pack. After the war began, it was found that the second requirement was unnecessary, as tactical command could be handled from shore. This model had sufficient range to enable patrols in the South Atlantic, Indian, or even the Pacific oceans, but was handicapped by a slow diving time because of its size. The Type IX carried more torpedoes than the Type VII, but was slightly more vulnerable to attack, again because of its comparatively large size.

A Type IX at sea. Note the broad, flat deck characteristic of this type.

U-boat Weapons & Ordnance

Torpedoes

German torpedoes were of two basic types, the steam-powered G7a and the electrically propelled G7e. They had identical external dimensions, as they were both designed to be fired from the standard U-boat torpedo tube. Both magnetic and contact exploders were used on these weapons, and most torpedoes mounted both types. The magnetic pistol was triggered by the magnetic field of a ship's steel hull, and was designed to explode beneath the target. Such underbelly explosions could break the back of the target vessel, sinking it quickly with only one torpedo. However, significant problems were encountered with the magnetic exploder early in the war, so for much of the conflict the less-effective contact head was used. These two basic torpedo types were the basis for a number of variations, including acoustic and pattern-running torpedoes.

T I (G7a)

Range/Speed: 12.5 km at 30 kt; 8.0 km at 40 kt; 6.0 km at 44 kt

Warhead: 280 kg

The T I, the earliest German U-boat torpedo, was powered by an alcohol-fueled steam engine that turned a single six-bladed propeller. Although very reliable and possessing good range, these torpedoes left a telltale stream of bubbles behind them as they ran, which could warn targets of the attack and allow them time to evade. Because of this, the T I was used mainly for night or long-range attacks.

T III (G7e)

Range/Speed: 5.0 km at 30 kt

Warhead: 280 kg

The battery-powered T III featured two counter-rotating two-bladed propellers. While not as long-ranged as its alcohol-powered counterpart, this weapon left no bubble trail, making it more suitable for daylight attacks. This torpedo was more fickle than the G7a, however, and needed to be pulled from its tube and serviced every three to four days.

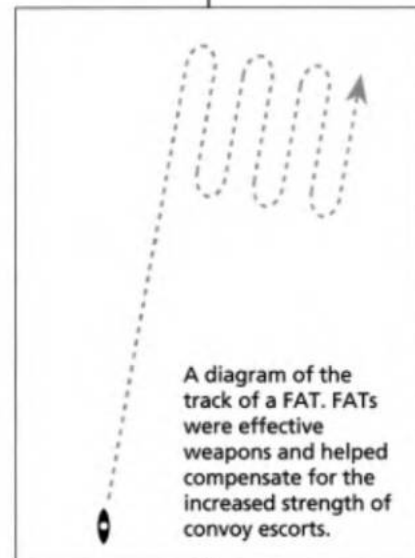
T IIIa FAT II (G7e) Pattern Running Torpedo

Speed/Range: 7.5 km at 30 kt

Warhead: 280 kg

Designed as a specialized anti-convoy weapon, the FAT (for *Flächenabsuchender* ["area-searching"]) Torpedo would run a pre-selected pattern. When fired, it ran straight for a certain distance. If it did not hit a target, the torpedo then turned to the left or right (as pre-set) and reversed course for 800 or 1,600 meters before reversing course again. It would continue this zigzag operation until it struck a target or ran out of fuel. If this pattern ran across the path of the convoy, the chances of hitting a ship were quite good.

U-boats launching FATs were required to radio a warning to any nearby U-boats to stay clear for half an hour. U-boats already inside the convoy had to leave at high speed or dive to at least 50 meters. The crooked course of the FAT meant that the target usually had to



be within half the range of the pattern-running torpedo to insure that the weapon would reach its target.

T V (G7es) Acoustic Homing Torpedo

Speed/Range: 5.7 km at 24 kt

Warhead: 274 kg

Although development of the acoustic torpedo began in 1934, the technology was slow to mature. The principle was straightforward enough; the guidance system had two hydrophones side by side that directed the torpedo to turn in the direction of the loudest propeller noise. The first model, *Falke* (Falcon) became available in February, 1942. While designed to be used against escort vessels, its slow speed and lack of a magnetic detonator made it of dubious value in this role. Only a few U-boats had been issued this weapon when it was succeeded by the next generation.

The T V *Zaunkoenig* (Wren—called the “Gnat” by the Allies) was an improvement on the earlier model in a number of areas. It was faster running, had a combination magnetic/contact exploder, and was equipped with more sensitive detection gear. However, the T V was prone to premature detonation in rough water, and because it was attracted to the noise of propellers it tended to cross through the wake of its target, often causing the torpedo to explode well behind its intended victim.

The Allied response to the T V was immediate. Interrogation of prisoners quickly revealed that the sensor was only sensitive to a narrow band of sound, equivalent to the propellers of a ship sailing at about 15 knots. If escort captains ordered a speed significantly higher or lower than that, the Gnat would have difficulties tracking them. The Allies also rapidly deployed an anti-acoustic torpedo device called the Foxer. This noisemaker was towed behind the escort and simulated the sounds of an escort’s propellers, luring the Gnat away. The Foxer was often more of a hindrance than a help



Courtesy National Archives

Ice covers the 8.8 cm deck gun of a Type VII on Arctic patrol.

though, as it made such a loud noise that it could attract U-boats that might otherwise not have heard the convoy. It also interfered with ASDIC sensors, and it took an inordinate amount of time to deploy or retrieve. As later versions of German acoustic torpedoes were developed to counter the Foxer, the Allies continued to improve the device.

Deck Guns

The standard antiship cannon was the 8.8 cm (on Type VII) or 10.5 cm (on Type IX) quick-firing cannon. (The 8.8 cm version was not the same as the famous German Army “88.”) Three men operated the 8.8 gun, usually under the supervision of the Second Watch Officer. Three additional men were required above deck to bring the rounds from the conning tower to the gun, while others inside passed the ammunition from the main locker below the control room. A small waterproof locker held a few more rounds ready on the deck by the gun to provide an advantage in the first few vital seconds of an engagement. Each round was a single unit (projectile and cartridge) and weighed about 20 pounds (9 kilograms). With a good crew, the gun’s rate of fire was 15-18 rounds per minute.

While the gun could be elevated to 85 degrees, there are not many accounts of a deck gun being used against aircraft. When used against stragglers, however, the weapon was quite effective and helped save the

scarce torpedoes for trickier prey. As more battles were fought against escorted convoys and aircraft became more prevalent, the deck gun was used less frequently. Eventually, BdU phased them out, though some U-boat skippers were allowed to retain their guns.

Antiaircraft Guns

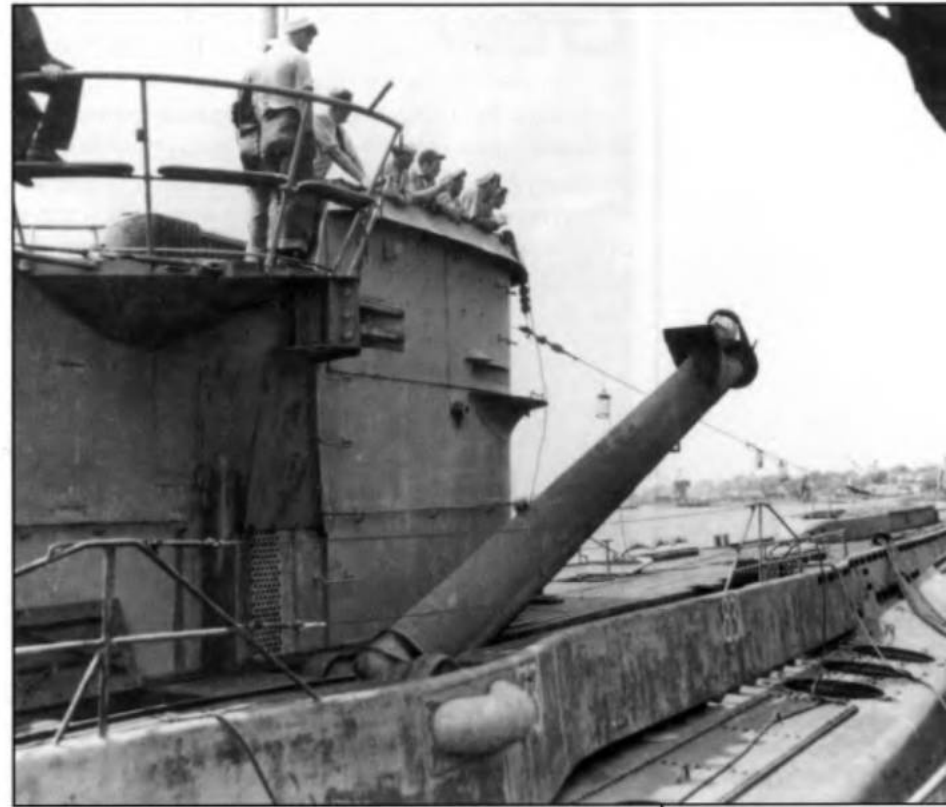
At the beginning of the war, the standard U-boat "flak" armament was a single 2 cm gun. ("Flak" comes from *Flugabwehrkanon*, or "anti-aircraft cannon.") Mounted on the main deck, far from the conning tower hatch, the gun had to be removed and stored before diving, which increased the amount of time required for the boat to dive. Eventually, the weapon was relocated to a platform just aft of the bridge.

By mid-1942, it was clear that the single gun was an inadequate defense against a determined pilot. Until a heavier weapon was available, twin and even quadruple 2 cm antiaircraft mountings were tried. Finally, a heavier 3.7 cm gun was added to the AA defenses, but even this was inadequate. Ultimately, the U-boat's only defense was to detect the airplane in time to crash-dive to safety.

Auxiliary Equipment

Snorkel

Late in the war, many U-boats were equipped with gear that allowed them to run on diesel engines even when underwater. Called a snorkel, this device was simply a pipe with a valve on the end which could be extended above sea level while the boat was submerged. The valve kept sea water from entering the intake, but allowed air to flow to the diesels and exhaust gases to be expelled from the top of the pipe. While quite effective at bringing air into the boat, the snorkel could not be used if the boat's speed was over six or seven knots.



Courtesy United States Naval Institute

BOLD Canisters

One of the devices that submerged U-boats employed to evade attackers was the "BOLD." This was a canister filled with a compound which gave off large quantities of gas when mixed with sea water. To underwater locating devices such as ASDIC, the resulting bubble cloud could resemble a submerged submarine. A BOLD canister was designed to stay at a certain depth, so unless the sound operator of the searching vessel was especially skilled it was often difficult to distinguish from a sub. The Allies called this device a "Submarine Bubble Target" (SBT).

American sailors examine the snorkel of a surrendered U-boat, May 1945.

Crew

A Type VII U-boat housed approximately 44 officers and men, while a Type II carried 25, and a Type IX about 50. Depending on a boat's specific mission, the number of crew members varied greatly. A typical crew consisted of four officers and four chief petty officers, with the remainder of the crew consisting of petty officers and ratings.

While the number of petty officers on board varied, generally two were assigned for every three seamen. Petty officers on a U-boat included bosun's mates (*Bootsmannsmaat*), helmsmen (*Steuermann*), torpedomen (*Mechaniker*), motormen (*Maschinisten*), and radiomen (*Funkmaat*).

Officers:

Title	Rank	Responsibilities
Captain	<i>Kapitanleutnant</i> or <i>Oberleutnant zur See</i>	Commanding Officer
First Watch Officer	<i>Oberleutnant zur See</i> or <i>Leutnant zur see</i>	Executive Officer, torpedo aiming on surface attacks.
Second Watch Officer	<i>Leutnant zur See</i>	Watch officer, deck guns
Engineer	<i>Leitender Ingenieur</i>	Physical systems, maintaining trim

Noncommissioned Officers:

Title	Rank	Responsibilities
Navigator	<i>Obersteuermann</i>	Navigation, quartermaster
Bosun	<i>Oberbootsmann</i>	Crew discipline
Engine Officer	<i>Diesel Obermaschinist</i>	Care of diesel engines
Motor Officer	<i>Electro Obermaschinist</i>	Care of electric motors



Courtesy National Archives

A U-boat skipper just back from patrol. He's relating some of the incidents of the mission to members of the U-boat command staff.

Courtesy private collection of Wilhelm Grap



Two "Funkers"—radiomen—from U-506 get some fresh air on the bridge.

Decorations

U-Boat War Badge

The U-boat War Badge was modeled after a similar medal from the First World War, with the Prussian crown replaced with the German eagle, and with a more modern U-boat instead of the World War I version. It was reinstated on October 13, 1939. There were several ways to earn the U-boat war badge: to have been involved in an especially successful mission, to have participated in more than three missions, to have been awarded with a decoration for bravery on a mission, or to have been wounded while on a mission. Death in the line of duty also earned the badge, in which case it was presented to the recipient's next of kin.

Iron Cross

Although Germany gave many different awards for valor, the Iron Cross in its various grades was the primary award recognizing bravery. The Iron Cross itself came in two grades: Second Class and First Class. The Iron Cross First Class could only be awarded to one who had previously received the Second Class distinction. The two medals were very similar in appearance and were worn in the same position. When the First Class medal was worn, the Iron Cross Second Class was signified by a small ribbon attached to a uniform button. While the Iron Cross Second Class was very widely distributed, the First Class honor was more restricted, and hence more highly prized.

In addition to the two primary classes of the Iron Cross, a set of super grades was created—the Knight's Cross of the Iron Cross. These were the ultimate awards for valor in the German Armed Forces. A number of decorations were also designed to commemorate service rather than valor, though sometimes the distinction between these categories was blurred.



Courtesy National Archives

Engelbert Endrass, skipper of *U-46*. On the lower left of his jacket is the U-Boat War Badge, with the Iron Cross First Class just above. The ribbon buttoned on the right side of his jacket represents the Iron Cross Second Class. At his throat he wears the Knight's Cross.

Knight's Cross of the Iron Cross

Few awards captured the imagination of the German public like the Knight's Cross. A series of postcards featuring the recipients were traded as avidly as baseball cards are in the United States today. To the U-boat men, the Knight's Cross was the ultimate recognition of valor. Captains would joke about having an "itchy neck" that could only be cured by administering the black, white, and red ribbon of the Knight's Cross medallion. This medal was usually awarded only to captains, but Heinrich "Ajax" Bleichrodt refused to wear his medal until Dönitz gave one to his First Watch Officer as well, because that officer had done all the surface shooting. When a captain received this award, his crew would sometimes paint it on the conning tower or incorporate the cross into the boat's or captain's emblem. If a radio message arrived announcing that the medal was to be awarded to a captain, his crew would often delay the message until they had a cake and hand-made facsimile to present to him as well.

Originally introduced in 1813, the Knight's Cross of the Second World War (like the Iron Cross) had the year of its reintroduction (1939) in its center. Unlike the Iron Cross, it was worn on a ribbon around the neck. The medal hung from a plain hanger that resembled a bent paper clip. Approximately 7,318 of these awards were presented to members of all branches of the German Armed Forces. U-boat men received 135.

Knight's Cross of the Iron Cross with Oak Leaves

The Knight's Cross with Oak Leaves, introduced on June 3, 1940, was awarded to Knight's Cross recipients for further acts of courage. A fan of three oak leaves in silver surmounted the "paper clip" hanger. In all, 890 of these medals were presented, 29 of which went to U-boat men.



Courtesy United States Naval Institute

Captain Otto Kretschmer wears his Knight's Cross with Oak Leaves. He later won the Crossed Swords as well, but the award had to be presented to him in a POW camp.

Knight's Cross of the Iron Cross with Oak Leaves and Swords

Introduced on July 15, 1941, the Knight's Cross with Oak Leaves and Crossed Swords was intended to award Knight's Cross with Oak Leaves recipients for further acts of bravery. A pair of swords crossed at 40 degrees was added below the oak leaves. Only five U-boat skippers received this award.

Knight's Cross of the Iron Cross with Oak Leaves, Swords, and Diamonds

The Knight's Cross with Oak Leaves, Swords, and Diamonds was introduced at the same time as the Oak Leaves and Swords. Twenty-seven servicemen received this award, only two of which were in the *Kriegsmarine*: *Kapitan zur See* Wolfgang Lüth and *Fregattenkapitan* Albrecht Brandt, both U-boat captains.

U-boat Tactics

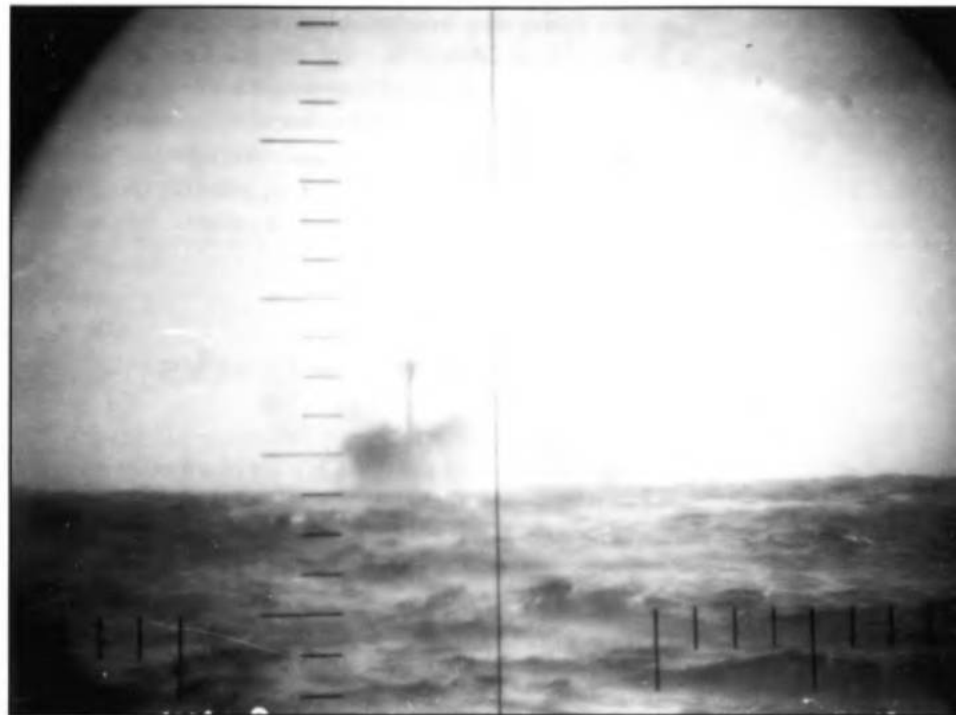
Attacking Convoys

An unescorted merchant vessel is the easiest target—some, particularly tankers, can be sunk with the deck gun at your leisure, even in daylight. But convoys require a more cautious approach. The general course of a convoy attack is to observe, approach, penetrate, attack, and withdraw without being attacked yourself. During the observation period, you should try to determine the convoy's size, course, speed, and the number, type, and location of escorts guarding it. Based on this information, you will plan your approach and attack.

Surface Attacks

You have the greatest advantage at night, on the surface. Surfaced, your U-boat is faster than many escorts, highly maneuverable, and difficult to spot visually. (Later in the war, radar will make surface approaches more difficult.) You can approach or withdraw at will, follow at a distance before closing in, or run ahead of your target to set up an attack. You can exploit momentary gaps in the escort screen to penetrate the enemy formation, or use the long range of your torpedoes to attack from outside of the escorts. Keep your bow or stern pointed at the enemy as much as possible to minimize your silhouette, and try to approach facing the moon—this makes it harder for enemy lookouts to see you. If spotted, you can often use your high speed to run away. Even if an escort is closing fast, your ability to turn rapidly can often give you enough time to evade on the surface or dive safely.

You will want to be a little ahead of the convoy for your penetration of the perimeter. The ideal position, slightly ahead and on the beam of the convoy, gives you the greatest chance to attack the convoy broadside. The



Courtesy National Archives

A periscope view of a merchant vessel.

targets will be crossing your course at about 90 degrees—the optimum firing angle. Once inside the escort screen, try to set up a simultaneous attack on as many big targets as you can. At optimum range, between 250—1,000 meters, the targets have virtually no time to see and evade your torpedo. (Your torpedoes need at least 250 meters of run before they arm, so don't get too close.) Also, keep the gyro angle of your torpedo (the angle between the firing end of your boat and the target) as small as possible. The wider the gyro angle, the greater the chance for error.

If you have selected several targets at various ranges, try to get all the eels to hit at about the same time by firing at the farthest targets first. This helps conceal your presence a few vital seconds more. Very large targets may require two or more torpedoes, but even a single hit will usually cause the ship to fall out of the convoy, where you can finish it off later.

When you have emptied your torpedo tubes it is time to withdraw. The best plan is to go back the way you came. Not only will you have the advantage of light that made you choose that direction for your approach, you will also avoid the risk of being rammed or run down by the freighter columns when crossing the convoy. Once safely away, reload your torpedoes and plan your next move.

Submerged Attacks

Submerged attacks are necessary for daylight attacks and against warships, but are much more difficult. Underwater, your U-boat is slow, almost blind, and unable to make long or rapid approaches. If possible, move into position on the surface ahead of the convoy, then submerge. Once the escort screen has passed over your position, you can come up to periscope depth and attack. Your hydrophones will give you important clues as to the positions of the escorts and the convoy. You will need luck—if the target changes course, you will be left far out of position.

When making a submerged attack, make your periscope observations in short peeks, then go a little deeper between observations. Remember that at periscope depth you are vulnerable to ramming, so be aware of what is happening all around you. Keep your speed low during submerged operations. This will make your scope more difficult to spot (less of a wake), your motors harder to detect on hydrophones, and will conserve battery power. Also, keep the sun at your back to help conceal the scope.

Attacking Warships

Virtually every attack you make against a major warship group (as opposed to escorts) will be the result of an accident. Generally speaking, warships are too fast

and too well-guarded to make planned attacks feasible. However, you may suddenly find yourself in position to make a torpedo attack against a carrier or battleship. Try to hit the target with a spread of several torpedoes. Then be prepared to endure a severe pounding from the escorting destroyers.



Courtesy National Archives

A convoy escort knives through the water.

Defensive Tactics

Escorts

If you are spotted and attacked by an escort vessel while on the surface, your best defense is usually to dive immediately. Escorts will do anything to stop you, including ramming. You will need at least 30 seconds to achieve a depth sufficient to avoid a well-conducted attack. If the attacking ship is too close, you may have to



Courtesy National Archives

Depth charge chutes on the stern of an escort vessel.

maneuver on the surface to get the time you need. You can outrun many escorts, including corvettes, and you can outmaneuver all of them, but it takes only one unlucky shell to penetrate your pressure hull and make diving impossible.

Dive as deep as you can, as quickly as you can. Depth reduces the effectiveness of ASDIC and gives you more time to dodge depth charges. Your hydrophone operator can determine much about your pursuer's position and speed. Try to stay end-on to the attacker to reduce your ASDIC echo. Take advantage of the fact that your attacker will often lose contact with your boat just before a depth charge attack is launched. Use this time and the few moments just after the explosion of depth

charges to change course, but keep in mind that unless you are traveling very slow, the escort's sound gear will soon be able to hear your screws and track your position.

The moment you submerge, you take on many critical concerns besides the enemy: buoyancy versus water in the bilge, leak rates versus pump capacities, water pressure against hull strength. Without adequate electrical power, you cannot run your pumps or keep your boat underway, and you must do both to keep from sinking. Without enough compressed air, you will be unable to drive water from your ballast tanks, and hence be unable to rise swiftly, or perhaps, if there is too much water aboard the vessel, to rise at all. Spend too long underwater and carbon dioxide levels will start to rise, eventually reaching a level which will render your crew unconscious and doom the boat. Go very deep, and your pumps will be unable to eject water from the boat's constant leaks—you may also be unable to surface in time from an emergency or mortal hit. Go too deep, and the pressure hull fails. In fact, the enemy may be the least of your worries when running deep.

Be alert for trickery. Often an escort will wait for you in silence, trying to fool you into thinking that it has left the area. Keep your speed low and check the area at periscope depth before returning to the surface.

Aircraft

If you spot an aircraft in time, your best defense is to crash dive to safety. This takes about 30 seconds, however, and aircraft approach very quickly—if you don't have time to dive safely, you may have better luck using your AA guns to fend it off.

Sometimes the airplane will circle just out of range of your AA guns, while staying close enough to bomb you effectively if you try to dive. If the stand-off continues for long, rest assured that other aircraft or surface ships will appear.

Allied Ships

Merchant Ships

With the advent of war, a motley assortment of ships were banded together into convoys by necessity. Old Great Lakes steamers (never designed for ocean crossings) jostled state-of-the-art refrigerator ships, oil tankers, and whaling factory ships. Whenever possible, ships were separated into fast and slow convoys. The more strategically important ships (carrying oil, munitions, and troops) were usually placed in the center of the convoys. Those with less vital cargo, such as raw materials, were placed on the more vulnerable convoy perimeter.



Courtesy National Archives

An ASW aircraft watches over an Atlantic convoy.

As the war progressed, new standardized ships replaced the inevitable losses. Two of the more common mass-produced ships were the Liberty and Victory ships. These were built in sections, then assembled at the shipyards. In this fashion a new ship could be built in as little as 80 hours. Regardless of Allied successes or failures against the U-boats, the massive production of



Courtesy National Archives

Captain Johann Mohr, skipper of U-124, returns from patrol.

Your Mission

No other vessel of war demands more from its commander than a submarine. You must make instant decisions, and they must be right every time, or you and your crew will find a watery grave. Always be prepared to improvise and make the most of conditions. Remember also that technological capabilities will change radically as the war progresses—be ready for surprises. Successful U-boat captains must combine the skills of a surgeon with the nerves of a riverboat gambler. Patience and intelligence are vital, but ultimately it will be your courage, your will, and your combat skills that make the difference between glory and doom. Good luck.



Courtesy National Archives

An Allied merchant vessel at anchor in Iceland.

these prefabricated ships doomed Dönitz's tonnage war doctrine. German sinkings could not possibly keep up with the Allies' production of new ships.

Destroyers

The destroyer was the most capable and most feared escort vessel. The largest and most heavily armed of the standard escorts, it was fast, agile, and of shallow draught, making it difficult to hit with torpedoes.

Many varieties of destroyer were employed on the North Atlantic convoy runs. The most common were the "H" class fleet destroyers, the "V" and "W" classes, and the more modern "Hunt" and "Tribal" types. Among



Courtesy National Archives

An American "4-piper" destroyer in 1926. Fifteen years later, ships like this veteran would make a critical difference in the Battle of the Atlantic.

the most interesting were the old "four-pipers" (named for their four distinctive smokestacks). These were World War I vintage U.S. destroyers pulled from mothballs and delivered to the British as part of the "Lend-Lease" Program of 1940. They arrived when the British were desperately short of escorts and months away from finishing their first new ships. As welcome as the ships were to Churchill and the Admiralty, they were old and largely unsuitable for North Atlantic operations. Many were in poor repair and none possessed modern weaponry or detection gear. In fact, one of these aged vessels was loaded with explosives and used as a floating bomb in a commando raid against the giant dry dock at St. Nazaire. One British officer commented unkindly that this was probably the best use for them.



Courtesy National Archives

A "DE" (destroyer escort) in Boston Harbor. In British service these vessels were called "frigates."

Frigates

With such great demand for destroyers, the Allies designed a ship that could serve on convoys just as capably as a destroyer, but would not be required to perform a destroyer's fleet responsibilities. This result was the frigate (or "destroyer escort" in the US Navy). Smaller, less well-armed, and slightly slower than a destroyer, the frigate could be built more quickly, and proved highly successful against submarines.

Corvettes

With the outbreak of war, it became apparent that the Royal Navy could not meet the U-boat threat with its current number of destroyers. Building times for destroyers were so long that other, more quickly-built boats were needed until more destroyers could be brought on line. The ship chosen to fill the gap was a new, untested design based on a whaling ship. Its top



Courtesy United States Naval Institute

A Royal Navy Flower-class corvette in Atlantic service.

speed was only 16 knots (while the top speed of a surfaced U-boat was 18 knots). Corvettes were short and broad-beamed, allowing them to patrol in fierce weather when the larger destroyers could only concentrate on survival. However, their wide hulls also made them quite lively—they were said to be able to "roll on wet grass." Eventually about half of all escorts employed on the North Atlantic convoy runs were corvettes.

Sloops

Like corvettes, sloops were slow (16 knots), small, and relatively lightly armed. They were designed with long voyages in mind, so they were not as limited in range as the corvettes. Originally intended for Mediterranean and South Pacific service, they were cold and miserable mounts in the winter North Atlantic. One class of sloop designed after the outbreak of hostilities was the *Black Swan*, which was faster (19 knots) and had increased anti-aircraft armament. Sloops generally carried a large number of depth charges and were well equipped with sensors, which made them effective anti-submarine platforms.



Courtesy National Archives

A *Bogue*-class escort carrier. These relatively small vessels made a large difference in the antisubmarine war.

Escort Carriers

Between the wars, many naval commentators were outspoken proponents for smaller aircraft carriers based on cruiser or merchant hulls. A greater number of small carriers could be built for the price of a fleet carrier and, with more carriers, more territory could be covered. Additionally, they argued, the loss of a "pocket carrier" would not be as heavy a blow as the loss of one of the larger ships. Small escort carriers were given the chance to prove their versatility in the Atlantic, where they fulfilled transport, landing support (in North Africa and southern France), and training missions, in addition to convoy escort and antisubmarine patrols. The increasing presence of escort carriers in 1943 helped close the "air gap" in the middle of the North Atlantic, where the U-boats had enjoyed some of their greatest successes earlier in the war.

Antisubmarine Aircraft

ACES of the DEEP

Consolidated PBY Catalina

The twin-engine PBY Catalina was an ugly, slow, and ungainly aircraft, and few pilot trainees wanted to be assigned to it. Those who were assigned to this tough, dependable plane, however, soon found themselves falling in love with it. The U.S. began shipping Catalinas to the RAF in 1939. With a greater range than the British Sunderland, the PBY served well in antisubmarine missions, accounting for 45 U-boats sunk or badly damaged. Of the four Victoria Crosses awarded to RAF Coastal Command pilots, two went to Catalina pilots.

Grumman TBD Avenger (Tarpon)

Famous for its duty as a torpedo bomber in the Pacific, the single-engine Avenger also saw service in the Atlantic aboard escort carriers. This plane, armed with bombs or rockets, presented a significant threat to any U-boat caught on the surface. The Avenger could also be equipped with depth charges or an acoustic homing torpedo to attack submerging targets. Made available to the Royal Navy in 1943, it was called the "Tarpon" in British service.

Grumman F4F Wildcat (Martlet)

The single-engine Wildcat fighter was used on escort carriers for antisubmarine missions both on patrol sweeps and hunting forays. As part of a hunter team, the Wildcat would suppress the AA fire on a U-boat with its six .50-caliber machine guns and force it to submerge, while an Avenger (the other part of the team) would sweep in for the kill with depth charges or an acoustic homing torpedo. While serving on British escort carriers, the Wildcat was called the "Martlet."

Consolidated B-24 Liberator

Competition for the four-engine Liberator was fierce, since the plane was proficient at long-range heavy bombing missions for Bomber Command as well as VLR (very long range) patrols for Coastal Command. The few B-24s Coastal Command was able to acquire did massive damage to the U-boat fleet, however, sinking or badly damaging 100 boats. While originally used to meet convoys in the mid-Atlantic and patrol around them, Liberators were equipped with radar and Leigh lights (large airborne searchlights) later in the war for night attacks.

Hudson

Based on the civilian Lockheed 14 airliner, the twin-engine Hudson was the first U.S. aircraft to be sold to England. The Hudson was initially intended to be a RAF training plane. When the war broke out, the Hudson and the Sunderland were the only Coastal Command planes that were not hopelessly obsolete. The Hudson had a range of more than 1,000 miles and an endurance of six hours. In one notable action, a Hudson of No. 269 Squadron managed to damage *U-570*, preventing it from diving until its capture by surface vessels. As more effective aircraft became available later in the war, the Hudson was reassigned to transport and communications missions.

Sunderland

Known to the U-boat crews as “tired bees” because of their shape and lumbering speed, the four-engine Sunderlands saw active service from the 1930s right up to the Korean War. As long as the RAF Bomber Command insisted on control of all long-range bombers, Sunderlands (with an endurance of 13 hours) were about the only air threat U-boats faced in the mid-Atlantic. They were responsible for at least 58 U-boats damaged or destroyed by war’s end.



Courtesy National Archives

A German U-Boat under attack from an allied ASW aircraft.

Mosquito

The twin-engine Mosquito was used by Coastal Command in its second offensive over the Bay of Biscay. Heavily armed with cannons and rockets, these fast-moving planes were a dangerous opponent to any U-boat caught on the surface.

Beaufighter

The twin-engine Beaufighter, available much earlier than the Mosquito, filled a similar role in the war against the U-boats. It was often used to shoot down prowling German bombers that were attacking convoys, as well as attacking surfaced U-boats.

Submarine Detection

Some of the most decisive technological advances during the war came in the area of submarine detection gear. Allied breakthroughs eventually helped transform convoy escorts from blind shepherds into relentless, all-seeing avengers.

ASDIC

By the very end of the First World War, the Allies had developed a system of active sound location called ASDIC (for Allied Submarine Detection Interrogation Committee), which broadcast a pulse of sound from an underwater directional speaker. If a submerged object was in the path of the pulse, part of the sound energy would echo back to the source, where an underwater microphone (hydrophone) could pick up and amplify the reflected sound. The direction of the sound pulse provided the object bearing, and the time it took for the echo to return provided the range. Called sonar (Sound Navigation And Ranging) by the Americans, this device became the primary method of detecting submerged U-boats in World War II. By the end of the war, ASDIC sets could even determine the speed and depth of a target, and were integrated into weapons systems that automatically tracked and targeted the U-boat.

Passive Sound Location

The main drawback to an active system such as ASDIC was that its sound pulses effectively broadcast the hunter ship's location, helping the prey avoid it. In contrast, "passive" sound location methods relied on hydrophones to detect submarine noises: propeller or engine noise, water turbulence on a damaged hull, or even the clang of a dropped dinner tray, which could carry for miles underwater.

However, U-boats were capable of very quiet operation, especially when escorts were nearby. Early passive systems were also incapable of providing range data, so



Courtesy National Archives

Part of the listening apparatus aboard an American escort vessel.

the listener could never be sure how far away the contact was. Finally, passive systems were subject to frequent interference from the vessel's own gear, as well as from natural phenomena such as whales.

Radio Direction-Finding

The High Frequency Direction Finding (HF/DF, or "huff duff") technology worked by intercepting U-boat radio signals and providing a directional bearing on the transmission. In the early days of the war, the HF/DF system relied on a series of land-based intercept stations located around the Atlantic basin. But the great distance reduced the accuracy of these intercepts, and communications delays often delivered them far too late.

The big advance in HF/DF came in late 1942 as the receivers were installed aboard convoy ships. Radio intercepts were now at short range, increasing the

accuracy and timeliness. As the number of vessels equipped with HF/DF gear increased, it became possible for two or more ships in a convoy to intercept the signal and get cross-bearings to pinpoint a shadowing U-boat's location. Now a fast destroyer from the convoy escort could be dispatched at full speed to "run down the bearing" of the intercept. Even if the destroyer did not find the sub, it would usually force it to dive and lose contact with the convoy. The convoy could then change course undetected, and avoid the gathering wolf pack—at least for one more night.

Radar

Perhaps the most useful of the devices used to detect U-boats was radar (Radio Detection And Ranging). This technology relied on the transmission of a pulse of electromagnetic energy which was reflected from a solid target such as an airplane, a ship, or the conning tower of a surfaced U-boat. The direction from which the echo was received provided the target bearing, while the length of time it took the pulse to return to the transmitting site yielded the range. Since these transmissions were not blocked by fog or clouds and were unaffected by darkness, this new ability to see in the dark and through atmospheric obstructions became a powerful weapon in the battle to detect U-boats. When radar emerged as a common tool for the escorts and for antisubmarine aircraft, it was no longer as possible for the U-boats to approach their targets undetected, making their job more and more difficult.

The British deployed a crude airborne radar to help in the search for submarines early in the war, and ship-based sets followed swiftly. These early sets, although very useful for finding surface ships, for navigation, and for keeping station in convoys, were ineffective at finding surfaced U-boats. In most instances the human eye, even at night, was a better tool for finding the small silhouettes of the attacking submarines. It was not until 1941, when improved sets became available, that the first radar contact with a U-boat resulted in the sinking

of the target (*HMS Vanoc* versus *U-100*, March 17, 1941). Thereafter radar became a more and more important tool for convoy protection. By the end of the war it was virtually impossible for a U-boat to approach a convoy on the surface without being detected.

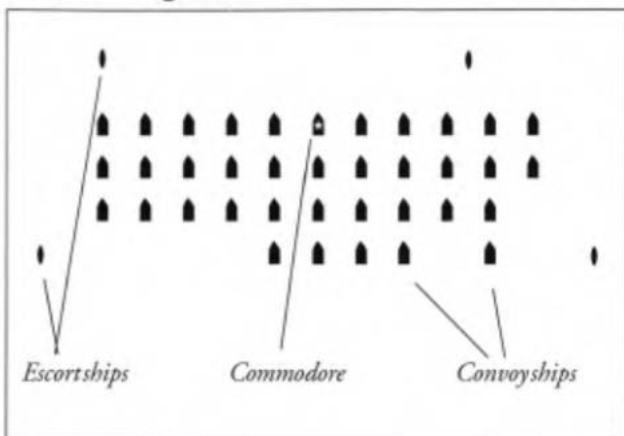
Radar aboard aircraft also became a very effective submarine location system, especially in conjunction with the airborne searchlight system known (after its inventor) as the Leigh Light. Aircraft patrols in the vicinity of the convoys and especially on the routes the U-boats had to take to leave and reenter their bases in France took away all the advantages which darkness had formerly granted the submarines. Besides being attacked with increasing regularity, the very presence of radar-equipped aircraft meant that transit times back and forth between the U-boat bases and their operational zones got longer and longer, which meant that each sub could spend less time in the patrol area. By the end of the war approximately half of all U-boat sinkings were by aircraft, most of which used radar to find their victims.

The increasing Allied use of radar eventually forced a German response. German radar technology was always somewhat behind that of the Allies, so it was usually a case of "too little, too late" for them in the struggle to keep up in the electronic technology race. The U-boat service did deploy a number of radar warning receivers, designed to pick up the transmissions from Allied radar sets and warn the U-boat of the presence of a vessel or airplane so equipped. Though quite effective so long as the Allies made no leaps in radar technology, the fact that the Western Democracies were continually making such leaps meant that the German warning technology continually fell behind.

A few German U-boats were equipped with radars of their own, but their performance always suffered in comparison with those of the Allies. In addition to the technical backwardness of the sets, U-boat skippers were always extremely reluctant to employ any device which radiated any energy which could be detected.

Allied Tactics

Convoys



A typical convoy formation.

Most of the merchant vessels you attack will be in or around convoys. Convoys deploy in wide but shallow formations consisting of many columns, with only a few ships in each. A typical 60-ship convoy in 1943 covers a rectangle about 6 nautical miles across and 2 nautical miles deep, organized into 12 or 13 columns of 4 or 5 ships each. The columns will be separated by about 1,000 meters, with about 400 meters between the ships in a column. By 1943, convoys will be either slow and fast, moving at about 7 or 9 knots respectively. A convoy travels at the best speed of its slowest member.

Not all merchant vessels are able or willing to stay within the confines of the convoy. Some ships are unable to keep up with the convoy because of damage or mechanical problems and straggle behind. Other ships, fearing their exposed position on the outside of the convoy, try to "sneak" to the interior of the formation, but often miscalculate and lose contact with the convoy. Finally, some ships feel that they can do better on their own, usually because they are capable of a higher speed than the convoy as a whole. Sometimes these ships, known to the escorts as "rompers," break away from the convoy and proceed independently.



Courtesy National Archives

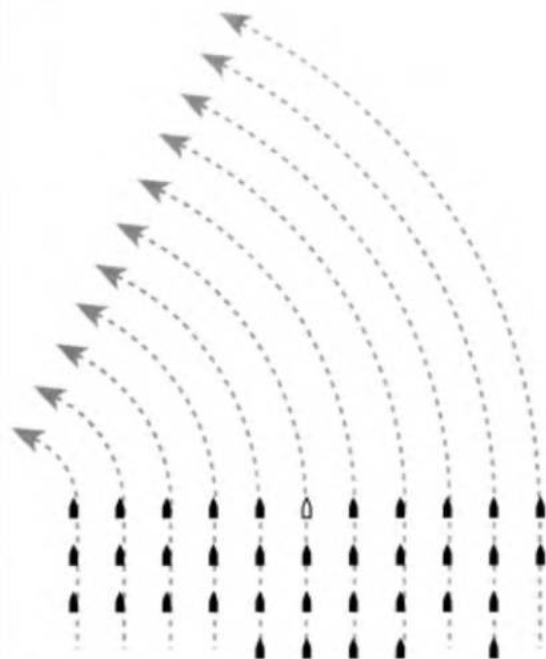
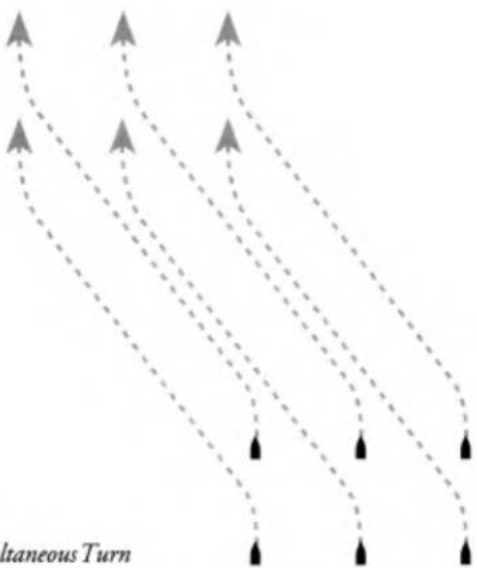
Stragglers, sneakers, and rompers will provide some of your easiest victims, since they are the ships most likely to be alone and unescorted.

A convoy plods across the Atlantic, 1942.

Convoy Maneuvers

The basic convoy maneuver is the turn, of which there are two types. The first is the columnar turn, used for maneuvers which can be scheduled well in advance, such as establishing a new navigational leg for the convoy. In a columnar turn the entire convoy will make a gigantic wheeling movement, with the inside ships slowing down and the outside ships speeding up. The convoy winds up in proper formation but with a new course.

The second type is the simultaneous turn. This maneuver requires that each ship simultaneously turn a certain number of degrees in a specified direction. After a designated time the ships return to their original course. The convoy will have the same base course as before the turn, but will be on a different track. The simultaneous turn is simpler and quicker than the columnar turn but runs a greater risk of scattering the convoy, particularly if the initial leg of the maneuver is

*Columnar Turn**Simultaneous Turn*

prolonged. Convoys often perform such a turn just after dusk, especially if U-boats are suspected in the vicinity. This can throw shadowers off the trail or ruin an approach calculation.

Convoys sometimes zigzag, making regular small course changes back and forth across their base course. When trying to track a convoy you will have to make several observations to discover its true course.

On rare occasions a convoy may be ordered to scatter. The ships will then disperse and proceed to their destinations individually. This tactic will be ordered only when the convoy fears attack from large German surface vessels and lacks an escort strong enough to handle them. Scattered convoys are easy targets for submarines.

Escort Organization

The escort for a convoy or a group of warships normally consists of four to eight ships. Escorts generally deploy in a rough screen around the ships they are guarding, concentrating on the front and flanks of the formation. This basic formation can be modified if special conditions make it advisable. For example, the commander of an escort will often reinforce the screen on the side of the convoy away from a light source, such as the moon or the aurora borealis. Reorganization may also occur if the escort commander suspects that U-boats are concentrating to one side of the formation or the other. The distance the escort vessels maintain from the convoy is also variable, depending on the time of day, the technological capability of the ships, and the number of escorts available.

Escorts spend much time sailing up and down the formation, zigzagging and conducting searches. Often it will appear that an escort vessel is heading directly toward your U-boat, perhaps preparing to attack. However, normal course changes and other position modifications will often put an escort on a collision course with

a U-boat when the escort does not even suspect the presence of a submarine.

The quality of the escorts will change as the war proceeds. During the early days, the escorts will not be well organized. You will often find it possible to slip in close to a target formation through gaps left in the perimeter of the guard. Attacks against submerged U-boats may seem perfunctory, since escorts frequently lack persistence in the hunt. The escorts will often consist of an ad-hoc group of vessels, unused to working together and relatively untrained in antisubmarine tactics. Later in the war, escort groups will be formalized. If they have trained together and established standard procedures, fewer gaps will appear in the convoy screen. Also, once the convoy escorts detect a submarine they will devote a great deal of time and energy trying to sink it. In addition, a new type of escort group will eventually appear. These formations are dedicated entirely to hunting and sinking submarines and do not have any direct responsibility for convoy protection. You can expect such support groups to spare no effort to destroy your boat. They are willing to take days and make hundreds of attacks to accomplish their goal. Sometimes these support groups contain an aircraft carrier as well as several antisubmarine vessels, adding a new dimension of danger.

The quality of different escort groups will also vary a great deal, especially in terms of their skill at detecting and attacking a target, their willingness to spend time in an attack, and the variety and professionalism of their individual tactics. Some groups are of mediocre quality and will seem somewhat unimaginative in their approach to their duties. Others are fully professional and can be expected to provide a significant challenge. A few escort and support groups are of the highest caliber and will demonstrate a degree of skill and coordination that will make them deadly opponents. If you are attacked by one of these elite escort groups you will be lucky to survive.

Escort Tactics

Individual Ship Tactics

When an escort vessel detects a U-boat, it will generally attack at once. If the submarine is on the surface, the escort's first priority is to force it to submerge by shelling it. A submerged U-boat is virtually blind and quite slow, so forcing it to dive temporarily frustrates its attack. The closer the escort gets before the submarine submerges, the better its odds of carrying out a successful attack. Many escorts will ram if they get the opportunity.



Courtesy National Archives

The basic technique for attacking a submerged submarine is to perform a series of runs over the suspected position of the underwater target, each accompanied by a salvo of depth charges. These attacks will be continued as long as contact can be maintained by the underwater detection apparatus. The odds of maintaining contact depend on the depth of the target, the speed of the escort, the state of the sea, and the quality of the escort crew. Crew quality will also influence the number of depth charges or other weapons that can be launched during each attack.

Making a successful attack against an underwater target is difficult, even when contact has been firmly

A frigate lays a tight pattern of depth charges.



Courtesy National Archives

A gun emplacement aboard a merchant vessel in the Atlantic, 1944.

established. For example, contact will almost always be lost during the last moments of a run because of the shape of the sound beam generated by the underwater detection apparatus. During this last phase of a depth charge run, the sub will usually be below the sweeping sound beam, so the sub's actual position at the moment that the depth charges are launched is a matter of guesswork. Here again, crew quality is a primary factor in the accuracy of such a guess. Also, the explosion of depth charges will make underwater sound detection impossible for a few moments, giving a submarine the opportunity to change location without fear of detection.

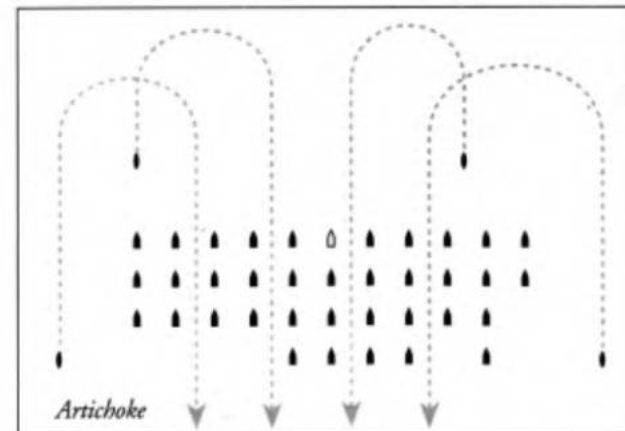
If underwater contact is lost, the attacking ship has a number of options. Inexperienced escorts may just leave and rejoin the convoy. More experienced U-boat hunters have several tricks for regaining contact. An escort can come to a full stop near the last known position of the submarine and listen passively, maintaining silence in hope that the submarine will assume that the escort has left the vicinity. If the sub then surfaces or attempts to travel underwater at higher speeds, the escort will be able to detect it and attack. A variation on this technique is for the escort to withdraw at moderate speed, then to charge quickly back to the U-boat's position, hoping that the sub thinks that the escort is no longer present. Impatient or inexperienced U-boat crews can often be caught by these maneuvers.

Escort Group Tactics

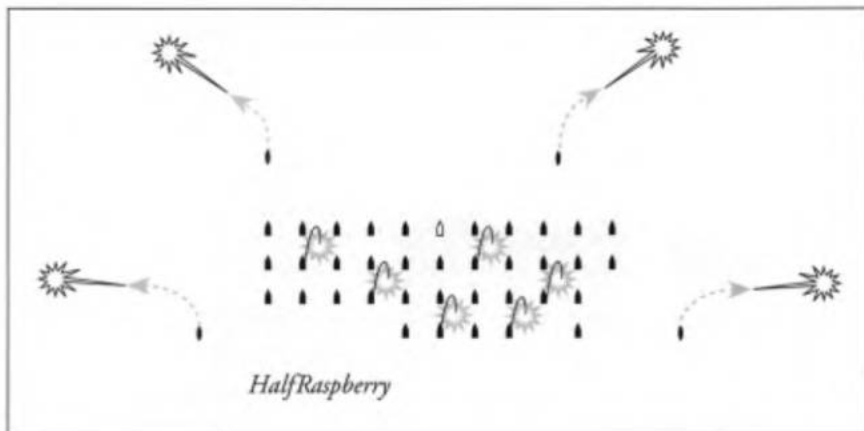
If an escort group can spare two or more ships to pursue a submarine contact, success is far more certain. Two or three escort vessels can scan a greater volume of water, increasing the possibility of detecting the submerged sub. A greater number of attacking vessels can also deliver a greater number of weapons on a target.

One successful detection technique requires the escorts to form a line and sweep the target area. The length of this line decreases the ease with which a sub can reach a position of safety outside the detection zone and increases the likelihood that the sub will be broadside to one of the sweeping escorts. (A broadside sub creates a much larger sonar target than one end-on to the attacker, and is much easier to detect.) Multiple escorts in an attack also serve to eliminate some of the problems associated with loss of contact during the last moments of an attack run. If two or three ships are conducting the operation, one can make the attack run while the others maintain sound contact with the target. This way the U-boat's last-second maneuvers to escape can be detected and the attacking ship warned of changes in the target position.

Several tactics involve the entire escort force of a convoy. The two most spectacular are called the "Artichoke" and the "Half-Raspberry." The Artichoke is used



GAME PLAY



when a merchant ship in the convoy has been torpedoed during daylight hours by an undetected, submerged submarine. The rearmost escort vessel will go directly to the stricken ship to rescue survivors. The others race to the front of the convoy and form a rough line ahead of the merchant ships. They then turn together and sweep through and alongside the convoy conducting an underwater search. If no contact is made, the escorts will stop their search a few thousand yards behind the convoy and race back to their original positions and resume normal operations. This technique can be quite effective at locating a submerged submarine inside or near the convoy perimeter.

The Half Raspberry, unlike the Artichoke, is used in case of a nighttime torpedo attack. On signal from the escort commander, the merchant ships will fire "Snowflake" flares to illuminate the interior of the convoy. At the same time, each escort will turn away from the convoy and fire star shells to light up the perimeter. Any surfaced submarine in or near the convoy should be illuminated and spotted. This tactic is designed to be used as soon as possible after the confirmation of a torpedo attack. Calling for it too late or by mistake serves only to put a giant spotlight on the convoy.



Courtesy United States Naval Institute, Horst Bredow

Tutorial

The following "Tutorial" section introduces *Aces of the Deep* through a step-by-step orientation tour as you set up and initiate a convoy attack. This is a good way to learn U-boat command procedures. (Actually, you can learn by playing any mission type, but use the easier Encounter Options and Realism settings until you know your way around.)

For a menu-by-menu description of each mission selection function, see the "Ashore" section beginning on page 132. U-boat controls are described in "At Sea," starting on page 151.

- First, install *Aces of the Deep* (AOD) as described on page 8.
- After AOD is installed, go to the directory in which you installed AOD, type **aod** and press [ENTER] to start the game. (To skip the title sequence, press [SPACE].) After the title sequence, you will see the Main Menu.
- To start the tutorial, select SINGLE MISSION, and then HISTORIC MISSION.



Mission Setup

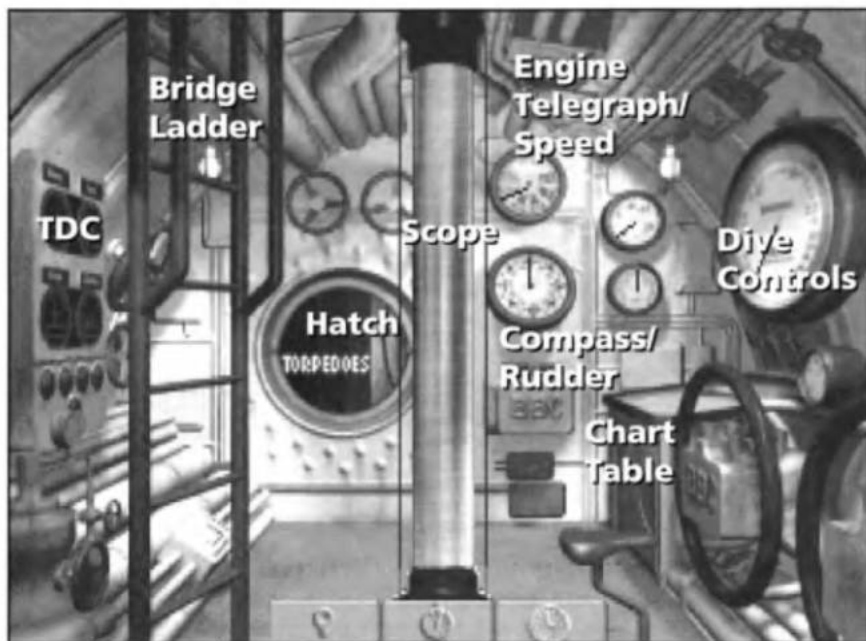
In the Historic Mission screen, click on the first mission, TUTORIAL, to highlight it and read its descriptive text. As with the Historical and Career missions, the TUTORIAL mission conditions (number of ships, aircraft, weather, etc.) are pre-defined. It is dusk, March 1, 1941, and you are commanding a Type VIIC U-boat. The Allies have yet to deploy effective radar or anti-submarine tactics, so you may conduct a night surface attack. Your boat is operating alone, and the sea is calm. (In the Convoy and Warship Encounters, you may define these and other mission conditions variables yourself.)



To adjust the realism settings, click on the REALISM button. The more options you select (X), the more realistic and difficult the mission becomes. For now, use the default settings—press DONE to return to the Historic Mission screen.



With the TUTORIAL mission highlighted, click the SELECT button. You will then see the Mission Briefing screen, which recaps your mission selection. To continue, click ACCEPT. After a few seconds, you will see the Control Room of your U-boat.

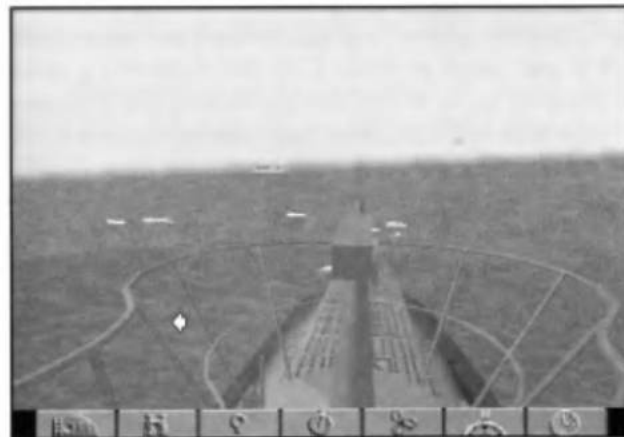


Control Room

For a quick tour, move your mouse cursor through the Control Room from the left. (You can control the entire mission with the mouse, and many controls also have key commands.) You'll see labels appear as you point to the TDC (Torpedo Data Computer), the Bridge ladder, and the hatch leading to the Torpedo Room, Radio, Damage Report and Captain's Log. In the middle is the Scope, and to the right of that are the Engine Telegraph/Speed controls (top) and Compass/Rudder controls (bottom). The large Dive Controls are on the right bulkhead. Just below (on Type VII boats) is the Chart table. The command buttons along the bottom provide other controls: the Voice Tube (to give crew commands), Stopwatch (for timing torpedo runs) and the Clock (for time compression). Different buttons appear in other screens.

Bridge

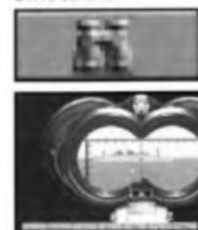
By now, you should have received a contact report from your Watch officer. Click on the ladder to go to the Bridge and investigate. From the Bridge, click the mouse to scan the horizon for ships: click near the middle of the screen (small cursor) to scan slowly, and click near the edge (big cursor) to scan quickly. If you see ships, click on the Binoculars button, and scan with the binoculars to locate the ships again—you'll see their relative compass bearing below the eyepiece. Click on the Engine button at the bottom—the engine room telegraph—and click AHEAD FULL. Then click on the Compass button and drag the compass indicator to the target bearing. Your boat will begin to head directly for the target. Right-click to close the Compass and Telegraph display. Click the far-left "ladder" button to return to the Bridge view.



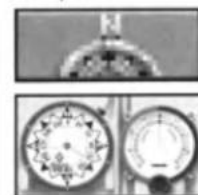
Clock

From the Bridge, click on the Clock button. The clock shows the time (in 24-hour notation) and lets you speed time up while getting into position, and slow it down again when ready to attack. Click the right-hand scroll bar arrows or press the [+] key until the display shows 32X or so. (Each click greatly increases the speed: be careful with time compression, or you may zip right past the convoy.) Press [ENTER] to return to 1X time.

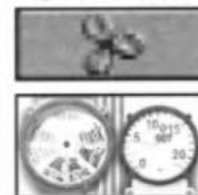
Binoculars



Compass

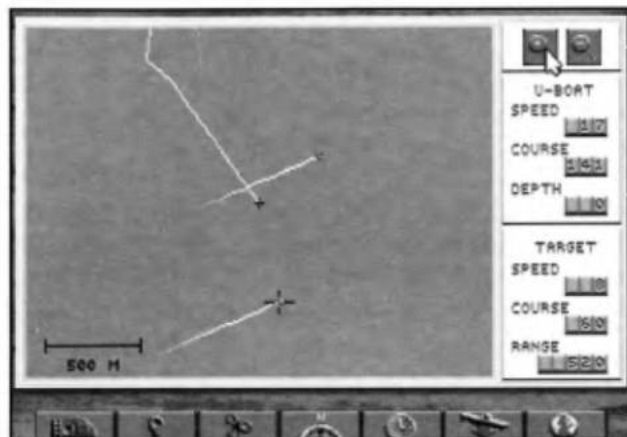


Engine (Propeller)



Clock





Tactical Chart

To see a “map” view of the convoy as you approach, press [F5] to open the tactical chart. This display helps you see the convoy’s zigzags and true course, range, and can also show where the largest targets and escort ships are if you zoom in close. Click the magnifying glass buttons to zoom in and out. By clicking the Compass button here, you can adjust your intercept course more accurately. Now click the Globe button on the far right. This gives you the strategic chart you’ll use to navigate to and from base in Career missions. For now, click the Globe button again to return to the tactical chart.

Magnifying Glass buttons



Compass



Globe



Setting Up the Attack

While stalking the convoy, you can switch directly between the Chart [F5] and the Binoculars [F3] to monitor target course and range. You want to pull even with or ahead of the convoy at a safe distance (5,000 meters or so), and then angle in from the side to firing range (under 1,000 meters). Remember, the Binoculars bearing display is relative—a reading of 90 degrees means you are looking 90 degrees starboard of the bow, regardless of your boat’s compass heading. When you start getting close, click on the Clock button to slow down time again to 1X (normal). Keep an eye on the escort—if you see an escort suddenly head for you, your surprise attack is blown. At any time, you can press [CTRL]+[P] to Pause the game if you need a moment to decide your next move.

Aiming with the TDC

When your U-boat is to the side of the convoy, go to the bridge Binoculars view [F3]. Locate a ship in the vertical crosshair and press [SPACEBAR]. This selects the target, distinguishing it with a red crosshair and entering its data into the TDC. Click the Torpedo button to see this TDC data, which includes target bearing (relative to your boat’s heading), speed, range, and actual compass heading (if within range). The crosshairs grow brighter the longer the target is selected, showing the increasing accuracy of the firing data. To see your Watch Officer’s estimate of the selected target vessel’s type and gross tonnage, press [I].

Before firing, you want the U-boat pointed within 20 degrees of the target for best accuracy. (To turn toward a selected target you’re currently viewing, press [H]—this turns your heading to the current view. To change the view to the current heading, press [V].) You want to be between 300-1,000 meters from the target, and perpendicular to it—check your firing angle using the chart.

Clock



Torpedo



Fire

When the firing conditions are acceptable, click the red fire buttons I and II on the TDC. You can switch to the chart to see the torpedoes' course, and switch back to the binoculars in time to watch them hit (if your aim was true) or watch them hit using "Victim View" [F10]. Two torpedo hits will sink all but the largest ships.



Evade

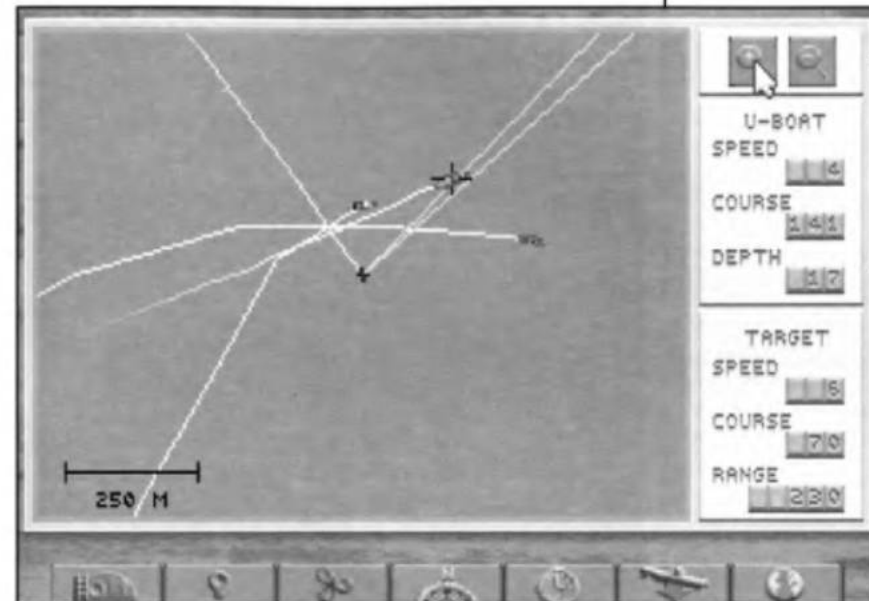
Once your first "eel" hits, the escorts will be alerted and will try to attack you quickly. In many night attacks early in the war, you can evade slower escorts on the surface by using your speed and the chart to outmaneuver them. You may be able to line up and sink other targets while the escorts pound the wrong area to a froth. If the escorts are cornering or overtaking you, you should dive before their deck guns hit your boat and prevent you from diving (track them in the TDC to check range).

Diving

If forced to dive, return to the control room [F1]. Click the Voice Tube button, select CHIEF ENGINEER, and order CRASH DIVE. You may also click the Dive Controls and drag the depth indicator to the desired depth. Below 150 meters, depth charges will have little chance of hitting you (this changes later in the war). Once you reach your depth, go to your Engine ("propeller" button) and reduce speed to Ahead 1/3—this will reduce your engine noise so the escort hydrophones cannot detect you as readily, but gives you enough headway to turn.

Go to the chart. You should see the escort charging to the point where it saw you last. If you make it safely below, the escort will start "pinging" with ASDIC (sonar) pulses as it tries to box you in with its search patterns. Keep turning your boat end-on to these pulses to reduce

your echo. You can also use the noise of the merchant ships to cover your sounds. Using depth and the chart, and constantly angling away from the escort, you should be able to slip away fairly soon. You may then surface and make another approach on the convoy, or retire from the engagement.



Ending the Mission

Any Single Mission where you sink a ship and get away is a good one. The mission will continue as long as you maintain contact with the enemy—if you lose contact with the enemy ships or sink them all, the mission ends. (Naturally, the enemy can end your mission by sinking or capturing you.)

In Career mode, you end missions (war patrols) by navigating back to a friendly base and radioing for an escort into the harbor.

You can also end missions in progress by selecting ABORT MISSION from the Simulation Options menu ([CTRL]+[O]), or by pressing [CTRL]+[D]. If you abort the mission while engaged in combat, however, your mission score will be zero.

Voice Tube



Engine (Propeller)



Ashore

Main Menu Overview

This section introduces the AOD mission setup options, starting with the main menu. Each subscreen is described in detail on the following pages. For a guided tour of the U-boat, try the preceding "Tutorial" section. For a U-boat control reference, see "At Sea" starting on page 151.



Single Mission

Launch one U-boat combat mission at a time, selecting all aspects of the mission conditions and setup. Single missions get you into specific convoy, warship, or historic actions quickly, and are scored independently. (See page 134 for more.)

Career Menu

Undertake an entire career as a German U-boat commander, starting with assignment to your first command. Your career will be composed of patrols, each a series of actions that correspond to the actual circumstances, technology, and events in the Battle of the



Courtesy National Archives

Wolfgang Lüth, second highest scoring U-boat ace, and his new bride.

Atlantic. Career scores are cumulative, accounting for performance on all missions. (See page 143 for more.)

Hall Of Fame

Review your highest-scoring single missions and careers. You may also view profiles of the most famous historic U-boat aces. (See page 149 for more.)

Vehicle Preview

View the ships and planes you will encounter on patrol, and learn to recognize them from any direction or distance. The more familiar you are with appearance and capabilities of the enemy units, the better your chances of surviving your encounters with them. (See page 150 for more.)

Exit To DOS

Leave *Aces of the Deep* and return to DOS.

Single Mission

The options on this menu let you undertake one combat mission at a time, and give you control of each mission's setup. If you select **CONVOY ENCOUNTER** or **WARSHIP ENCOUNTER**, you may select the number of ships, time of day, weather, as well as the difficulty and realism levels you will encounter. In a **HISTORIC MISSION** (including the **TUTORIAL**), the mission options are predetermined, but you may still adjust the realism settings.



To begin the selected mission using the current Encounter Options (page 136) and Realism (page 139) settings, click **SELECT**. This takes you to the mission briefing, which will describe your objectives for this mission. You may **CANCEL** from the Mission Briefing and return to your mission menu. If you **ACCEPT** the mission, you will go to sea in your U-boat.

Single missions begin with your boat near the enemy, and end when you lose contact with the enemy or are killed or captured. When your mission ends, you will see the Patrol Summary screen, which shows the number of ships you sank, their cumulative gross tonnage, and your mission score based on your achievements, mission difficulty, and realism factor. Unlike Career missions, you cannot save a Single Mission in progress.

Note: If you abort a mission ([CTRL]+[D]) while engaged in combat, your mission score will be zero.

Mission Types

This section describe the types of missions you will encounter in AOD Single Missions or Careers.

Historic Mission

The screen lets you experience an actual historical U-boat action from the Battle of the Atlantic. The mission conditions and forces will be those of the actual battle, but now you will be commanding the U-boat. Also included is the Tutorial mission, which guides you step by step through an example convoy action. (The "Tutorial" section starts on page 124.)



The menu at the upper left lists the available missions. Click on the mission name to highlight it and see its corresponding description below. To see other missions on the list, click on the scroll bar arrows.

Convoy Encounter

On this mission type, you will intercept a convoy and attempt an attack.

Warship Encounter

On this mission type, you will intercept and attempt to attack a group of Allied warships. Warships are much faster than convoys—often faster than your U-boat—and are always heavily guarded and risky to attack.

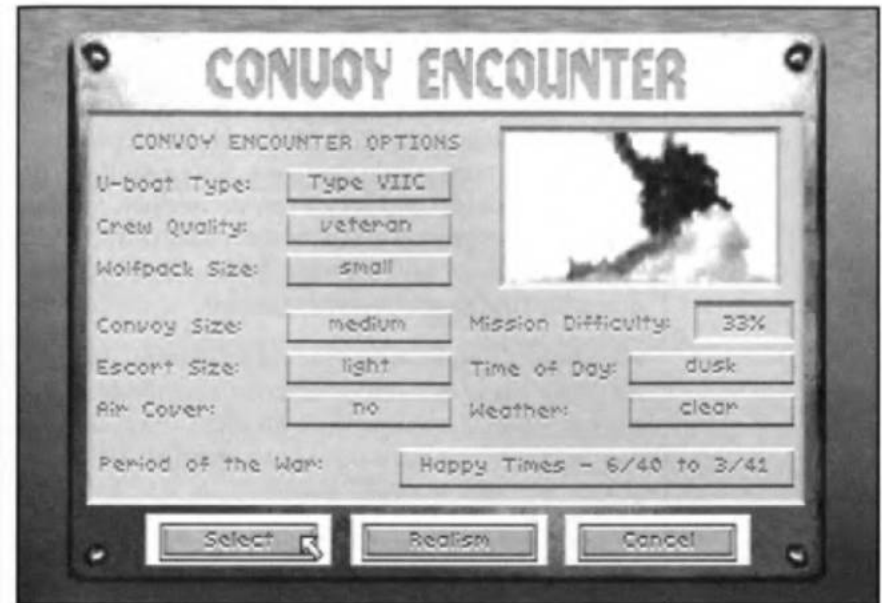
Encounter Options

When you select a Single Mission Convoy or Warship Encounter, you may change the encounter options that, together with the Realism Settings you select, will affect the difficulty and scoring potential of your mission. The same options are available in both Encounter types, except WARSHIP TYPE replaces CONVOY SIZE in the Warship Encounter screen.

To change a default encounter option, first click that option button to open its menu. Double-click the option you want, or highlight the option and then click the SELECT button. Long option menus have scroll bars: click the arrows to see other options. The CANCEL button takes you back to the previous menu without changing the setting.

U-boat Type. Choose which type of U-boat you will command for this encounter. Selecting a Type II U-boat will increase the difficulty of this encounter, since these smaller U-boats were not as fast as the larger Type VII and Type IX boats, and carried fewer torpedoes. See the “U-boats” section (page 78) for details on each type and variant.

Crew Quality. Choose the quality of the crew of your U-boat. Crews may be GREEN, VETERAN, or ELITE. Skilled crews are able to crash dive more quickly, reload



torpedoes more rapidly, etc. The more highly skilled your crew, the less difficult your mission will be.

Wolfpack Size. Select the size of the U-boat pack attacking the enemy ships: NONE, SMALL (2-3), MEDIUM (4-6), or LARGE (6 or more). The more U-boats there are to gather at the convoy, the less likely it is that the escorts will be able to concentrate on you.

Convoy Size. (Convoy Encounter only). Choose the size of the convoy you wish to attack: SMALL (5-15), MEDIUM (20-35), or LARGE (40-60). Larger convoys decrease the mission difficulty since they provide more targets and their escort perimeter is easier to penetrate.

Warship Type. (Warship Encounter only). Select what kind of warship group to attack: a CRUISER, BATTLESHIP, or CARRIER group. This option defines the main target in the warship group, the one you should try to sink. All warship attacks are difficult. There is no greater glory for a U-boat skipper than to sink one of the enemy's price-less capital ships. However, warship tonnage is not

Note: You must radio in convoy contacts to gather a wolfpack.

added to your tonnage list, since your primary mission is to sink merchant shipping.

Escort Size. Select the number of warships escorting the target: NONE, LIGHT (2-3), MEDIUM (4-6), or HEAVY (7+) escorts. The more escorts there are, the easier it will be for them to detect and attack you successfully. Increasing the escorts greatly increases the mission difficulty: it is very difficult for even the most skilled skipper to evade a coordinated attack by several escorts.

Air Cover. Choose whether or not your target will have air cover: YES or NO. Anti-submarine aircraft will make operations much more difficult for your U-boat, subjecting you to the constant threat of sudden attack.

Mission Difficulty. This displays the relative difficulty of the mission encounter options you have currently selected, indicated as a percentage. The tonnage you sink on a given mission is weighed against the Mission Difficulty, Realism Factor, and other variables to determine your mission score.

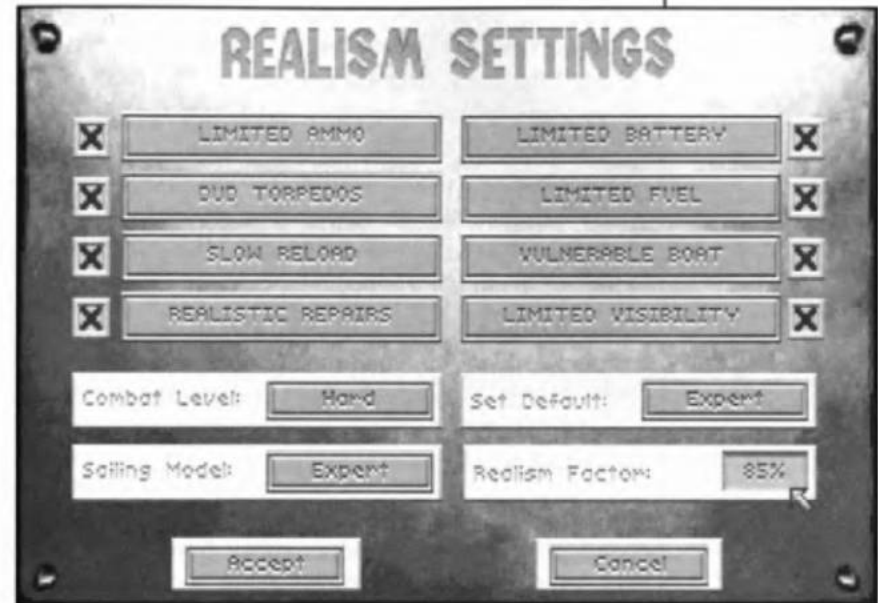
Time of Day. Select what time of day the mission simulation begins: DAWN, DAY, DUSK, or NIGHT. Early in the war, U-boats conducting night attacks on the surface are almost invisible. Later, radar makes night approaches much more difficult.

Weather. Select the weather conditions for the mission scenario. You may choose from CLEAR, OVERCAST, CLOUDY, or STORMY. Inclement weather reduces visibility, which usually favors the U-boat (but also conceals approaching aircraft).

Period of the War. Choose the time period in which the encounter will take place. Different periods will present different advantages and challenges to the player (see the "Historic Overview" for details). In general, the later in the war, the more difficult the mission will be. Note: You may select Encounter Options that do not correspond historically to the selected period (i.e., selecting a Type VII C in 1939, before they were available).

Realism Settings ACES of the DEEP

This screen lets you determine how realistic and difficult your mission conditions will be, and is available for both Single Mission and Career play.



You may set the default realism level at NOVICE, INTERMEDIATE, or EXPERT to match your level of experience. You may also turn the specific realism settings on or off, and set general difficulty settings for COMBAT and SAILING independently. Once you have defined your Realism settings, press ACCEPT to continue with your mission setup using those settings, or press CANCEL to return with no change in the default settings.

You may switch the following eight specific realism settings on ("X") or off (blank) by clicking on them. Each box selected increases the Realism Factor of your mission, and thus also increases your potential score in proportion to its relative difficulty. Once you begin a mission or war patrol, you cannot change the realism settings until your return.

Limited Ammo—If selected, this setting limits your submarine to the actual number of torpedoes your U-boat type could carry historically: 14 for a Type VIIC, for example. Running out of torpedoes effectively ends your offensive mission, and indicates a good time to return to base. Turning this setting off gives you an unlimited number of torpedoes.

Dud Torpedoes—If selected, this setting subjects you to an historically accurate percentage of “dud” torpedoes: some of your torpedoes will go too deep, explode early, or fail to explode even if they hit a target. The percentage of duds on a given mission depends on the period of the war in which the mission takes place. Turning this selection off means your torpedoes always work if you aim and fire them correctly.

Slow Reload—If selected, this setting imposes realistic torpedo reload times on your crew. If you switch it off, you can reload torpedoes much more rapidly than was actually possible. On either setting, better crews reload the tubes faster.

Realistic Repairs—If selected, this setting makes damage repairs at sea much more realistic. Some repairs may put you out of action for days—others may force you to surface, or return to base in Career missions. If you switch this option off, you will be able to repair any damage to your U-boat relatively quickly.

Limited Battery—If selected, this setting models the U-boat’s consumption of battery power realistically. (If you run out of battery power when submerged, you may sink!) If you switch this option off, you will not run out of battery power.

Limited Fuel—If selected, this setting models the U-boat’s consumption of diesel fuel realistically. You will have to monitor fuel carefully, or you might run out in mid-ocean. If you switch this option off, your sub will not run out of diesel fuel.

Vulnerable Boat—If selected, this setting makes your U-boat vulnerable to damage from enemy weapons.



Courtesy National Archives

Depth charge exploding behind an American escort vessel.

If this option is not selected, your boat cannot be damaged by enemy depth charges, torpedoes, hedgehogs, or guns.

Limited Visibility—If selected, this setting limits your [F5] tactical chart to show only those ships currently visible from the bridge as indicated by the red ring. At more difficult combat settings, the chart will not show ships beyond the visible horizon, and won’t show any ships if you submerge below periscope depth. If you switch this option off, all vessels in your area will be visible on the tactical display.

Combat Level—This setting determines your general advantage, if any, in offensive and defensive action. For example, it affects visibility, the accuracy of your torpedo targeting computer and of your deck gun and AA fire, as well as the damage caused by your weapons’ hits.

It also determines how easy you are to spot on radar, how much damage your boat suffers from an enemy hit, and how much information is displayed on your tactical chart (including ASDIC pings and torpedo tracks). On the **EASY** setting, your boat is relatively hard to hit, while you can hit and sink enemies rather easily. On **MEDIUM** or **HARD**, your advantage is reduced. On **EXPERT**, you have no advantage.

Sailing Model—This setting determines the realism of your U-boat's maneuverability, a critical factor in avoiding enemy attacks. Specifically, it affects how long it takes your boat to crash dive, change depth by a given number of meters, or complete a turn at a given speed. The **NOVICE** setting makes your boat much more maneuverable than historical boats, while **EXPERT** models maneuvering rates realistically.

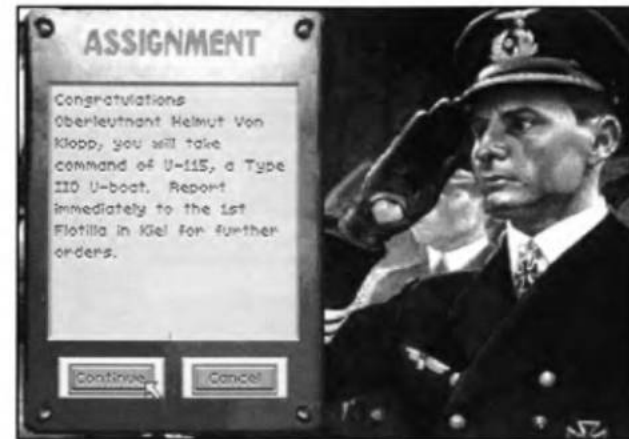
Set Default—This setting lets you define all your Realism Defaults with a single selection. The options are **NOVICE**, **INTERMEDIATE**, and **ADVANCED**. You may still modify the individual default settings as you wish.

Realism Factor—This setting displays the realism level (and scoring potential) of the realism settings you have currently selected. This level is expressed as a percentage, with 100% as a maximum. Your mission score is determined as follows: tonnage (or warship sinkings) are combined with your selected realism factors and mission difficulty (Encounter Options). At 100%, your achievements at sea can be scored at their highest potential value. You will see your score in the Patrol Summary screen that appears at the end of each mission.

Career Options

ACES of the DEEP

Select **CAREER** to begin or resume a career as a U-boat commander in the German Navy, the *Kriegsmarine*.



Careers begin with your assignment to your first command. Your career will then be composed of war patrols. Each patrol is a mission that corresponds to the actual circumstances, technology, and events of that period in the Battle of the Atlantic. You will sail from historical bases and navigate the hazardous course to your patrol area. Following radio orders from BdU (U-boat Headquarters) or engaging targets of opportunity, you may encounter enemy convoys or warship groups and then return to base.

Between patrols, you may relax on well-deserved shore leave. You may also be assigned to a new base or U-boat, be decorated for your victories, or be promoted. If you succeed and survive, your weapons will become better, and your crew more proficient—as will those of the enemy. You may become a legendary skipper, competing for medals and glory and the top ranking in the Hall of Fame. You may end up in an a prison camp. Or you and your crew may end up in a dark iron tomb on the cold floor of the Atlantic. Your luck and skill as a commander will decide.

Select a Career

This screen lets you create a new career (captain), load an existing career to continue, or see details of existing careers. Initially, the career roster will be empty. You may save multiple careers for each captain you create, but you can have no more than 20 saved careers at a time.



Load. To load an existing career to continue, click on the career to highlight it, and then click **LOAD**. A Career labeled "At Sea" will resume the war patrol at sea from the point it was saved. A Career labeled "In Port" is between patrols, and will resume from the Career menu (page 145).

New. To create a new career, click the **NEW** button on the Select a Career screen to open the New Career screen. Type your captain's name in the Your Name box exactly as you want it to appear. Then click on the **STARTING PERIOD** button to select when your career will begin. You may then select the personal emblem that

will decorate your U-boat conning tower: click the arrows next to the emblem window until the emblem you want is displayed.

When your selections are complete, click **SELECT** to go to the Assignment screen. Here you will be given the number and type of your new U-boat and assigned a base of operations for your first patrol. You may **CANCEL** to return to the Select a Career screen, or **CONTINUE** to go to the Career Menu (see below).

Detail. Click this button to see details on the progress of the current career. Click **DONE** to exit.

Cancel. Click this button to return to the Main Menu

Career Menu

Once you start a career, or resume one saved "in port," you will play from this menu.



War Patrol

This option sends you first to a mission briefing. Here you may review the mission objectives for this patrol and adjust your Realism settings. When ready to ship out, click **ACCEPT** to leave port and go to sea on your next War Patrol.



War Patrols differ from Single Missions in that you must make the journey to your patrol area (using the Strategic Chart to navigate) before engaging in assigned missions. To end a patrol (after you run out of torpedoes or targets, or run low on fuel), you must return to the escort perimeter of your base (green circle on strategic chart) and request an escort to finish the mission. You can also end missions in progress by selecting **ABORT MISSION** from the Simulation Options menu ([CTRL]+ [O]), or by pressing [CTRL]+[D]. If you abort the mission, however, your mission score will be zero.

Tonnage Leaders

This screen will give you a list of the top U-boat skippers up to the current month. This lets you compare your performance against that of the historic aces.

COMMANDER	TONNAGE
Lemp	23206
Schuhart	19405
Liebs. W.	16698
Schultze, Herbert	14777
Heintcke	14018
Rellmann, W.	13891
Hübner	8706
Prien	8270
Helmut von Klöpp	0

With enough sinkings, your current captain's name may some day top this list.

Nightclub

This is your chance to relax between patrols with your fellow U-boat captains in the company of the lovely Elise, sweetheart of the U-boats.

Here you may pick up interesting gossip, rumors, and current war news from your comrades. Click **NEXT** to hear the next bit of "news," and click **DONE** when you've heard enough. Be careful, though...you cannot believe everything you hear in a bar.

View Career

Select this option to see the war record of the current captain. The screen displays totals for patrols, tonnage, sinkings, and score, as well as a list of sinking by date, and any decorations awarded to the captain. You can also access this screen with the Details button in Select a Career.

Hall of Fame

Use this screen's options, available from the Main Menu only, to compare your current performance with your earlier missions or with the greatest submarine commanders of the Battle of the Atlantic.

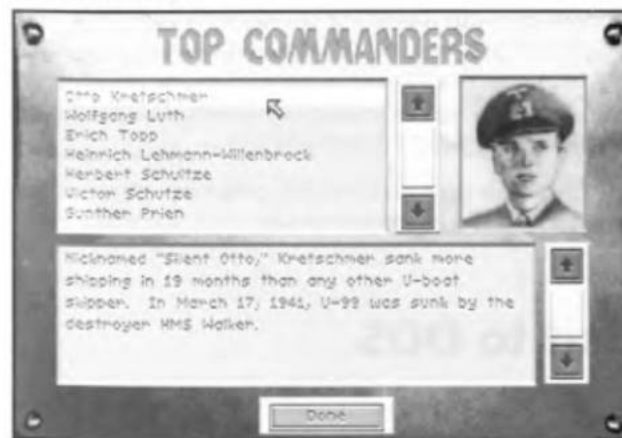
The primary mission of the U-boat forces is to sever the ocean supply routes to England. Accordingly, your performance is scored by factoring the cargo tonnage or warships you sink with the overall mission and realism difficulty.

Top Missions—This screen shows you a list of your highest-scoring single missions, ranking them by tonnage, ships sunk, and score. Click the **DETAIL** button to see a more detailed list of ships sunk; click **DONE** to exit.

Top Careers—This screen lists your highest final career scores by name, tonnage, ships sunk, and score. For more information about the career, click the **DETAIL** button; click **DONE** to exit. Careers are eligible for the top career list when you finish the war, are killed, captured, or you retire.

Historic Aces—This screen profiles the most successful historic U-boat aces. You may click on an ace's name to see his picture and a brief description of his war record.

Return to Main—Exit the Hall of Fame and return to the Main Menu.



June 1942. Captain Erich Topp is back safe from another war patrol. He wears his brand new Knight's Cross around his neck.



Courtesy United States Naval Institute

Save Game

Select this option to save the current career when you are "in port" between patrols. If you already have 20 careers saved, you will need to replace a previous career to make room. You may also save your career at sea during a mission (if you are not in combat with the enemy) using the **SAVE GAME** option on the [CTRL]+[O] pop-up menu. Using this option, you just click on a blank slot or existing career to replace it with the current career. Enter a description for the saved game and press [ENTER].

Return to Main

Exits the Career Menu and returns you to the Main Menu.

Vehicle Preview

This screen displays views, descriptions, and statistics for the ships, aircraft, and submarines featured in the simulation.



Click on the arrow buttons on the right or left to rotate the vehicle horizontally; click on the up and down arrow buttons to rotate the vehicle view vertically. Click on the "+" or "-" buttons to zoom the view in or out.

Click the STATISTICS/DESCRIPTION button to learn about the vehicle's history and capabilities.

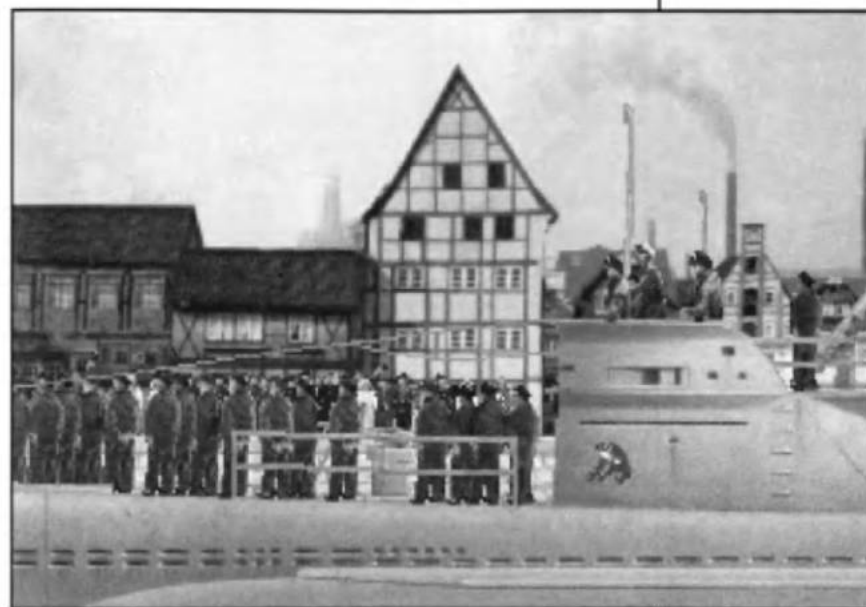
Click NEXT or PREVIOUS to see other vehicles, or click DONE to return to the Main Menu.

Exit to DOS

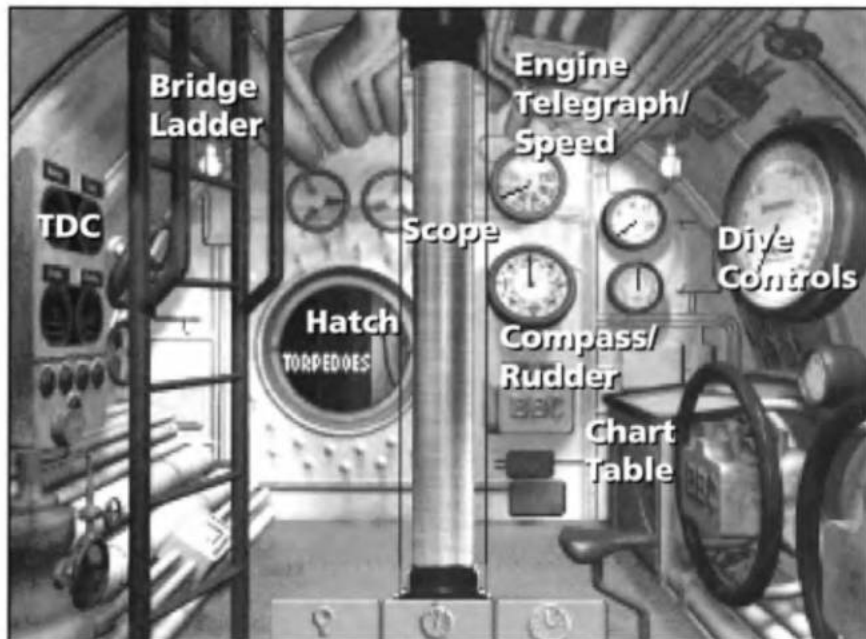
This Main Menu option lets you leave *Aces of the Deep* and return to DOS.

At Sea

Once you have chosen to undertake either a Single Mission or a career War Patrol you will receive a Mission Briefing summarizing your initial orders. After you click ACCEPT to end the Briefing, your boat puts to sea.



At sea, you can move to the different areas of the boat (see Command Screens) and give commands with the mouse. Many commands have keyboard equivalents as well. Command screens also have a row of command buttons across the bottom that provide related functions. See "Buttons" (page 169) for command button functions.



Voice Tube Stopwatch Clock

Command Screens

Control Room

The Control Room is the command center of your U-boat, and the place where you begin each mission at sea. You can access it throughout the boat by pressing [F1] or by clicking the Control Room command button found in most other screens. The Control Room provides point-and-click access to most of the command screens and controls you use to maneuver your boat and conduct attacks. As you point to each area of the Control Room, you will see the name of the corresponding screen or control appear: Torpedo Data Computer (detailed on page 175), the ladder leading to the Bridge (page 155), and the hatch leading to the Torpedo Room (page 165), Radio Room (page 163), Damage Report

(page 168) and Captain's Log (page 162) screens. Dividing the Control Room is the Periscope. Just to the right of the periscope are the Engine Telegraph/Speed (page 172) and Compass/Rudder controls (page 170). On the right bulkhead are the Dive Controls (page 171), used to submerge or surface the boat. On Type II and Type VII boats, the Chart table (page 157) is below the Dive Controls; on Type IXs, the Chart table is on the left, behind the ladder.

The Control Room has the following command buttons: Voice Tube, Stopwatch, and Clock. Different buttons appear in other screens: all are described in the "Buttons" section (page 169).

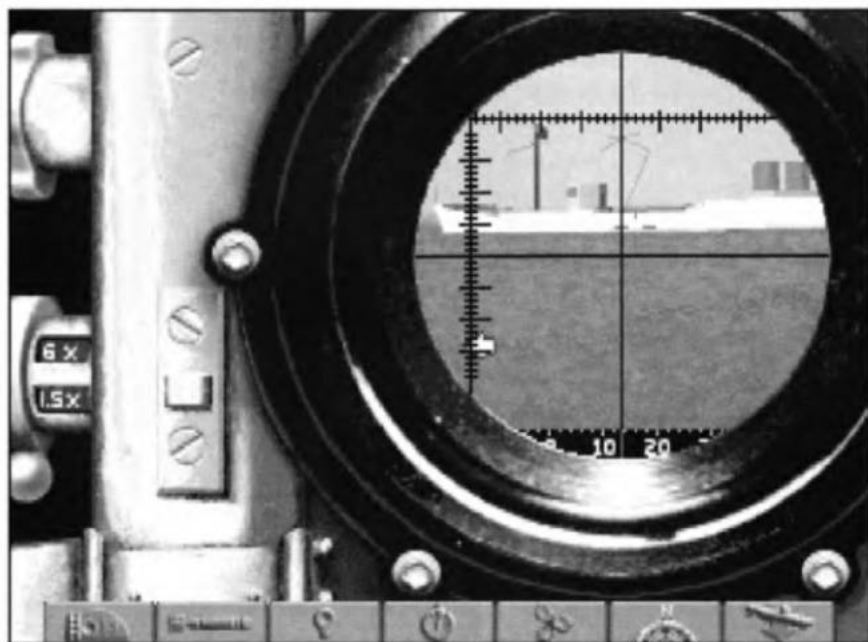
Periscope

You can access the Periscope from the Control Room by clicking the periscope column, or by pressing [F2] when the boat is at periscope depth or surfaced. It allows you to scout the horizon or conduct attacks while submerged. Keep in mind, however, that the periscope can be spotted by lookouts or radar, especially if the water is smooth or the moon is behind you, and that your visibility and speed are greatly reduced at periscope depth. Also, you are vulnerable to ramming or air attack at periscope depth. Take quick peeks to update your target contacts, and lower the scope as you move into position.

To scan the horizon with the periscope, click the arrow cursor right or left near the middle of the screen (small cursor) to scan slowly, and click near the edge (big cursor) to scan quickly (or use the [,<] [>.] keys). The periscope has two magnification settings: click on the knob at the far left of the eyepiece to change the setting between 1.5X and 6X, or press [Z] for Zoom.

You can select a ship you see in the periscope to input its targeting data (bearing, speed, range, and heading) into the Torpedo Data Computer, or TDC. To select a target, center the periscope on the target and

Note: To go to periscope depth, press [P].



Control Room TDC Voice Tube Stopwatch Engine Compass Dive Controls

Note: From the tactical chart, you may order your watch officer to raise/lower the periscope with [ALT]+[P].

press [SPACEBAR]. This selects the current target (indicated by a red cross) and sends its data to the Torpedo Data Computer. (When surfaced, you may also select targets using the Binoculars or by clicking on them in the Tactical Chart.) To "padlock" the selected target (keep it centered in the periscope), press [ALT]+[F2]. To break the lock, select another view.

The bearing indicator at the bottom of the eyepiece displays the bearing of the current view relative to the bow of your boat (*not* your compass heading).

The Periscope screen also uses the following command buttons: Control Room, TDC, Voice Tube, Stopwatch, Engine, Compass, and Dive Controls. See "Buttons" (page 169) for details. Related quick keys: Periscope Depth [P]; Crash Dive [C]; Set Heading to View [H]; Set View to Heading [V]; Identify Target [I]; Surface [S]; Zoom View [Z].

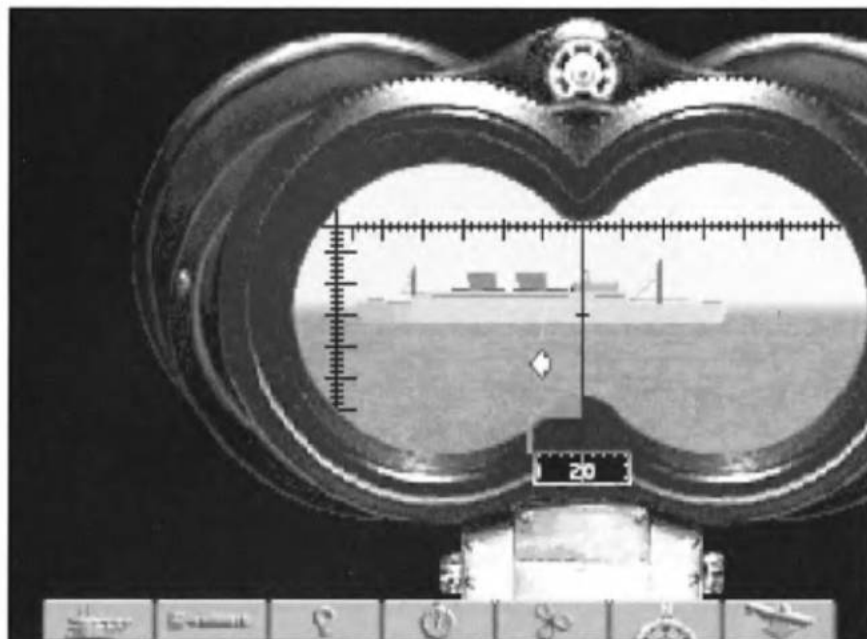


Control Room Binoculars Voice Tube Stopwatch Engine Compass Clock

Bridge

When your boat is surfaced, you can access the Bridge from the Binoculars or the Bridge ladder, or by pressing the [F4] key. It provides a panoramic view of the surrounding ocean from the conning tower, and allows the best vantage point for spotting aircraft. Facing forward, you will see the smoothly pointed bow; facing astern, you will see the railing around your anti-aircraft gun platform.

As with the periscope, click the arrow cursor to scan the horizon right or left: click near the middle of the screen (small cursor) to scan slowly, and click near the edge (big cursor) to scan quickly (or use the [,<] [,>] keys). The Bridge uses the following command buttons: Control Room, Binoculars, Voice Tube, Stopwatch, Engine, Compass, and Clock. See "Buttons" (page 169) for details. Related quick keys: Crash Dive [C]; Set Heading to View [H]; Set View to Heading [V]; Identify Target [I]; Man/Unman AA Guns [A]; Man/Unman Deck Gun [D].



Bridge TDC Voice Tube Stopwatch Engine Compass Dive Controls

Binoculars

Accessed via the Bridge or the [F3] key when your boat is surfaced, the Binoculars provide a magnified (7X) view of the horizon, and, like the Periscope, function as a target bearing transmitter for torpedo attacks. As you do with the Bridge and Periscope view, click near the middle of the eyepiece (small cursor) to scan the horizon slowly, and click near the edge (big cursor) to scan quickly (or use the [<] [>] keys). You cannot change the Binoculars magnification level.

Below the eyepiece is a gauge showing the relative bearing of the current view. For example, a reading of 90 degrees means you are looking 90 degrees (due starboard) of the bow, regardless of your boat's compass heading.

To select a target ship in the Binoculars, move the center vertical crosshair over the target and press [SPACEBAR]. This selects the current target (indicated by a red cross) and sends its data to the Torpedo Data

Computer (TDC). To "padlock" the selected target (keep it centered in the binoculars), press [ALT]+[F2]. To break the lock, select another view. The longer a target is selected, the more accurate the TDC data will be (crosshairs brighten).

The Binoculars screen uses the following command buttons: Bridge, TDC, Voice Tube, Stopwatch, Engine, Compass, and Dive Controls. See "Buttons" (page 169) for details.

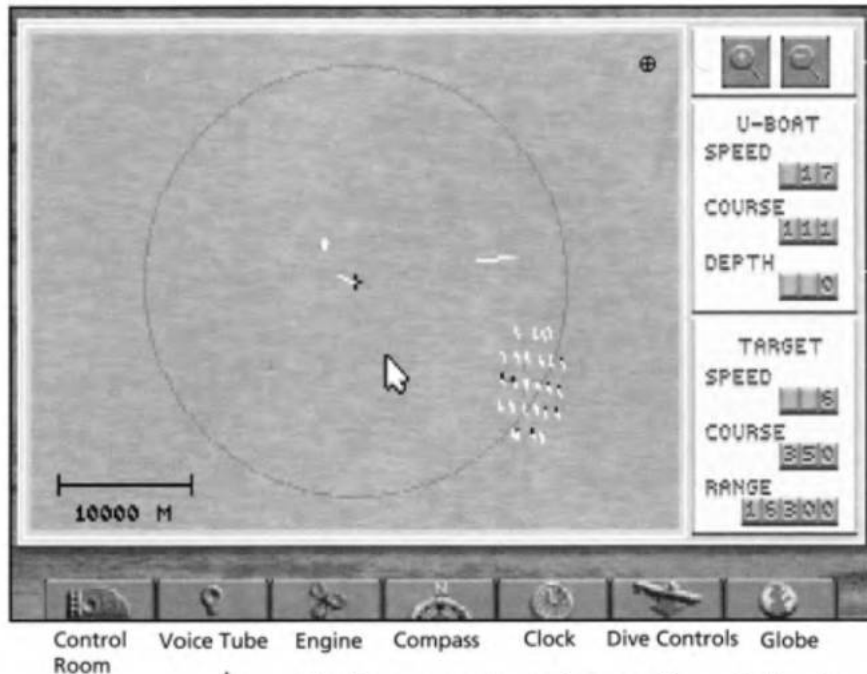
Related quick keys: Crash Dive [C], Set Heading to View [H]; Set View to Heading [V]; Identify Target [I]; Man/Unman AA Guns [A]; Man/Unman Deck Gun [D].

Charts

Accessed from the Control Room or [F5], your Tactical Chart displays a "map view" of the nearby tactical situation, while the larger scale Strategic Chart helps you navigate long distances. To switch between the Tactical Chart and Strategic Chart, click on the Globe button (far right) or press [F5]. The other Chart command buttons are Control Room, Voice Tube, Engine, Compass, Clock, and Dive Controls. See "Buttons" (page 169) for details. Related quick keys: Up/down periscope [ALT]+[P]; Identify Target [I]. (Must be at periscope depth; watch officer performs both.)

Tactical Chart

The tactical chart displays the vessels, ocean, and land in your immediate area. It is always centered on your U-boat and oriented to compass North. Your boat is marked with a black cross, and surrounded by a red circle showing your approximate range of visibility. (If the Limited Visibility realism setting is disabled, you can see all ships in the chart range, regardless of the weather, time of day, or whether you are submerged or not.) If you dive, your dive point is marked with a red square.



Note: your U-boat must be stopped or moving slowly to use the hydrophone.

The charts are animated to provide tactical updates in real time. The tactical chart automatically plots and displays all visible ships, and displays their wakes to highlight course changes. It also displays hydrophone contacts from your sound room as lines along the contact bearing: bright red for high-speed screws (escorts), and gray for low-speed screws (merchant ships), and white for convoys. Similarly, when an enemy is using ASDIC or SONAR to find your boat, you will see the directional "pings" of its underwater search pattern as it tries to locate you (except in Expert Combat mode). You can pick up hydrophone contacts far beyond visual range.

Zoom. Click on the Magnifying Glass buttons to zoom the chart scale in "+" and out "-." The tactical chart has several display scales from 50 meters to 20,000. For larger-scale views, use the Strategic chart (Globe button).

Scale. The scale bar (lower left) displays the chart scale at a given zoom level. For example, at 100 M, the bar represents a distance of 100 meters.

U-boat. These indicators display your U-boat's current SPEED (in knots), COURSE (compass heading), and DEPTH (in meters).

Target. These indicators display the current estimated SPEED, COURSE, and RANGE (in meters) of the selected target vessel. Estimate accuracy varies with crew experience, your selected Combat level, and how long the target is selected. To select a target ship from the tactical chart, click on it. (You can also select the ship from the Periscope or Binoculars.) The selected ship will be marked with a red cross, and its estimated target data will be input to all ready torpedoes.

Periscope. If you have selected Limited Visibility, your target data will "fade" when you submerge unless you regularly check the periscope or surface to keep the contact current. To have your watch officer raise or lower the periscope from the chart and update the contacts, press [ALT]+[P]—you will see a periscope icon on the upper right of the chart as long as the scope is up. Press [ALT]+[P] again to lower it.

Note: Don't leave the periscope up, or it will be spotted.

Strategic Chart

The Strategic chart shows you events on an oceanwide scale, and allows you to plot a course to join up or avoid them.

Coordinates. The chart will display the latitude, longitude, and *Kriegsmarine* patrol quadrant coordinates of your current mouse cursor position whenever you click on the chart. Use this feature to fix your position and plot courses.

Zoom. As in the tactical chart, click on the Magnifying Glass buttons to zoom the chart scale in "+" and out "-."

Scroll buttons. To center the chart on your sub, click on the U-boat button. To scroll the chart North, South, East, or West, click on the corresponding arrow buttons

Control
RoomVoice
Tube

Engine

Compass

Clock

Dive
Controls

Globe

surrounding the U-boat. The inner arrows scroll slowly, and the outer arrows scroll quickly.

Set Course. These buttons allow you to plot courses all around the North Atlantic. You draw a course as a series of legs, or line segments, with the **PLOT** function.

PLOT. To set a course, first change the Zoom level to where you can see your destination. Click the **PLOT** button. Now when you move the mouse cursor, you will see a line stretching between the cursor and your boat's current location. At lower left, the chart will now display the cursor's location in longitude, latitude, and *Kriegsmarine* patrol quadrant, and the **PLOT** button will now read **ENTER**.

Ideally, you can plot a straight line course to your destination. (Prevailing winds and currents are not factors.) However, you will usually have to plot the course in segments (legs) to avoid enemy coastlines, aircover, or formations. As you move the cursor to the next navigation waypoint, a valid course is shown with a light gray line. (If the line crosses land, it turns red.) Click at the

waypoint, and the line turns dark gray to set the course for that leg. Continue setting waypoints until you have plotted the course to your destination. To lock in the course, right-click the final waypoint or click on the **ENTER** button.

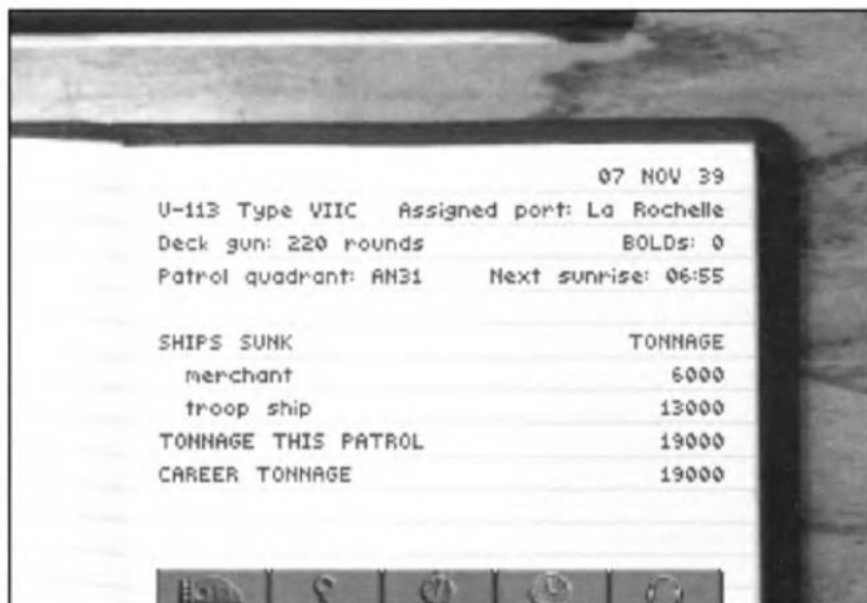
Your boat will now undertake that course until you interrupt with new orders or reach your destination. You can use the **Clock** to compress time on your journey: it returns you to normal time if your lookouts spot a target or threat. Note: Your navigator will inform you of arrival at your destination, but your boat continues on its last heading and speed until you give new orders.

RESUME. If your U-boat's course is interrupted (you spot a target or are jumped by aircraft, for example), you may return to your course afterward by clicking on the "Resume" button.

CLEAR. To erase a set course, click on the **CLEAR** button.

Strategic Chart Symbols

- Your U-boat is a red square. Click the U-boat button to center the map on your sub.
- Other U-boats appear as light yellow squares.
- Enemy convoys and warships appear as black or gray squares. Black squares indicate current, reliable contacts. At easy Combat levels, contact courses are displayed as white lines. At more difficult Combat levels, the course plots disappear, and the black contacts soon fade to gray (become less reliable) if not updated by new intercepts or shadowing reports.
- Enemy air bases appear as blue squares. Each base is surrounded by a blue circle indicating the reported scope of its air patrols. (As escort carriers become more common later in the war, you can expect air attack anywhere.)
- Friendly bases appear as green squares within a green circle. If your U-boat is within one of the green circles, you may radio for a friendly vessel to escort you into the base. This is how you end a War Patrol in the Career mode.

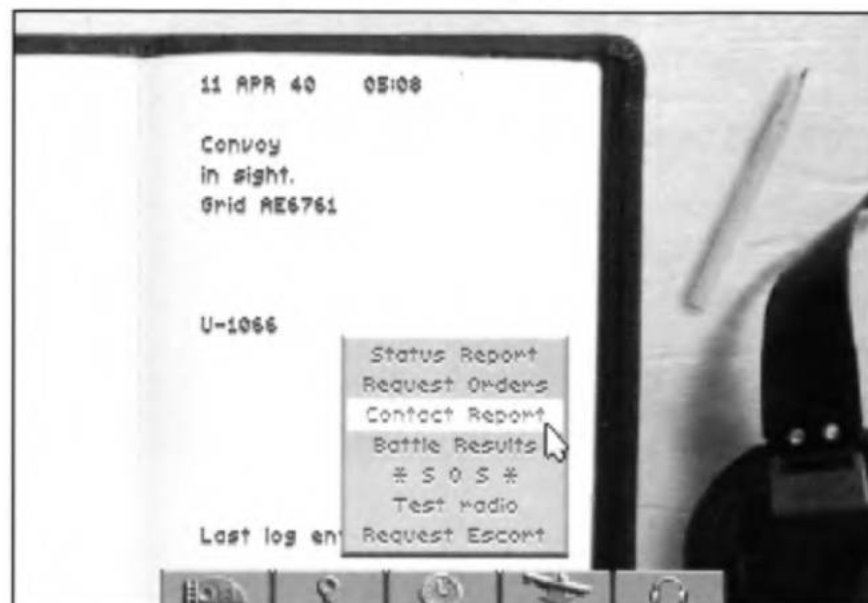


Control Room Voice Tube Stopwatch Clock Radio

Captain's Log

The Captain's Log (accessed from the Control Room hatch or by pressing [F9]) displays the name of your captain (in Career mode), the current date, the number and type of the current U-boat, and its home port. It also shows the number of deck gun rounds and BOLD canisters remaining, and the current patrol quadrant (location), along with the times for the next sunrise or sunset. Below that, the log records a complete list of ships sunk, with the type and tonnage of each vessel sunk for this single mission or for your career (in Career mode).

In Career mode, your log may be many pages long. Click on the left-hand page to page back through the Log, or the right-hand page to page forward. The Captain's Log uses the following command buttons: Control Room, Voice Tube, Stopwatch, Clock, and Radio. See "Buttons" (page 169) for details.



Control Room Voice Tube Clock Dive Controls Radio

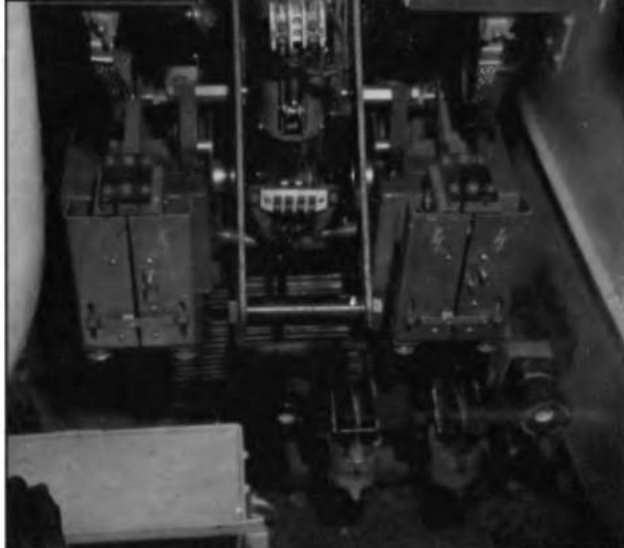
Radio Room

Accessed from the Control Room hatch or by pressing [F8], the Radio Room lets you send, receive, and log various messages from U-boat Headquarters (BdU) and other U-boats by clicking on the Radio button. (You cannot use your radio below periscope depth.) It may take a while for a response—your radio mate will alert you when a message is received. Note: Later in the war, any radio use may be detected by Allied HF/DF. Other Radio Room command buttons are the Control Room, Voice Tube, Clock, and Dive Controls. See "Buttons" (page 169) for details.

Orders and information are tracked in the Radio Log for the duration of your patrol. On long patrols, your radio log may be many pages long. Click on the left-hand page to page back through the Log, or the right-hand page to page forward.

Note: All reports include current date, time, U-boat number, and patrol quadrant (grid).

Hydrophone gear
in the sound room
of U-505.



Courtesy National Archives

Message Options:

Status Report—Inform BdU of fuel status, torpedoes remaining, and location. (See Torpedo room for complete torpedo inventory.)

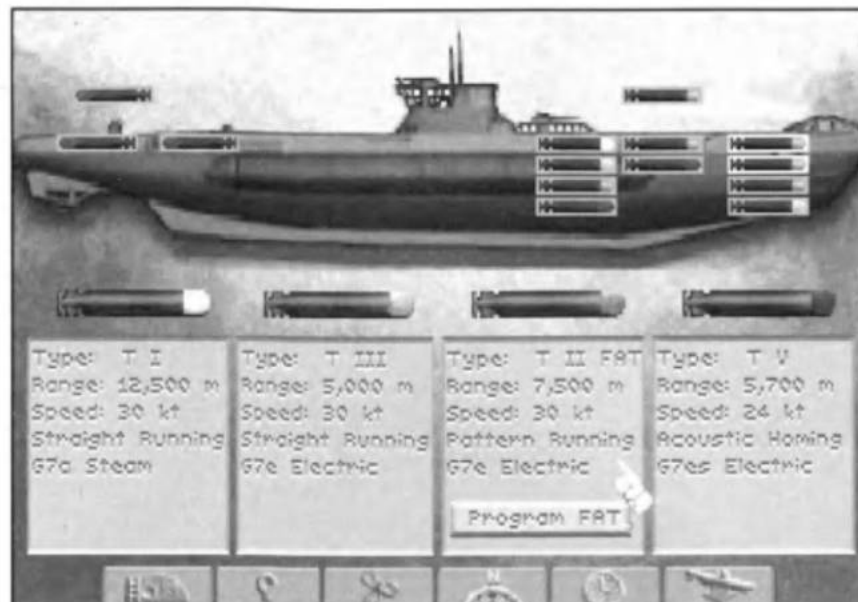
Request Orders—Request new or additional orders from BdU on a arrival at a designated area.

Contact Report—Report or update an enemy ship sighting. This will help BdU and other U-boats coordinate a wolf pack attack on the contact.

Battle Results—Reports type, number, and estimated tonnage of any sinkings to date on this patrol. Sinkings you report are added to your record, even if you do not survive the patrol. See “Captain’s Log” (page 162) for Career sinkings.

SOS—Broadcasts “Attacked! Sinking!” Sending an SOS is your only chance of being assisted or rescued by friendly forces.

Request Escort—Asks for an escort ship or minesweeper to guide you into a friendly base. You must be within the range of a friendly base’s escorts (green circle on strategic map). This is how you end a War Patrol in Career mode.

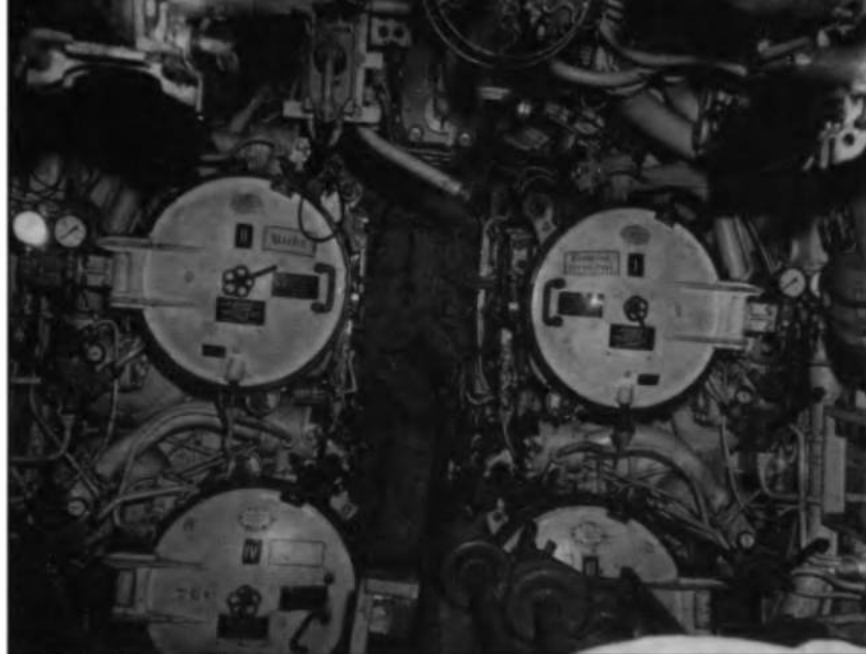


Control Room Voice Tube Engine Compass Clock Dive Controls

Torpedoes

Accessed from the Control Room hatch or by pressing [F6], the Torpedoes screen helps you manage torpedo moving and reloading. (You will use the TDC—Torpedo Data Computer—to fire torpedoes.) The Torpedoes screen uses the following command buttons: Control Room, Voice Tube, Engine, Compass, Clock, and Dive Controls. See “Buttons” (page 169) for details.

The U-boat diagram displays your current torpedo location and status. Depending on your boat type, you may have torpedoes located in bow and stern torpedo firing tubes, interior storage slots (inboard of the torpedo tubes) and external storage slots (shown above deck). Torpedoes that are ready to move or fire are shown with a green background. If a torpedo is being moved to or from a tube, both the tube and storage slot will have a yellow background until the transfer is complete. To see how much longer the transfer will take, point to the firing tube (“Status” cursor) and click, and the mate will tell you the time remaining. (You may



Courtesy National Archives

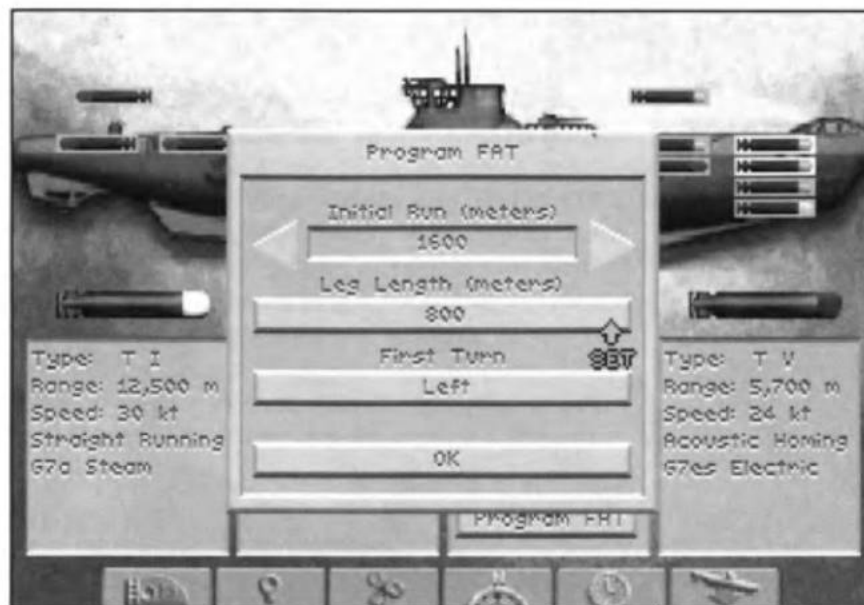
The forward torpedo tube interior doors on a Type IX U-boat.

not cancel a transfer in progress.) A damaged tube is shown in red, and is unusable until repaired.

You may make torpedo loading automatic by enabling the Autoreload function (see "Simulation Options," page 180). If you prefer to manage torpedoes yourself, turn Autoreload *OFF* and use the following procedures.

To load a torpedo from storage to an available firing tube (empty, green) click on a stored torpedo (green background) to select it, then click on the empty tube. Both "slots" will turn yellow to indicate the transfer is underway, and the torpedo mate will tell you how much time loading will take.

You may move externally stored torpedoes inboard at either end. Be aware that your deck hatches must remain open throughout the transfer, and you will not be able to dive for up to two hours. Also, you may not transfer internally stored torpedoes to the other end of the boat.



The available torpedo types increase during the course of the war. You may have up to four types: each will be described below the sub diagram. See "U-boat Weapons" for details.

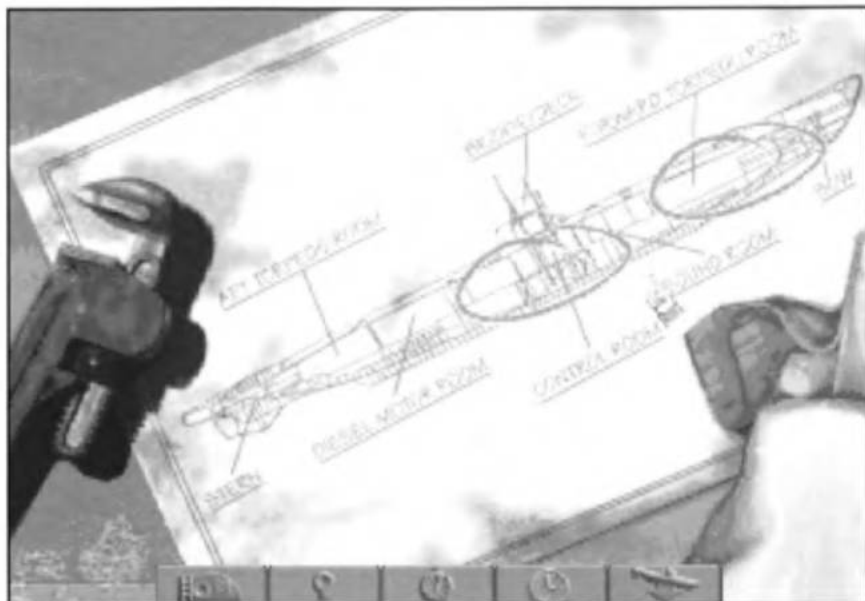
Program FAT—If you are carrying FAT torpedoes, you can click this button to view or change the default running pattern of all your FATs. (FATs became available later in the war.) If a FAT misses on its initial run, it will run a large zigzag to the left or right until it hits something or depletes its batteries.

Initial Run (Meters)— This is the distance the FAT will run straight before starting a zigzag pattern. This entry should be the distance to your initial target or greater.

Leg Length (Meters)— This defines the width of the zigzag pattern: either 800 or 1,600 meters.

First Turn— After its initial run, the FAT turns to the left or right to start the zigzag. Make this turn into the main body of the convoy to maximize odds of a hit.

Note: Once you fire a FAT, dive or steer clear of its pattern—it doesn't care what it hits.

Control
RoomVoice
Tube

Stopwatch

Clock

Dive
Controls

Damage Report

Accessed from the Control Room hatch or by pressing [F7], the Damage Report screen shows you a blueprint of your boat, with any damaged areas circled in red. To see a list of the damaged equipment in a circled area, click on the area. You can then click on the listed item(s) to see a report of the damage severity, estimated repair time, status, and notes relevant to operations. You may continue to monitor repairs as they are being completed. Not all items could be repaired at sea—at higher levels of realism, you may have to return to base before some items can be fixed. The Damage Report screen provides the following command buttons: Control Room, Voice Tube, Stopwatch, Clock, and Dive Controls. See “Buttons” (page 169) for details.

Buttons

This section describes (in alphabetical order) the gray command buttons that appear throughout the simulation to provide access to controls, menus, or other screens or areas of the boat: Binoculars, Bridge, Clock, Compass, Control Room, Dive Controls, Engine, Globe, Headphones, Stopwatch, TDC, and Voice Tube. Most of these buttons appear in several screens. Click the button to access the associated control or areas. When done with the control, you may right-click or press [Esc] to close the display, or leave it open—the next screen or control you open will replace it.

Binoculars [F3]

On the Bridge, click this button to bring up the Binoculars and the surface targeting sight. See the “Binoculars” command screen section for details on using the Binoculars and tracking surface targets. Related quick keys: Crash Dive [C], Set Heading to View [H]; Set View to Heading [V]; Identify Target [I]; Man/Unman AA Guns [A]; Man/Unman Deck Gun [D].



Bridge [F4]

In the Binoculars screen, click this button to go to the Bridge view. See the “Bridge” Command Screen section for details on Bridge operations. Related quick keys: Crash Dive [C], Set Heading to View [H]; Set View to Heading [V]; Identify Target [I]; Man/Unman AA Guns [A]; Man/Unman Deck Gun [D].



Clock

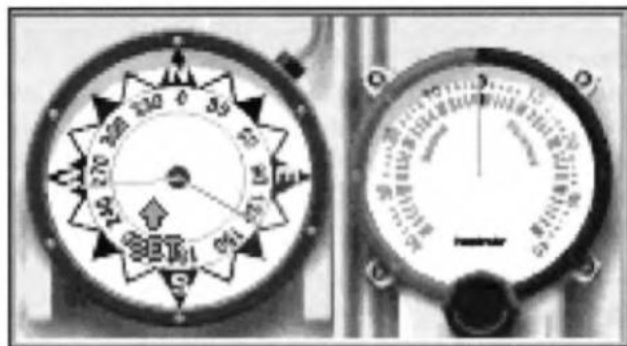
Click this button to see the local time in military notation (0-12 for am, 13-24 for pm) and to check or set the current level of time compression. Related quick keys: [+] to increase or [-] to decrease time compression, [ENTER] to set to 1:1.



To set/change time compression, click on the clock's scroll bar arrows—compression may be set from 1 to 4096 by powers of two. Time compression is automatically halted if your crew spots a new enemy target or threat. Higher levels of time compression may not always be available due to the combat situation or your PC's computing capacity.

Compass

Click this button to access the interlinked Compass and Rudder controls. You may also access these controls directly from the Control Room (middle right). Related quick keys: Right Rudder (right cursor or keypad [6]); Left Rudder (left cursor or keypad [4]); Center Rudder [5].



The Compass shows your current course as a red line, and your ordered course (if different) as a blue line. To change course, click on the Compass "rose" in the desired direction, and a blue line will appear to mark the new heading. The boat will then come around to the chosen compass heading automatically. (Note: the boat must be underway to change course.) In contrast, the Rudder lets you manually set the boat's rudder from 1-40 degrees port (left/red) or starboard (right/green). The vertical red line shows a straight rudder: click on the desired number of degrees rudder left or right, or press [4] or [6] on the numeric keypad. Once the rudder is set, it keeps turning the boat until you recenter the rudder. To recenter the rudder, click on the rudder's red center

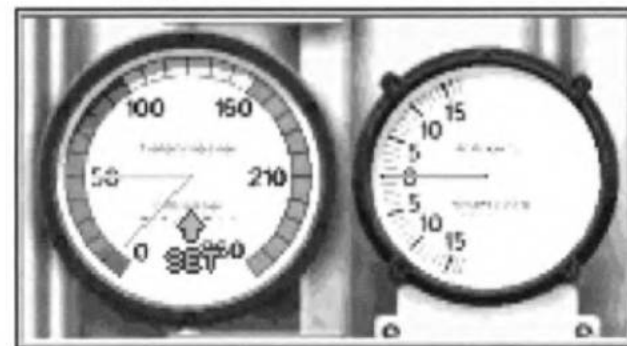
line, click on the Compass, or press the center key [5] on your numeric keypad.

Control Room [F1]

Click this button to go to straight to the Control Room. The various screens and controls you can access from the Control room are described in their specific sections.

Dive Controls

Click this button to access the interlinked Depth Gauge and Dive Plane (Inclinometer) controls and change the boat's depth. These controls are directly available on the right bulkhead of the Control Room. Related quick keys: Crash Dive [C]; Periscope Depth [P]; Surface [S]; and Dive Planes Up [8], Down [2], Level [5].



Depth Gauge. The Depth Gauge shows the current depth of the boat as a red line, and the ordered depth (if different) as a blue line. To move the boat to a specific depth, click on that depth: a blue line will appear there, and the boat will make its best climb or descent to the indicated level. Safe depths are shown in the green part of the gauge, and you may descend to depths in the yellow range if your pumps or hatches are not seriously damaged. Your boat is not rated for depths marked in red—if you descend into the red, you risk discovering your particular U-boat's crush depth first-hand. Note: you may make the boat descend or ascend without



forward motion, as long as you have sufficient compressed air and working pumps. To ascend immediately to the surface, Blow Tanks (from Voice Tube—Chief Engineer).

Akin to the rudder, the Inclinator shows the up or down angle of the dive planes (hydroplanes), the small horizontal “wings” on the boat that allow it to use engine thrust to dive or climb through the water when submerged. To set the dive planes manually, press the Up arrow [8] or Down arrow [2] keys on your numeric keypad, and press [5] to level off. In a crash dive, the Engineer puts the engine at flank speed and sets the dive planes to drive the boat deep quickly. A crash dive continues to 150 meters, unless you select another depth. If you order crash dive from below 150 meters, the dive continues (past crush depth!) unless you select a specific depth to level off.

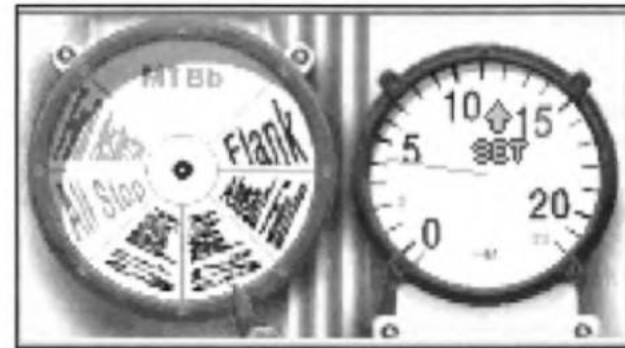
Note: The speed with which your boat can change depth depends on your boat’s speed, your crew quality, and your Sailing Model settings. It takes a long time to surface from a great depth, even if you blow your ballast tanks. If you have an emergency, such as a severe leak, or chlorine gas contamination from cracked battery casings, you may not have time to reach the surface. Also, outside pressure may prevent your pumps from ejecting water from the boat, and the bilges will begin to fill—the only remedy is to come up to a depth that allows the pumps to work.



Engine

Click this “propeller” button to access the interlinked Engine Room Telegraph and Speed Gauge controls. You may also access these controls directly from the Control Room (upper right). Related quick keys: Battery Gauge [B]; Fuel Level [F], Engine Setting [1]...[6].

Together, these controls set your U-boat’s speed. Click on the Telegraph or press number keys [1] through [6] to order your diesel engines or electric motors to a



given direction and power level setting: Full Astern, All Stop, Ahead 1/3, Ahead 2/3, Ahead Full, or Flank (emergency). Alternatively, click on the Speed Gauge to set a specific speed in knots, and the Telegraph will shift to the appropriate settings. The boat’s actual speed depends on if you are surfaced, submerged, or damaged. It also depends on your Sailing Level realism selection.

Note: By default, the boat runs on diesel engines when surfaced and electric motors when submerged. Low speeds conserve fuel. When your boat is submerged, higher engine settings are more easily detected by enemy hydrophones. Flank speed on the electrics will deplete the batteries in about one hour. If you lose power, you will be unable to run your pumps, and will have no power to drive the boat to the surface.

Globe

In the Charts screens, click this button or press [F5] to switch between the Tactical Chart and the Strategic Chart. See the “Chart” section, page 157, for details on using the charts.





Radio Headphones

Click this button to choose the type of radio message to send. Where appropriate, the response to your message will appear in the radio log.

Radio Message Options:

(Note: All reports include current date, time, U-boat number, and location.)

Status Report—Inform BdU of fuel status, torpedoes remaining, and location. (See Torpedo room for complete torpedo information.)

Request Orders—Request new or additional orders from BdU on a arrival at a designated area.

Contact Report—Report or update an enemy ship sighting. This will help BdU and other U-boats coordinate a wolf pack attack on the contact.

Patrol Results—Reports type, number, and estimated tonnage of any sinkings to date on this patrol. Sinkings you report are added to your score even if you are sunk later in the mission. See Captain's Log for Career sinkings.

SOS—Broadcasts "Attacked! Sinking!" Sending an SOS is your only chance of being assisted or rescued by friendly forces.

Request Escort—Asks for an escort ship or minesweeper to guide you into a friendly base. You must be within the range of a friendly base's escorts (green circle on strategic map). This is how you end a War Patrol in Career mode.

Stopwatch [W]

Click this button or press [W] to see estimated run time and status for all fired torpedoes.

Whenever torpedoes are launched, your crew will mark the status of each on the stop watch as follows: Black mark=torpedo has over one minute to go; Blue mark=torpedo should hit when the sweep second hand reaches the mark; Red mark=past due to hit—a probable miss or dud. At higher realism levels, this may be your only indication that a torpedo has missed the target.

Torpedo Data Computer (TDC) [T]

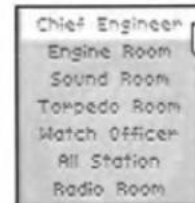
Click this button to access the Torpedo Data Computer, or TDC. This panel is also directly available on the left bulkhead of the Control Room, but you will normally operate it from the Binoculars or Periscope.

The TDC gives you information about your selected target, calculates the proper torpedo firing angle or "solution," and allows you to fire "spreads" of torpedoes. It continually updates target information on the selected ship for all torpedoes. (To select a target, you must center it in the Binoculars or Periscope and press Spacebar, or click on it in the Tactical Chart.) Note: TDC data is supplied by your lookouts—its accuracy depends on your crew's experience, and how long you have been tracking this particular target.

Bearing—Indicates in degrees the direction to the selected target relative to your boat. 0 or 360 degrees is straight ahead, 90 degrees is off the starboard beam, 180 is due astern, etc.. Although advanced torpedoes can follow course changes of up to 135 degrees, your firing tube(s) should be aimed within 20 degrees of the selected target to give the eel's gyroscopes the best chance of guiding it accurately the rest of the way.



Note: Your targeting crosshairs will brighten as the data becomes more accurate.



Speed—Indicates the estimated speed of your target in knots. Fast, agile targets such as warships can be difficult to hit with anything less than a perfect firing solution.

Range—The estimated range to the selected target in meters. Torpedoes must run at least 250 meters before their detonators are armed. Beyond that, distance increases the difficulty of the shot.

Heading—The estimated current heading of your selected target. Expect convoys to change course frequently. Plan your firing solution so the torpedoes hit the target at as close to a right angle as possible, and avoid head-on or tail shots if you can.

Fire Buttons—The numbered button lights at the bottom of the TDC show the status of your corresponding torpedo tubes. Ready tubes are bright red. Tubes that are empty or being loaded are dark red. To fire a ready torpedo using the current TDC data, click the corresponding tube's button.

The number of torpedo tubes depends on your U-boat type: the top row shows forward tubes, and the bottom row shows stern tubes (if any). A Type II boat has three forward tubes only; a Type VII has four forward tubes and a fifth stern tube; a Type IX has four forward tubes and two stern tubes.

Offset—Torpedoes fired together will normally follow the same track to the target, differing only by the movement of your boat between launches. While you always want to fire your first eel straight, you may also fire subsequent torpedoes in a "spread," each with a slightly different course, to ensure a hit. To define a spread, use the Offset "dial" just above the Fire Buttons. Zero represents center, the TDC bearing: click the arrows on the dial sides to offset this bearing by X degrees for the next torpedo.

Voice Tube

Click this button, available in all command screens, to give or delegate orders to crew members in other sections of the boat. You'll first select the crew member/area, and then the specific order, from the menus that open. To cancel a voice command, right-click or press [Esc]. Options that don't apply to your particular boat or mission will be grayed-out (not available). Related quick keys are shown next to the appropriate commands. Note: To see the last voice message to you, press [BACKSPACE].

Chief Engineer

Periscope Depth—Submerge (or rise) to periscope depth. Quick Key = [P]

Crash Dive—Dive as rapidly as possible: flood tanks, down dive planes, flank speed. Continue diving to 150 meters unless told otherwise. Quick Key = [C]

Blow All Tanks—Rise as rapidly as possible: blow out ballast water with compressed air, elevate dive planes, flank speed.

Surface—Bring the boat to the surface. Quick Key = [S]

Damage Report—Go to Damage Report screen.

Oxygen Remaining—Show how much breathable air is inside the U-boat. Quick Key = [O]

Deploy Snorkel—(if equipped with snorkel). Go to snorkel depth and raise snorkel. This device, available towards the end of the war, allows U-boats to pipe down air from the surface to run diesel engines while submerged. The snorkel lets you travel submerged without draining batteries, but its large head may be spotted visually or by radar more easily than the periscope. Note: You must keep your speed under seven knots for the snorkel to work properly.

Stow Snorkel—(if equipped with snorkel). Lower snorkel and switch to electric motors.



Engine Room

Battery Level—Shows amount of remaining battery power. (If you have selected the Unlimited Battery realism setting, you will always have a full battery charge.) Quick Key = [B]



Fuel Level—Shows amount of remaining diesel fuel. (If you selected the Unlimited Fuel realism setting, you will always have full diesel tanks.) Quick Key = [F]

Sound Room

Report Contacts—Report current or last hydrophone contact. You must be running slowly to use hydrophones. Also, hydrophones work very poorly below 200 meters.

Depth under Keel—Report distance between keel and bottom. Use to check diving room, and avoid running aground.

Record Player—Select a record to pipe through the boat for the crew.

Torpedo Room

Report—Brings up Torpedoes screen.

Launch BOLD—Launches a bubbling canister that interferes with ASDIC.

Watch Officer

Man/Unman AA Guns—Orders men to anti-aircraft (flak) guns. AA fire is automatic. Quick Key = [A]

Man/Unman Deck Guns—Prepares deck gun for firing, for boats that have one. Once a target is selected, firing will continue until the target is destroyed, a new target is chosen, or you order the gun abandoned. Quick Key = [D]



Courtesy National Archives

Diving plane control station and valve set aboard U-505.

Report Contacts—Report current or last contact.

Identify Target—Estimates vessel type and gross tonnage of currently selected target. The estimates improve at close range. Quick Key = [I]

Rig for Silent Running—Must be submerged. Lower speed to two knots, turn off pumps and ventilation, and send non-essential personnel to bunks.

All Stations

Abandon Ship—If your boat is on the surface or in shallow water, your crew will abandon the vessel as best they can. This usually results in your capture, but you may be rescued if you radio an SOS first.

Radio Room

Opens Radio Room screen.

Simulation Options Menu

At any point in the simulation (at sea), you may access the following options by pressing [CTRL]+[O] and clicking on the appropriate button. The simulation is paused until you select OK to close the Options menu.

- **Music On/Off**—Turns the music sound track on or off. Also [CTRL]+[M]
- **Sound Effects On/Off**—Turns all simulation sound effects on or off.
- **Engine Sound On/Off**—Turns the engine sound effect on or off.
- **Crew Speech**—Requires installation of additional Speech Disk. Turns the crew speech sound effect on or off, and toggles between English and German.
- **Torpedo Screen On/Off**—Turns the torpedo firing animation on or off.
- **Torpedo Autoreload On/Off**—If turned on, Autoreload automatically reloads empty torpedo tubes with the next available torpedo (selected by shortest reload time). With Autoreload turned off, you manage all aspects of torpedo reloading yourself in the Torpedoes screen [F6].
- **Calm Ocean On/Off**—This setting overrides the weather simulation, providing you with smooth sailing as long as it is turned on.
- **Status Line On/Off**—This setting displays your current course, speed, and time compression settings in the upper left of the simulation screen as long as it is turned on.
- **Load Game**—Careers only. End current mission, resume previously saved career.
- **Save Game**—Careers only. Save current mission (must not be in combat with the enemy.) If the Saved Careers list is full, select an earlier career to overwrite. You may add descriptive text to help you select the mission later.
- **Abort Mission**—Abort current mission and return to the menus. Note: If you abort on a war patrol, you will lose any score earned on the mission so far.
- **Quit to DOS**—Exit immediately to DOS.
- **OK**—Close the Options menu and return to the simulation.

Quick Reference

Control Room	[F1]	Man/Unman AA Gun	[A]
Periscope	[F2]	Check Battery Level	[B]
Binoculars	[F3]	Crash Dive	[C]
Bridge	[F4]	Man/Unman Deck Gun	[D]
Charts	[F5]	Check Fuel Level	[F]
Torpedoes	[F6]	Set Heading to View	[H]
Damage Report	[F7]	Launch BOLD	[Ctrl]+[R]
Radio Room	[F8]	Identify Target	[I]
Captain's Log	[F9]	Fire Tube	[Ctrl]+[1]...[Ctrl]+[6]
Torpedo Camera/ Victim View	[F10]	Check Remaining Oxygen	[O]
		Periscope Depth	[P]
Increase Time Compression	[+]	Surface Boat	[S]
Decrease Time Compression	[-]	Open TDC	[T]
Reset Time to 1/1	[Enter]	Set View to Heading	[V]
Repeat Last Message	[Backspace]	Zoom Periscope Mag.	[Z]
Select/Deselect Target	[Spacebar]	Padlock View	[Alt]+[F2]
View Left	[<.]	Raise/Lower Scope (in chart)	[Alt]+[P]
View Right	[>.]	Stopwatch	[W]
Dive Planes Up	[↑]	Abort Mission	[Ctrl]+[D]
Left Rudder	[←]	Options Menu	[Ctrl]+[O]
Straight and Level	Keypad [5]	Pause	[Ctrl]+[P]
Right Rudder	[→]	Music On/Off	[Ctrl]+[M]
Dive Planes Down	[↓]	Quit to DOS (confirm first)	[Ctrl]+[Q], [Alt]+[X]
Engine Speed	[1]...[6]	Quit to DOS (don't confirm)	[Ctrl]+[Alt]+[Del]

Appendix A Troubleshooting

Problem: I have installed *Aces of the Deep* on a compressed drive, and it does not run.

Possible solution: *AOD* may need more disk space. Compression software estimates available disk space using an expected compression ratio of 2 to 1 or more. However, many *AOD* files will not compress much. This means you may need to free up to twice as much space as the compression software says.

Problem: My computer has at least 4 megabytes of memory, but even after creating a boot disk, I still receive a message saying that I do not have enough memory to run the game.

Possible Solution: Your boot disk may require further modifications to load your device drivers correctly into upper memory. See the "Customizing the Boot Disk" section, or consult your computer system manual or manufacturer for assistance.

Problem: My mouse is not responding.

Possible Solution: Your mouse driver may not be loaded for MS-DOS programs. You will need to edit the AUTOEXEC.BAT or CONFIG.SYS files on the boot disk to include your mouse driver.

Problem: I have a SCSI drive and *AOD* does not work properly.

Possible Solution: There are incompatibilities between SMARTDRV.SYS and SCSI drives. Do not use SMARTDRV.SYS for *AOD* if you have a SCSI drive.

Problem: I am getting vertical white bars or other graphic anomalies in the game.

Possible Solution: You may be using a mouse driver that is not fully compatible. *AOD* requires a 100% Microsoft compatible mouse.



Courtesy National Archives

A convoy in stormy weather, 1943.

Error Messages

This section offers possible solutions for error messages you may encounter.

YOU NEED XXX MORE BYTES OF FREE MEMORY AVAILABLE TO RUN THIS GAME. Try using a boot disk.

GENERAL FAILURE READING DRIVE (floppy drive letter). You may have a low-density drive that cannot read the high-density game disk(s).

CRC ERROR.

DATA ERROR READING DRIVE (A or B or C or D)

SECTOR NOT FOUND READING DRIVE A or D

These mean you have a faulty game disk, and should return it for a replacement.

ASSERTION FAILED...

The program cannot load a file because of insufficient memory, or because the file is missing or corrupted. You should be able to avoid this by keeping your files in the default directories and configuring your PC correctly for the game.

Appendix B Configuring Memory

Even if you have the minimum 4MB of RAM, *Aces of the Deep* may not run correctly unless the RAM is configured (set up) correctly for the game. If *Aces of the Deep* DOES NOT start correctly, use the MS-DOS MEM command to see if you need to free up some of your computer's memory. From MS-DOS, type MEM and press [Enter].

You need about 3,320 kilobytes (KB) of free memory to run *Aces of the Deep*. MS-DOS 6.0 or later shows this as "Total Free Memory" in kilobytes (KB). If you have MS-DOS 5.0, add "Largest executable program size" (free conventional memory), "bytes free EMS" (free expanded memory,) and "bytes available XMS" (free extended memory). Together, they must add up to about 3,400,000 bytes (3,320 KB) total free memory. If you do not have enough free memory, you probably have resident or "background" programs and device drivers taking up memory that the game needs. This means you will need to free up memory for *AOD* by reconfiguring or removing one or more of these programs.

Freeing up Memory

1. If you cannot run *AOD* because of low memory, try the Install program's "Make Bootable Floppy Disk" option as described below. A boot disk is a fast and effective way of freeing more memory to run the game.
2. If you continue to have problems even with a boot disk, try customizing the boot disk's AUTOEXEC.BAT and CONFIG.SYS start-up files. See "Customizing the Boot Disk," below, for details.



A U.S. Coast Guard cutter plows through the heavy seas of the North Atlantic.

Courtesy National Archives

3. Consult your DOS and memory manager software documentation for detailed information about system memory and how to optimize it.

Creating a Boot Disk

A boot disk is the simplest way to configure your computer's memory for running *AOD*. The *AOD* Install program has a "Make Bootable Floppy Disk" option that makes creating a boot disk easy. If you set it up successfully, all you will have to do is put the boot disk in your floppy drive and restart the computer to configure its memory correctly and launch the game.

Although the "Make Bootable Floppy Disk" option does a very good job of configuring most systems, it may not be able to properly recognize every possible sound card, mouse, or disk-controlling device driver. This means that you might have to make additional changes to the boot disk to get the program running. If you are having

trouble starting the game, try "Make Bootable Floppy Disk"—it can't hurt. If it does not work, however, proceed to the "Customizing the Boot Disk" section.

"Make Bootable Floppy Disk" Option

You can use the Install program to format and create a *AOD* boot disk for your computer's A: drive. Before you start, have a blank or formattable floppy disk for your A: drive ready. (All files on it will be erased.)

1. Start the Install program from your *AOD* directory on the hard disk, or from disk #1.
2. From the Installation Choices window, select "Make Bootable Floppy Disk."
3. The Install program will guide you through the process—follow the on-screen prompts carefully. Insert the blank diskette into your A: drive when prompted. Install will use DOS commands to format the floppy disk and write all the necessary start-up files to it.

When the process is finished, exit the Install program. You can then re-boot your computer with the boot disk in the A: drive.

Using a Boot Disk

The boot disk you have created with the Install program's "Make Bootable Floppy Disk" option contains a stripped-down version of your usual start-up files. You must start (or restart) your computer with the boot disk in the A: drive for it to work. (Note: a boot disk will work only in the A: drive).

1. Place the boot disk in the A: drive and start the computer. (If your computer is already running, exit any programs and restart the system with your PC's Reset button, or use [Ctrl]+[Alt]+[Del] from the keyboard.)

2. The computer will start up using the boot disk's memory configuration. (If you created the boot disk with the Install program from within the AOD directory, it will also try to start the game automatically.) Otherwise, start the game manually by entering **aod** as usual in your AOD directory. (To return your computer to its normal setup later, just restart it again without using the boot disk.)

Customizing Your Boot Disk

To customize a configuration for your specific system, you can edit the CONFIG.SYS and AUTOEXEC.BAT start-up files on the boot disk the install program created, or create a new boot disk from scratch. CONFIG.SYS and AUTOEXEC.BAT are simple text files that you can edit using your MS-DOS EDIT utility, the Windows Notepad, or your preferred word processor in its text-only mode. On your hard drive, these files tell your computer how to arrange its memory for normal operation. On the boot disk, these files tell your computer how to arrange its memory specifically for running AOD.

Warning: Manually altering the CONFIG.SYS and AUTOEXEC.BAT start-up files can be a trial and error process. When opening a file to edit, triple-check to MAKE SURE you are working with the files on your boot disk in the A: drive. Otherwise, you may change the CONFIG.SYS and AUTOEXEC.BAT files on your hard drive instead, which in turn may impair the normal operation of your system.

If you prefer to create a boot disk from scratch, you will need a freshly formatted system diskette for your A: drive. (See your MS-DOS manual for details on how to create a system diskette.) You can then create a new CONFIG.SYS and AUTOEXEC.BAT from scratch right on the boot disk.

Compare the CONFIG.SYS and AUTOEXEC.BAT files on your boot disk to the following examples. Differences may indicate places where you can remove a



Courtesy National Archives

A depth charge leaves its launcher.

driver, load it into upper memory, or change a device switch to use less memory. As always, refer to your system reference manuals if unsure about anything.

These examples show a "minimum configuration" that will let you run AOD on most PCs. The lines in your start-up files will differ according to your system's drivers and directory names, and the version of MS-DOS you use. (Note: Parentheses indicate comments that are NOT part of the file.)

Sample Boot Disk CONFIG.SYS File

DEVICE=C:\DOS\HIMEM.SYS

DEVICE=C:\DOS\EMM386.EXE

(You may use a different memory manager)

DOS=HIGH,UMB

(Loads DOS into Upper Memory)

FILES=30

BUFFERS=20

BREAK=ON

LASTDRIVE=Z

DEVICEHIGH=C:\MOUSE\MOUSE.SYS

DEVICEHIGH=C:\DOS\DBLSPACE.SYS /MOVE

(Only if using DBLSPACE. See "Disk Compression Drivers," below.)

Sample Boot Disk AUTOEXEC.BAT file

@ECHO OFF

PROMPT AOD Boot Disk \$P\$G

(If you are working with files created with "Make Bootable Floppy Disk.")

PATH=C:\DOS

SET COMSPEC=C:\COMMAND.COM

(Will use your actual COMMAND.COM location)

LOADHIGH C:\MOUSE\MOUSE.COM

(Only if you do not use MOUSE.SYS in CONFIG.SYS. See "Mouse Drivers.")

C:

(From "Make Bootable Floppy Disk." Changes to hard drive.)

CD C:\DYNAMIX\AOD

(From "Make Bootable Floppy Disk." Changes to current AOD directory.)

aod

(From "Make Bootable Floppy Disk." Starts AOD.)

To disable a line in one of your start-up files, you can just type REM in front of it. For example, REM DEVICEHIGH=C:\MOUSE\MOUSE.SYS will disable the mouse driver. To re-enable it, just take the REM back out again.

Mouse Drivers

If you have a mouse, the Install program will have assumed that you want to be able to use it with AOD, and put a mouse statement on the boot disk. This means you should have one mouse driver line in either your CONFIG.SYS or AUTOEXEC.BAT file—but not both! For example:

DEVICEHIGH=C:\MOUSE\MOUSE.SYS (Used in the CONFIG.SYS file only.)

LOADHIGH C:\MOUSE\MOUSE.COM (Used in the AUTOEXEC.BAT file only.)

If you have a different mouse driver name (MOUSE.EXE, IMOUSE, GMOUSE, HPMOUSE, etc.) or if you keep the driver in a different directory (C:\MSMOUSE, C:\DRIVERS, etc.) the path and driver name will be different. See your mouse manual if unsure.

Mouse Hints

Use MOUSE.SYS rather than MOUSE.COM or MOUSE.EXE, if possible. MOUSE.SYS is smaller and takes less memory. Make sure you do not have a mouse driver line in both the CONFIG.SYS or AUTOEXEC.BAT files. If you do, remove one, because you are needlessly loading two mouse drivers into memory.

Disk Compression Drivers

If you use disk compression on your hard disk, you must include the correct disk compression driver statement on your boot disk, or your mouse or other drivers may not load correctly. The example CONFIG.SYS shows the correct statement if you are using the MS-DOS DBLSPACE utility.

If you are using Stacker 3.1 or later, use the following line instead:

DEVICEHIGH=C:\STACKER\STACHIGH.SYS



Courtesy National Archives

One of the more than seven hundred Type VII U-boats built in German shipyards during the Second World War.

For other utilities, refer to your manual or contact the manufacturer for complete instructions.

Reminder: For the boot disk to work, you must REBOOT your computer with the boot disk in your A: drive. Place the boot disk in drive A: and press your PC's Reset button, or [Ctrl]+[Alt]+[Del]. Your computer will now reboot, using the start-up files on the boot disk in A:. Have a great time!

Additional Boot Disk Instructions

If you have a modem, you can download additional boot disk instructions from the Sierra Bulletin Board Service, or BBS. The file to download is BDALL.EXE or BDALL.ZIP (BDALL.ZIP is compressed—you will need the PKUNZIP shareware utility to open it). After downloading this file, select the instructions that will best match your system and program needs.

In the U.S., the BBS number is 206-644-0112; in the U.K., the BBS number is (44) 734 304227.

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Appendix D

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Courtesy National Archives

Erich Topp of U-552, the "Red Devil" boat.

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Appendix E Glossary

AA. Antiaircraft.

abeam. To the side of the boat.

aft. To the rear or stern of the boat.

ASDIC. For Anti-submarine Detection Investigation Committee, the name given to the British gear for locating submerged U-boats with sound pulses.

ASW. Antisubmarine warfare.

ballast. Weight, usually cargo or sea water, used to control the buoyancy of a boat.

BBC. German manufacturer of U-boat machinery.

BdU. *Befehlshaber der Unterseeboote.* U-boat command, or Admiral Dönitz specifically.

beam. Side of the boat, as in starboard beam, port beam.

bearing. Angle of an object relative to the bow of the boat. 0 or 360 is straight ahead, 90 degrees is directly starboard, 180 is straight astern, and 270 degrees is directly to port.

bilge. Tank(s) at the bottom of the boat for collecting seepage water.

BOLD. Bubble-emitting canisters that could be ejected by hunted U-boats to mask submarine noises.

bow. Front end of the boat.

compass. The compass heading describes a direction on a circle divided into 360 degrees where 0 or 360 is North, 90 degrees is due East, 180 is due South, and 270 degrees is due West.

course. Path of a vessel. A course may consist of several sections, or legs, each on a different heading.

crash dive. Emergency dive.

crush depth. Depth at which the U-boat's pressure hull will fail. Actual crush depth for any particular boat is unknown—finding out kills you.

displacement. Size of a ship, measured by the tons of sea water it displaces (a ton being 35 cubic feet). Can be expressed as light (empty) or load (fully loaded) displacement.

dive planes. Horizontally mounted fins on the U-boat's external hull used to help the boat dive or climb.

eel. Slang for torpedo.

gross register tonnage (GRT). Total volume of a ship measured in units of 100 cubic feet. BdU measured U-boat performance using GRT sunk.

heading. The compass direction in which a vessel is currently traveling. Use the Compass to determine the U-boat's heading; use the TDC to determine a selected target's heading.

hedgehogs. Forward-firing antisubmarine weapon used by escorts that fires a tight pattern of contact fused mortar bombs.

HF/DF. Allied gear for locating the source of a radio transmission.

hydrophone. Underwater directional microphones for passive sound detection.

hydroplane. Same as dive plane.



Courtesy National Archives

Otto von Bülow, skipper of *U-404*. He and his boat were attacked and sunk by aircraft in the Bay of Biscay, July 28, 1943.

keel. Bottom edge of the boat.

knot. Rate of one nautical mile per hour.

nautical mile. Approximately 1.15 statute miles.

pressure hull. Cylindrical main hull protecting the U-boat's crew and internal mechanisms—surrounded by streamlined external hull.

range. Line-of-sight distance.

Rudeltaktik. German for pack tactics, or wolf pack.

silent running. Operating with minimal noise to avoid detection on enemy hydrophones—low speed, no unnecessary activity, etc.

snorkel. Retractable pipes fitted to later U-boats that brought air into the engines, and let exhaust out, allowing the boats to run on diesels while submerged.

stern. Rear end of the boat.

telegraph. Signal device between the control room and engine room.

TDC. Torpedo Data Computer. Electromechanical computing device that inputs targeting data estimates for a selected target directly into the guidance mechanisms of all ready torpedoes.

trim. Maintaining a state of neutral buoyancy at a given depth.

VLR. Very long range; used to describe special patrol aircraft modified with extra fuel capacity.

wabos. From German *wasserbomben*—depth charges.

waypoint. Intermediate course destination usually marked by a change in heading.

Appendix G

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