The Underwater War takes a fresh and authoritative look at submarines during World War Two. No other book has dealt as internationally and intimately with the way submarines lived and fought during the years 1939–45.

Practically all the material is drawn from original sources and life on operational duty is described in detail, closely involving the reader in understanding and appreciating the dangers, difficulties and often appalling conditions which had to be overcome and endured.

The story is unbiased. The author is a strong opponent of the familiar ‘Axis U-boats were nasty but Allied submarines were nice’ theory. However, tragedies and mistakes are not glossed over. He admits that the underwater battle was tough and bitter, but believes it was fought on both sides by exceptionally brave and fiercely dedicated men who thought little of their own safety or survival. Not only outnumbered by opponents on the surface and in the air, submariners had constantly to guard against their most bitter enemy of all — the sea itself.

Emphasis is placed on the tremendous impact of submarines in all theatres of war, which, in some areas, has been grossly underestimated before now. For example, it is not commonly acknowledged that the American submarine campaign had so crippled the Japanese merchant fleet by summer 1945 that the economic war against Japan had virtually been won before the atomic bombs were dropped, nor that British submarines in the Mediterranean contributed largely to Allied victory in North Africa by cutting Rommel’s supply line. The surprising diversity of conventional submarine operations are fully explored, and the author also underlines the little known but vitally important successes achieved by British and Italian midget submarines and human torpedoes.

The reader will come to realise that submarines played a decisive part in World War Two and that they will be equally significant in any future conflict. It will also become clear that the men are as important as the materials in this strange murky arena, and it may be that this factor deserves consideration today when judging the strengths and weaknesses of modern submarine fleets. In particular, a close look at the poor performance of Soviet submarines in World War Two, grossly hampered by political control, raises the question of their real effectiveness in a shooting as opposed to a cold war today.

The author writes from a submariner’s view point, but the reader requires no prior special knowledge: submarine principles are explained simply and as far as possible technical language is avoided.

The Underwater War is illustrated with some 280 black and white photographs, covering all aspects of submarines and the submariner’s life. Drawn from exclusive archives in several countries, very few have previously been published and many are very rare. The internationally renowned artist John Batchelor has contributed meticulously researched artwork of the major submarine types.
The
UNDERWATER
WAR
1939-1945
The UNDERWATER WAR 1939-1945

Commander Richard Compton-Hall
MBE, RN (Ret’d)

Artwork by John Batchelor

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To The Girls They Left Behind
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HMS Tabu, true to her motto 'Won by Valour', was one of the few early T-class to survive the war. She saw active service from Benghazi to the Barents Sea, sinking and damaging 68,000 tons of enemy shipping. Of the five different commanding officers who scored successes in her, Lt Cdr Arthur Pitt was the top scorer with 36,340 tons to his credit. In April 1944, whilst trying to penetrate the mine fields guarding the Shagerrak, Tabu was badly damaged by a mine and subsequently withdrawn from service. With two angled midship tubes, a T-boat had a bow salvo of ten torpedoes. The single tube later added aft, however, gave a very poor chance of hitting the sort of targets which the British expected, so the midship tubes were later reversed; this arrangement still left a powerful bow salvo of eight fish and increased the stern salvo to a useful three. However, only six tubes were internal: torpedoes in external tubes could not be worked on at sea and were apt to be less reliable so that 'mixed' salvoes did not always achieve the exact spread and spacing intended.

Contents page
Type VIIC U-boat adding to the numbers surrendered after the cessation of hostilities in May 1945. The crew of U-826 are waiting resignedly under British guard to receive the new arrival alongside.
I Fact and Fiction

There are now about 1,000 submarines in the navies of the world. At any one time about 250 are hidden, submerged and supposedly ready for action. Why they are there and what they may be capable of doing are questions most easily answered by looking back a little.

The history of the underwater war of 1939–1945 is particularly relevant because it was the last time that submarines were in action. Submarines have not fired a shot in anger since that time, when they had an unparalleled effect on the outcome of the war. The immensely powerful submarine forces of today, which have replaced the omnipotent surface battle-fleets of the past, only have simulated battle-experience to work with and develop from; and that, in the past, has proved notoriously unreliable. So many false conclusions were drawn in the pre-war years from unrealistic trials and exercises at sea, erroneous calculations on shore and misrepresentation in high places that it is worth a close look at what submarines were able to achieve, and not achieve, when it came to real action: and that may throw a little more light on the murky underwater threat today.

The difficulty lies in sifting true experience from false or over-written accounts: and these abound. One way of finding out what actually happened is to take a look from below, through the eyes of wartime submariners themselves. However, some caution is necessary. For one thing, when submariners got together it was (and still is) their habit to take opposite sides, automatically, in any given discussion; and for another, they were apt to use rose-tinted periscopes when staking their claims to success. But their view gives an intimate insight into the nature of underwater war—which was not what it seemed on the surface—and may suggest which side to back when histories conflict. That is the purpose of this book.

In the days when a tot of rum was issued daily to ratings in the Royal Navy, there was a pleasant custom of giving 'sippers' to a messmate—a taste rather than the whole tot. A few chapters about the submarines in action can do no more than offer 'sippers' to the reader; but many here are taken from bottles that have not been too often uncorked—at least not publicly.

A model of Bushnell's Turtle constructed from the best available data. The accounts of its attack in 1776 on HMS Eagle lying at anchor in New York Harbour, are more legendary than factual. Supposing an attack did take place, the operator would soon have been immersed in exhaled carbon dioxide and would not (in British submariners' terms) have known whether it was Christmas Eve or the Marble Arch. The auger at the top is attached to the back-pack delayed-action explosive charge by a lanyard.
The French Gymnote in 1899, a very advanced submarine for its time, capable of making three knots submerged for two hours on accumulators. Gymnote suffered the first battery (hydrogen) explosion on 16 September 1906; it was by no means the last in submarine history. She sank in harbour at Toulon on 19 June 1907 due to too much water being admitted to the ballast tanks when orders were confused. That, too, was a mistake to be repeated in various navies.

Lieutenant Isaac Peral of the Spanish Navy designed the first submersible driven by electric motors from a battery. It was tested on Christmas Day 1906 but, by then, its success was overtaken by other nations less doubting than the Spanish.

Before getting immersed in the second underwater war it is useful to take a brief glance at what led up to it, if only to see how hard it is to sort out fact from fiction. Submarine history is said to go back for more than two thousand years; but it is bedevilled by misunderstanding and exaggeration to the point where a submariner today with, of course, the benefit of modern technological and physiological knowledge, has to discount much of what was written until at least the latter part of the twentieth century. The Dutch physician, Drebbel (1572–1634), for example, has often been hailed as the 'Father of Submarine Navigation'; but it is impossible to believe that his boat, in which King James I of England (a nervous monarch at the best of times) was rowed down the River Thames, was capable of submerging fully, still less of being controlled beneath the surface. Like most early so-called submarines, it was no more than a tightly covered, airless rowing boat which could be weighted down to an awash and partially concealed condition.

Even quite well documented inventions like David Bushnell's Turtle must be taken with a large pinch of sea-salt. Sergeant Ezra Lee's immortalised attempt, on 6 September 1776, to attack the British flagship Eagle which was lying off Staten Island in New York harbour is not at all likely to have taken place in the way that most history books suggest. Growing American national pride
understandably made the best of a good story; but there is no reference to any kind of attack above or below water in HMS Eagle's journals covering the years 1776 and 1777. In particular, the (much later) assertion that Admiral Lord Howe was so alarmed that he lifted his close blockade and sailed away to safer waters simply is not true; he stayed where he was and evinced no signs of alarm whatever! There is undoubtedly a solid foundation of fact behind the legend; but all that can confidently be said is that George Washington's remark (made 11 years after the event) praising Bushnell's device as an 'effort of genius' was fair with regard to its concept irrespective of dubious practicalities. Covert attacks of this kind would have been ideally suited to a weak maritime power threatened by a powerful enemy fleet. The Turtle and Eagle affair was the first attempt to mount what might now be called a submarine deterrent. As such it fully deserves its place in history.

Several more underwater attacks involving mines (then usually, and confusingly, called torpedoes) and semi-submersibles, in which Robert Fulton and other unnamed American citizens were involved, were said to have been launched during the war of 1812-1815. These well publicised efforts, all of which were abortive, drew violent cries of indignation from Great Britain. While an American paper felt able to report that 'the much ridiculed torpedo is obtaining a high reputation,' the British press variously described the American use of underwater weapons as unhuman, barbarous, infamous, knavish and ignoble. HMS Ramillies, with Nelson's Captain Hardy in command, was cited specifically as a target for these infernal engines of war; but the log of HMS Ramillies makes no mention of them. Nor can any reliable contemporary record be found to substantiate a statement that Hardy filled up his ship with American prisoners-of-war as a counter-deterrent to torpedoes, although crews were, in the normal way, taken off prizes and either put to work or confined on board.

America reacted vigorously to British criticism and retorted that the English themselves had paid Fulton to experiment with similar weapons and were being hypocritical. So they were; but the cause of all this invective was largely a figment of a well-fanned public imagination. It is tempting to think that fear of a supposedly powerful new weapon was the underlying motive for these exchanges in the press; but that would be overrating the threat as it appeared to commanders at sea. Fear of submarines would indeed grow and it was to be carefully fostered by interested parties; but it did not become a meaningful factor in international politics until some seventy-five years later when submersibles at last became a demonstrable threat. Before that, underwater warfare was based more on words than action. The principal and continuing lesson to be learned from that era was not to trust the newspapers in regard to submarines!

It was with the greatest reluctance that the principal navies of the world at last allowed themselves to be dragged below the waves which Britannia had ruled, with a few lapses here and there, for centuries. Even the most sail-bound Admirals and the most prejudiced politicians could not fail to perceive that if the submarine was a success it meant the end of surface fleets as they knew them. Nearly one hundred years earlier the noble, much respected Admiral Earl St Vincent had said of Pitt, the then Prime Minister, that he 'was the greatest fool that ever existed to encourage a mode of warfare which those who commanded the seas did not want, and which, if successful, would deprive them of it.' This weighty, much quoted but profound observation was made to Robert Fulton in 1805: it summarised policy towards submarines for a very long time to come. In similar vein in France, Admiral de Crès, at the Ministry of Marine, curled his lip at Fulton's Bateau-Poisson (circa 1800): 'Your invention is good for Algerians and pirates but learn that...
France has not yet given up the seas.

By 1900, with the ugly, stunted, fishy creature actually at sea and showing its warlike capabilities nothing too bad could be found to say about it in Europe. In England the epithets were particularly violent. It was an 'underhand form of attack', thundered Admiral Wilson, VC, Controller of the Navy, 'treat all submarines as pirates in wartime ... and hang all the crews.' The Admiralty, at his back, remarked with smug satisfaction: 'we know all about submarines; they are the weapons of the weaker power; they are very poor fighting machines and can be of no possible use to the Mistress of the Seas.'

Of course, all this was sheer wishful thinking. Every navy with a large surface fleet profoundly hoped that submarines would magically disappear and never be seen or heard of again. But it was not to be. Savage epithets were thereafter increasingly hurled at submariners and their craft as they progressed, rather jerkily, towards the twentieth century. When allied with Mr Robert Whitehead's Device of the Devil, the free-running torpedo, the potent combination provoked more furious arguments. European politicians and Admirals spoke of 'stooping from our lofty ideals' (France) and this 'damned un-English weapon' (Great Britain) when submarines started to become an unavoidable fact of life at sea. But they were not speaking from a moral standpoint (although that was what they wanted people to think); they were plainly afraid that, if submarines could do what submariners claimed, underwater craft would wreak havoc upon the splendid imperialist fleets which had won empires and dominated the oceans for so long. Their fears were to be fully justified.

Outside Europe, there were snide interservice comments about the capabilities and usefulness of submarines when they were introduced into the United States Navy; but there was little criticism politically in America except, as usual, on grounds of cost and priorities. A leading armour manufacturer summed up a dominant misgiving when he said: 'We will oppose submarines. For if they succeed, Congress won't appropriate for so many ships.' The foremost figure in underwater design, John Philip Holland, experienced years of frustration in America and wrote bitterly, in 1887, that he was 'totally sick and disgusted' with the lethargy of the Navy Department. But he won through in the end. The only notable public shaft directed at his ultimately successful Holland VI came in July 1899 from Miss Clara Barton, the first President of the American Red Cross: after a brief dip in the little craft on a cold, rainy day off Sag Harbour, the first woman to go down in a submarine sharply reprimanded the bespectacled, school-masterish Irish-American for inventing a 'dreadful weapon of war'. Holland, unabashed, replied prophetically that submarines 'would serve as a powerful deterrent to international conflict.'

In Europe, after Holland had more or less proven the efficiency of his submersible, a curious attitude of ambivalence started to prevail. It required a good deal of weaselwording amongst politicians. Mr Arnold-Forster's speech in the House of Commons on 18 March 1901 was typical: 'I will not say much about submarine vessels,' he explained (sensibly, because he knew nothing about them), 'but I will say that I am glad that the Admiralty ... took the view that it was wise not to be found unprepared in regard to this matter. We have a great amount of information about these boats, but we do not attach an exaggerated importance to it. But we believe that an ounce of practice is worth a ton of theory ... we are comforted by the judgement of the United States and Germany, which is hostile to these inventions
which I confess I desire shall never prosper.'

During the years leading up to World War I, submarines were sometimes strongly favoured, sometimes actively opposed and sometimes blindly ignored. The fact is that only a scattering of enthusiasts in the various navies had more than a vague idea of how they worked and few, with the notable exception of the Royal Navy's Jackie Fisher and his stalking horse Admiral Sir Percy Scott, cared to raise their voices.

The United States Navy did not try to maintain its early strong position and, whilst Britain eventually caught up with the submarine idea and became vigorously occupied in developing a war-worthy vessel, France, which had displayed such marked enthusiasm for the submarine initially, relaxed her efforts and allowed the British to reduce her lead rapidly and, by 1912, to overtake her. By 1914 the French submarine fleet was numerically smaller, and technically little further advanced than her 1905 flotillas: many of the boats were obsolescent and some were still steam-driven.

What was to become the most effective submarine force in the world started auspiciously in Germany. Although Krupp-Germania at Kiel had already built three submarines for Russia, it was not until 1905 that they received the order to build U-1. The first U-boat owed its design to the Spanish engineer d'Equivilley who in turn was much indebted to French experience.

During the 1914-1918 war, when submarines first demonstrated their enormous power, opinion amongst the Allies crystallised (through skilful press-handling) into doctrine to the effect that German U-boat men were cowardly and bad but Allied submariners were heroic and good. The dogma was to be proclaimed again in 1939.

Outside submarine circles, and even inside a
few of them, this extraordinary distinction, spawned almost entirely by propaganda—admittedly an essential weapon of war—still persists quite widely among the former Allies. The two underwater wars were not fought by chivalrous, knightly battles. All war is murderous: that is its nature; and submariners were particularly skilled at dealing destruction and with it, necessarily, death. The Germans, as losers in both wars, saw their (very few) U-boat contraventions of the seaman’s code proclaimed and punished whilst the Allies, as winners, were not arraigned. But any belief that there was some kind of clear-cut division between U-boat men and Allied submariners in their conduct is arguably untenable and invidious.

Submarines between the wars tended, for political reasons, to be kept hidden in the background. Consequently, with the exception of the German U-boat arm so purposefully revitalised from 1935 by (then) Captain Karl Doenitz, the tactical and strategic influence of submarines was neglected. In England the Submarine Service regarded itself as a private navy and was treated as such by the other specialist branches. This led to the Submarine Service not being properly integrated into the Royal Navy and to widespread ignorance amongst the other specialists regarding the potentialities—and the weaknesses—of the submarine arm.

The situation was much the same in other navies outside Nazi Germany.

It is necessary to glimpse something of this lengthy history, littered with lack of logic, ignorance, dual-thinking, hesitancy and wrong reporting in order to understand why, as the various nations entered World War II,
so many submarines were poorly prepared for the coming battle. Perhaps submariners themselves, serving in the most silent of services, were principally to blame for not advertising their wares well enough. That is not something they can be accused of today; but whether the current advertisements can be wholly trusted is debatable; history suggests, as will be seen, that they may not be entirely accurate if put to the test of war.

Top Right
Bow view of HMS *M2*. She originally mounted a 12-inch gun but this was later removed to make room for a watertight hangar for a Parnell Peto seaplane. *M2* was lost with all hands on 26 January 1932, probably due to over-enthusiasm in attempting a rapid surface when the hangar door and access hatch were opened simultaneously. The Japanese took careful note of the design for their own World War II submarine aircraft carriers.

Bottom Right
The 12-inch gun, taken from a nineteenth century Colesse-class battleship and mounted in three M-boats (1917–18), was a far from stupid idea in view of torpedo unreliability at that time and much, much later! Although the gun had to be reloaded on the surface because the housing was not watertight, the submarine had only to broach to fire a round. Although never proved in action, each 850 lb shell would have done enormous damage both to ships and shore installations, the shells were a great deal cheaper than the cruise missiles developed in modern times from the same concept!
2 The Order of Battle

The indecision which dogged submarine development between the wars resulted in most boats that sailed to fight World War II being little different, basically, to those which had fought the first underwater war a quarter of a century earlier. They tended to be larger, longer-legged and a little more comfortable but there had been no giant strides forward. Propulsion was virtually unchanged and maximum speeds submerged were still around 8 knots.

Under the terms of the Versailles Peace Treaty of 1919 Germany was not only denied a U-boat arm but also prevented from maintaining an ability to design and construct a future underwater fleet. The latter prohibition was cleverly circumnavigated by German designers and constructors who had kept in close touch with each other after the Armistice. In 1930 they set to work on one submarine for Turkey and five for Finland.

The Turkish Gur was laid down in Spain in 1932 and furnished with machinery made principally in Holland. She was, in fact, the prototype for two Type IA, 862-ton U-boats built in 1936. These were not very successful, principally because they were over-engined; they were relegated to training duties at the outbreak of war. The Finnish submarines were much more interesting. Jane's Fighting Ships naively noted that the last of these, the 250-ton Vessiko was built as a 'private speculation' by the German firm A/B Crighton-Vulcan at Turku on the south-western point of Finland. She was actually the model for the Type IIA U-boat. She was used, without ostentation, as a training vehicle from 1931 to 1936 for future German U-boat crews. Great care was taken to conceal the true purpose of Submarine 707, as she was known throughout the Baltic, and a rumour was put about that she was destined for Estonia which she certainly was not. A German officer, Commander Barttenburg, and an Engineer Assistant were appointed to the Finnish Naval Staff and in the Spring of 1931 a German crew arrived in the special service ship Grille to take 707 through her trials.

With the exception of four engine-room ratings, the entire complement consisted of young German officers. Each springtime thereafter the Grille arrived with a fresh team for 707 and in this way a score of potential U-

The four submarines of the R-class all operated in the Mediterranean and although younger than the O-class were too large for service in that theatre of war. Three were lost due to enemy action and the fourth, Rover, acting as a floating power station to the damaged cruiser York in Suda Bay, Crete, was bombed and left unfit for further operational service. Rainbows, seen here in 1932, was sunk on her second patrol in a gun duel with an Italian submarine.
Right
Five classes of British submarines in commission in 1939 lying alongside at Fort Blockhouse with Portsmouth Harbour in the background. Two Q-class and one U-class are in the far trot.

Below:
Of six of this minelaying class only Rorqual survived, Seal being captured by the Germans and the other four, Porpoise, Grampus, Cachalot and Narwhal all being lost through enemy action. Porpoise and Rorqual were the most successful of the group, Rorqual spending three years of service in the Mediterranean.
boat officers each year received six months training in sophisticated attack methods at the expense of the Finns and without any complaint from the outside world.

Meanwhile, another very promising German design was being thoroughly tested by the supposedly Finnish 

\textit{Vetehinen}-class. This 490-ton ocean-going boat was to become, with very little modification, the German Type VIIA.

The 1935 Anglo-German Naval Agreement cleared the way for open expansion of the U-boat arm. It was signed on 20 June and, during the preceding conference, Admiral Schuster admitted that 12 250-ton boats had already been laid down and 12 more would be added during the year. German tonnage was restricted to 35 per cent of British equivalents in all classes except for U-boats which could be built up to 45 per cent. The latter percentage meant that Germany could legitimately build U-boats totalling 24,000 tons. The Royal Navy at that time had 59 submarines in commission of which 20 were in the 1350 to 1805-ton bracket with one, HMS X-7, of 2425 tons. The remainder were between 410 and 760 tons and that was approximately the size the Germans were aiming for. The Admiralty may have reckoned on Germany only building 45 per cent of the British total in numbers rather than in tonnage which would have resulted in only 26 U-boats: it is hard to understand otherwise why the British, without consulting the Dominions or France, still less America, signed the agreement so readily.

Lessons of history less than twenty years old were forgotten; but absolute (and misplaced) confidence in the new ASDIC underwater detection device apparently made the agreement seem perfectly acceptable. As it turned out, internal arguments within the German Navy were a much more effective restraint on the building programme than any treaty.

In July 1935, immediately after the signing of the Agreement, a certain Captain Karl Doenitz was suddenly ordered by his Commander-in-Chief, Admiral Raeder, to take over the submarine arm. Doenitz had had an undistinguished submarine career in World War I but was noted for exceptional leadership and organisational ability in the peacetime surface navy. He was not, at first, overmuch pleased by the idea of becoming the U-boat chief but Raeder was an accurate judge of character. It was to prove probably the most perceptive appointment made in the Armed Services of any nation before or during World War II.

Doenitz immediately applied himself to the task with a single-minded sense of purpose that was to endure unbroken for ten years and twenty days until finally, as head of the German Government, he authorised the signing of the instrument of surrender on 8 May 1945. But despite the unassailable logic he advanced for a fleet of 300 U-boats, only 46 boats were ready for action—a fortuitously large proportion of the 56 in commission—when at 1330 on 3 September 1939 the Naval High Command signaled: ‘Commence hostilities against Britain forthwith.’ Only 22 boats were suitable for service in the Atlantic. The rest, small 250-ton ‘canoes’, were for coastal work and could not contribute to Doenitz’ unwavering aim to destroy trans-Atlantic shipping. Although larger long-range boats, in the proportion of one to three, were also needed the bulk of the U-boat fleet should, he reasoned, consist of small, quick-diving submarines with a low silhouette and a high speed on the surface where they would primarily operate. A slightly enlarged Type VII met these requirements admirably: the result was the Type VIIIC and the first of the class were ready early in 1939. They displaced 769 tons on the surface and had an endurance of 8,850 miles at 10 knots with a maximum speed of rather more than 17 knots. With no periscope standards and a conning tower only 5·2 metres above the waterline, they were hard to see from an average ship beyond a few miles even in daylight; by night, end-on, they were practically invisible. They could dive in less than half a minute and could go down to 100 metres without strain and to just over 200 metres if hard-pressed. Their speed submerged was 7·6 knots for two hours, 4 knots for 80 hours or 2 knots for 130 hours. Depth and endurance at high speed were twice as good as in submarines elsewhere. Type VIIIC U-boats were the principal weapons with which Doenitz, soon promoted to Admiral, set out to wage war on commerce.

In September 1939 Britain had 58 submarines but there were only 21 boats in home waters and five of these were more than ten years old. A further 11 boats were building but British submarine strength, in terms of availability where it was most needed, was less than that of Germany. Most pre-war exercises involved boats performing in the role of a loyal opposition: but commanding officers, especially on the China Station, had seized every opportunity of practising submerged attacks so that, at the outbreak of World War II, the majority were highly skilled professionals. It took time to call the eastern veterans back but when they returned they quickly made their mark.

The strategy and tactics adopted in the Royal Navy by Rear Admiral Submarines were diametrically opposed to those of his German counterpart. Doubtless he would have liked more boats (and he had more than enough trained officers); but numbers meant less than they did to Doenitz. RA(S) had no intention of embarking on surface packet-tactics like Doenitz who intended to direct groups of U-boats on to convoys; fast warships were the principal targets for the Royal Navy and the British War Plan disposed submarines along lines in individual patrol areas where, far from chasing targets, they waited for the enemy to come to them. Thus, in the Royal Navy of 1939 submarines were, in the Admiralty mind, little more than mobile mines.

Britain’s world-wide commitments made Depot Ships necessary as well as bases and in 1939 four large, well-fitted ships were in commission. They were vital to British submarine strategy and the enemy, who had no such dependence, knew it. A depot ship had sufficient mess-decks, workshops, stores, torpedoes and provisions (including up to 4,800 dozen bottles of beer) to care for about 12 submarines. Unfortunately, whenever ‘Mum’ sailed sedately out of harbour she became a prize target. Her great length and slow speed made her easy to hit as the British found to their cost when HMS Medway, 580 feet long and making only 14 knots on her double-acting Doxford diesels, was sunk in the Eastern Mediterranean by U-372 in June 1942.

Unfortunately, the most important British base, the island of Malta, was not fortified against predictable attacks from the air. It would have been a simple matter to build submarine shelters beneath the fortress as submariners had asked in 1936: the cost would have been about £300,000 (about the cost of one submarine); but the proposal was turned down by the Cabinet in July 1937. As the naval historian Captain Roskill remarked it ‘was one of (Britain’s) most expensive negligences’.

It was the quality of the officers and ratings in all services which decided the effectiveness of the submarines themselves. In Nazi Germany men were drafted to U-boats more or less irrespective of their own inclinations provided that they were medically fit. But in the Royal Navy submariners were almost entirely volunteers. Out of 3,383 men mobilised in 1939 only 108 were pressed, although the ratio was to increase indicatively upwards as the war developed. Submarine pay and hard-lying money undoubtedly helped recruiting, nearly doubling the wage packet of many submariners. No upper limit was fixed for ratings but it was agreed that a captain should ideally be between twenty-
five and thirty years old: he was arbitrarily (and sometimes wrongly) reckoned to be over-age at thirty-four, whilst the few who rocketed to command in their very early twenties were thought (unfairly in most cases) to lack judgement.

A handful of boats from other navies whose countries were threatened with German occupation flocked to join the British submarine service soon after the outbreak of war. They included the Polish minelayer *Orzel*, a brand new Dutch-built boat, and *Wilk* which had been constructed by the French firm of Augustin Normand in 1930. Both escaped from the Baltic. *Orzel*, interned by Estonia in Tallin harbour, slipped her guards on 18 September 1939. Stripped of all navigational equipment, she eventually found her way to Rosyth in October using a home-made chart and arrived safely, after some unlooked for adventures and a gallant but fruitless patrol in the Baltic. From there the Poles made their way to Dundee where Allied non-British submarines were to gather for wartime patrols on a proper footing. The Norwegian *B-1* made an even more heroic effort to join the group. On 10 April 1940, the day after Norway was invaded, *B-1* cast off in a heavy snowstorm and bottomed in Narvik Fjord. She lay there for five days, surfacing briefly for orders that never came, but it was impossible to recharge batteries or replenish the air with so many German air and surface units above. On the fifth day the exhausted
crew anchored their boat, trimmed it right down so that only the top of the conning tower was showing and went ashore to rest; but by daylight they could see that the conning tower was dangerously conspicuous so the First Lieutenant rowed out and climbed on board, opened one of the main vents, raced up the conning tower, shutting the hatch behind him, and left B-1 deserted, to settle on the bottom. The crew retreated on horse-drawn sleds to Harstad. A month later they received secret orders to return and raise their boat. B-1 was duly brought to the surface and, with rapid makeshift repairs, was able to head out to sea on 18 June. She arrived safely in the United Kingdom but, sadly, was found to be in too bad a state to be used for anything more than anti-submarine training which, nonetheless, was very valuable to the war effort. Most of her crew transferred to one of the three British U and V-class submarines made over to the Royal Norwegian Navy.

Most of the Dutch boats also avoided capture. Of their 27 commissioned submarines, 15 were in the East Indies but, between 12 and 16 May 1940, the 12 operational boats in Dutch home ports, together with two more which were not quite complete, safely reached the British submarine base at Fort Blockhouse, Gosport. Three were fitted with schnorchels, the first operational boats in the world to be so equipped, but the Royal Navy shortsightedly saw no need to adopt the device: it would have proved invaluable in the Mediterranean. The Dutch also provided a merchant flagship, the Columbia which was converted to a depot ship at Dundee and for a year from August 1941 she mothered Allied submarines there.

By comparison with Germany and Great Britain, France and Italy had extraordinarily large submarine arms. Between the wars both governments had engaged in extensive building programmes, with France leading until 1930 when Italy started to overhaul her. It is not easy to perceive clearly the aims of either country and, in any case, they probably changed over the years; but the large submarines which France constructed, including the giant Surcouf, were more suited to the widely proclaimed (but seldom demonstrated) traditional French strategy of a Guerre de Course than to defensive warfare. France was consequently suspected of having failed to ratify the Washington Treaty of 1922 with regard to commerce-raiding by submarines. For long France, rather than Germany, had been England’s traditional enemy and history probably coloured French naval planning. But the real reason for the large French submarine building programme was that submarines were the cheapest possible way of exercising sea power; and any nation that had a sufficient number was bound to receive due attention at the conference tables of the world. In September 1939 France had 77 boats in commission of which 38 were ocean-going, 32 coastal, six minelaying and one, Surcouf, a cruiser. After the collapse of France, seven French submarines operated with the Free French naval forces which were based on Britain and four boats were taken over by the Germans. But the French boats were not all up to 1939 warfare standards; the Narval’s machinery, for instance, ‘had to be heard to be believed’.3

When Italy entered the war in June 1940 no less than 84 submarines were operational: the remainder of the 150 boats commissioned were in refit or undergoing trials. They were markedly inferior to all German U-boats: comfort played too large a part in their design. They were, in the main, good-looking vessels, capable of showing the Italian flag with pride; but their huge conning towers made them easily visible on the surface and they were slow to dive, clumsy when submerged and poorly equipped. It was hard to avoid the impression that the Fascist submarine service was intended more for show than action. There was scant evidence of realistic pre-war exercises; and the very special teamwork demanded of an aggressive submarine crew was lacking in the Latin temperament although individuals were brave enough: the outstanding successes of Italian human-torpedo volunteers and swimmers were emphatically to prove that.

When Italian submarines arrived at Bordeaux to join forces with the German fleet in 1940 the first order from Doenitz was to ‘cut short their towers to make them less visible’. That was unfortunate because some of the boat’s cooking arrangements were built into the superstructure. However, the point was quickly taken care of. ‘When they came’, grinned a German U-boat commander, ‘the Italian boats had four galleys—one for Officers, one for Chief Petty Officers, one for Petty Officers and one for the rest. Then, quite quickly,’ the smile thinned, ‘German advice prevailed. One galley was enough.’ Italian submariners operating under German orders were not, perhaps, entirely happy!

Russian statistics were, as always, imprecise. But when the Soviet Union entered the war in 1941 there were probably well over 100 submarines in commission. The Russians had by far the largest submarine fleet in the world and it was entirely intended for defence. A fair proportion of the boats were newly built; but their designs were outdated and their weapon systems were antique. Due to Stalin’s pre-war purges, only a quarter of the Soviet submarine officers had served for more than two years; and all submariners were governed by a system of centralised and very strict control which severely hampered their fighting ability. Successful submarine operations everywhere demanded freedom of action for commanding officers but that was denied by political commissars who watched every movement that a captain made. It was extremely unwise in the Soviet navy, even in peacetime, to admit that an operation had been a failure; so lessons were neither looked for nor learned. Technical and tactical
development suffered accordingly; and the potential of the vast Soviet underwater fleet was never to be realised.

Japan acquired her first submarines towards the end of the Russo-Japanese war in 1905. Thereafter, for many years, Japanese designs were based upon proven foreign types, especially the British L-class. Great emphasis was placed upon sea-going qualities in the rough waters around Japan but no particular purpose was evident in their submarines. Even when the first large trans-Pacific boats were built there were no concrete plans for their employment although the provision of aircraft in some implied reconnaissance for the surface fleet. However, the Imperial Navy eventually came to the conclusion that in the event of war with the United States (which by 1935 was regarded as inevitable) the Philippines, Borneo and Indonesia should be invaded immediately; after that the Submarine Fleet would assume a defensive role aimed at the attrition of American naval vessels when the enemy fleet steamed northward, bent on retribution but in an exhausted condition. It was a strategy of the sort that is more likely to have been concocted in Staff Colleges than at sea; and it was to be proved wholly unrealistic.

At the London Naval Conference of 1930 the Japanese delegates fought for a larger submarine arm than the other major powers. The size and number of capital ships and aircraft carriers were limited by the conference but the building of submarines was thereby unintentionally stimulated. In the

Depot ship HMS Medway with her flock

This chart, sketched from a souvenir of HMS Maidstone, shows how far-ranging and important a depot ship's support operations were in war.
end, Japan had to accept submarine parity with the United States and Britain, but in 1934 midget submarines began to be built under the direction of Captain Kishimoto Kaneji to swell the numbers. These prototype two-man, 49-ton craft, which carried two torpedoes, were credited with the exceptionally high underwater speed of 19 knots; if that was true they must have been difficult to handle. Special mountings to carry the midgets were fitted to a number of large submarines and they could be manned through a trunking without surfacing. There was no shortage of volunteers and, on the face of it, they were potent units; but in war they were to fail dismally. Meanwhile, irrespective of treaty limitations, plans were made for increasing the number of large boats as well.

On 8 December 1941, the Imperial Navy had 65 operational boats with a further 29 under construction. Of these, 48 were rated 'first class' and it was upon them that Admiral Yamamoto relied for carrying through a new plan for submarine employment. Instead of awaiting the arrival of a hopefully exhausted US fleet in Japanese controlled waters, Yamamoto now planned on a decisive fleet action, centred around his aircraft carriers, at the earliest possible moment. Submarines would not lie in wait for targets well clear of the surface action but would be closely tied to the fleet in the big battle itself. The decision was to have far reaching results during both the Pearl Harbour and Midway operations where Japanese submarines were robbed of their two greatest assets—surprise and freedom to manoeuvre.

In the United States submarines, as a strategic force, were not highly regarded before the war. A defensive strategy engendered the belief, copied in Japan, that the role of submarines was to sink warships advancing towards the unending coastline. This, in turn, generated peacetime exercises that were to be of little use in creating experience for the coming war and safety became the first consideration when exercising against high-speed naval targets. The danger of being rammed in peacetime could not be ignored when public opinion was
sensitive and when, within the Navy itself, internecine conflicts were constantly at work. Exercises had not only to be safe; they had to be successful (on paper) in the light of the creed current in the USN that only excellence merited promotion. Consequently, when America was at last forced to go to war with 112 submarines, 64 of them elderly, their commanding officers were over-cautious and the admirals were over-confident.

The submarines themselves were made up of widely assorted classes ranging from 520-tons upwards; but the tendency was to go for bigger boats with much greater comfort, larger crews, heavier weapon-loads and longer range, higher surface-speed capabilities than European boats. Sophisticated equipment, including radar and advanced fire-control systems, was given high priority but underwater performance and diving times were no better than elsewhere.

Between 1936 and 1941, building stabilised around Fleet submarines of the P and new (1937) S and T classes. All were rather more than 300 feet long and displaced from 2,000 to 2,370 tons with speeds around 20 knots on the surface. Complements ranged from 55 in the P-boats to 85 in the T-class and the crews were to become even bigger as the war went on. Two medium-sized boats were built, *Mackerel* and *Marlin*, but submarines smaller than the standard fleet-type found no favour in the fleet. The P-class and its successors had all-electric drive with four diesel-generators. Besides more important engineering advantages, diesel-electric propulsion did not drain the battery like direct-drive diesels (which could not, generally or reliably, be run astern) when manoeuvring in harbour. Hours of re-charging were thereby saved after entering harbour which reduced harbour watchkeeping, improved maintenance and enabled captains to be generous in allowing junior officers to gain valuable experience in ship-handling.

The comparative roominess of the large fleet boats, however, had an inbuilt disadvantage. It was much more difficult for a captain to maintain intimate contact with all that was happening throughout the submarine. He depended, sometimes far too much, on instrumentation (which was by no means always reliable) and, although no bad thing in the long term, he had to delegate a good deal of responsibility, especially to his 'Exec' who, much more than in other navies, was a true second-in-command. A submarine captain in the USN needed an exceptionally strong personality and roving habits, like Lcdr Dudley Morton in *Wahoo*, to imbue the whole crew with his own fighting spirit. Unfortunately, in 1941 personality and spirit were too often lacking and a sizeable proportion of USN peacetime captains were to fail the tests of war.

US Navy O-boat used for training. The practice of leaving hatches open and unwatched underway, even in harbour, was extremely unwise and it is strange to see it here in a training boat.
Control and trimming submerged was similar in all submarines and was not the black art that submariners made it out to be. It was very difficult to trim accurately enough to achieve exact neutral buoyancy (a 'stop trim') although all boats were designed so that, when fully manned, stored and fuelled, they would displace, when dived, their own weight in salt water of a specific density (the neutrally buoyant condition). In practice, a boat's bodily weight changed continually at sea as fuel, stores and weapons were used and as sea-water density altered. Density was significant and in some areas unpredictable but sharp changes could be helpful: HMS Parthian, for instance, was able to sit, stopped, an hour later for two-and-a-half hours while being hunted in the Mediterranean. Hull compressibility was also an important factor: instead of flooding in water to go deep it was necessary to pump out considerable quantities—typically 75 gallons for every 100 feet—to prevent a boat becoming negatively buoyant as it went deeper, compressed and so displaced less.

There were a number of compensating and trimming tanks in each submarine but only three were generally used when dived—the forward and after trimming tanks and a tank amidships. These allowed bodily weight and the trim angle (or pitch) to be adjusted. German U-boats used reduced high-pressure air to blow water from forward to aft and vice-versa. It was a quiet and simple method of balancing a boat; with the trim tanks at each end split in two, a pressure could be maintained in one tank of each pair and a cock had only to be opened on the appropriate line to send water from one set of tanks to the other. This method did, however, lead to minor air leaks and the occasional need for total tank-venting which could build up an undesirable air pressure inside the boat. Submarines in other navies used a small pump for the same purpose. Bodily weight was adjusted by an amidships tank, flooding it direct from the sea by external pressure or pumping water out through a powerful main ballast pump which could also be used to discharge water from any other tank or compartment. Separate bilge-pumps took care of the oily bilges which would have contaminated the main trimming lines and led to traces of oil floating to the surface in action.

Compensating and trimming tanks were mainly contained within the pressure hull. Fuel tanks were compensated, as fuel was used, by sea water admitted to the tanks themselves; the difference in specific gravities between oil and water resulted in a boat becoming heavier and this, too, had to be compensated by pumping water out.

The trim was calculated by simple arithmetic before leaving harbour and roughly checked by reading the draught marks at full buoyancy. If possible, a trim dive was carried out as soon as the 20-fathom line was crossed and, when dived thereafter, the trim was adjusted continually by trial and error. When diving it was only necessary to open

**HNMS 0-141 engine room platform.**
the main vents which allowed the supporting air in the main ballast tanks, mostly outside the pressure hull, to escape. Surface buoyancy, which differed greatly between classes, was thus destroyed and the boat, then in theory neutrally buoyant, was able to dive at an angle regulated by the forward and after hydroplanes whose effect naturally depended upon speed through the water. A special tank forward, 'Q' or 'Negative', was used to speed up the rate of diving and changing depth; it had a capacity of several tons, gave temporary bow-down negative buoyancy when flooded and was blown just before reaching the desired depth. It was then vented inboard, markedly increasing air pressure in the boat. Submarines were able to submerge fully from high speed on the surface in times varying, in most classes, from 27 seconds to 1 minute depending on the size of the boat and its course in relation to the sea and swell. Some of the larger types took considerably longer to dive, particularly the minelayers with external mine rails and, principally for this reason, large boats were dangerous to operate in restricted, heavily guarded inshore waters. If heading into a heavy sea, diving could be held up interminably and it was best to run on the surface with the sea abeam if possible. It was also much easier to keep periscope depth with a beam sea. Conversely, a steep sea or swell from ahead or astern could cause a submarine to broach from periscope

Top Right
Control Room of Dutch submarine O-14 (Lt Cdr G Quint). The British depth gauge shows the boat is at periscope depth (which was then measured from the surface waterline rather than from the keel as it is now). Dutch submarines fought with great distinction in the Mediterranean and Far East.

Centre Right
HMS Graph (ex U-570) and HMS Simoom in 1943. The British S-boats were broadly comparable to the Type VIIC U-boats but were markedly inferior in diving depth and endurance at high speed submerged.

Bottom Right
The upper conning tower hatch of HMS Taku. The stirrup and clip fastenings were peculiar to British boats and made the hatch much easier to control when surfacing with a high pressure inside the boat, than to wheel-and-spider arrangement usual in other navies.
There was also a danger of pooping on the surface with a following sea so that revolutions had to be increased or decreased to avoid making the same speed as the sea itself. Fortunately for submariners, it did not seem that these factors were understood by anti-submarine aircraft when assessing a submarine's course while attacking with bombs or depth-charges.

When changing depth normally a submarine's bow was simply pointed up or down by the hydroplanes which were also able to keep a boat level at the ordered depth at speeds down to about one and a half knots provided that the trim was not more than half-a-ton or so in error. If the trim was bad more speed had to be used; this drained the batteries needlessly so that good trimming was very important to a submarine's safety in more ways than one. The trimming officer was, naturally, a target for criticism by the whole crew, and especially the captain if the periscope dipped during an attack. One U-boat pricked the Chief Engineer's sensitivities more gently than most by putting on a recording of the well-known German song 'All right, we'll do it alright, we'll get the thing done yet' when he was endeavouring to catch a trim. Others, particularly in British boats, criticised the trim more crudely or asked sarcastically if somebody had forgotten to blow Q.

A men passing through the control room could change the fore-and-aft trim significantly and it was often a rule to ask permission before going either way. Sending men forward or aft at the rush was, in fact, an effective and rapid way of correcting a steep angle and many boats were saved in this way from plunging to the bottom under attack or when the trimming officer had simply got his sums wrong. Six men weighed the same as 100 gallons and could move much more...
Top
The after engine room in a US fleet submarine showing clearly how much easier it was to keep clean than the equivalent in other navies.

Bottom Right
The engine room of HMS Unruffled with its reliable Paxman Ricardo engines. In rough weather on the surface with the engines roaring and the boat pitching and rolling submarine life could be very grim.

quickly than an equivalent amount of water passing along the trim line.

Diving depth depended, of course, on the strength of the pressure hull and this was a factor not only of its thickness but also on its circularity with the least number of hatch openings to spoil the line. German U-boat hulls, particularly the Type VII C, were exceptionally strong and these boats could go twice as deep as most of their equivalents in other navies. This was due to their having well-shaped hulls between ½-inch and ¾-inch thick instead of just over 1-inch as in most British boats. That, in turn, was made possible by omitting certain features common to British submarines, which submariners would surely have given up if the advantages had been realised. Incredibly, it was insistence on a reliable magnetic compass in a certain position, to supplement the
Watertight doors (shown here in a US fleet boat) were not strong enough to resist pressure at any great depth and, in any case, the flooding of one compartment, in practically every class of submarine in all navies, prevented a submarine from diving safely by sheer weight of water. However, doors like this were sufficient to isolate compartments for escape from relatively shallow depths and were very useful to prevent the spread of fire or gas in the event of damage. Inter-compartment ventilation trunking and voice pipes could be shut off by valves which had the same resistance as the doors.

The hydroplane controls in USS *Cero*. The deep depth gauge above was shared by both operators. The lower of the two inclinometers registered up to 30 degrees but the deliberate use of steep angles was avoided because of equipment breaking loose, possible battery spillage and the fact that the bow (or stern) might be dangerously deep while the control room depth gauges still showed an acceptable depth.
sufficiently serviceable gyro, that was much to blame for restricting the diving depth of British boats. The magnetic compass was positioned, outside the hull, vertically above the helmsman and British designers would not accept steel within seven feet of it although the Germans were content with three feet and accepted a moderate performance thereby. The conning and gun towers and their surrounding areas in British boats had therefore to be built of bronze which was extremely heavy and prevented thicker steel being used for the main hull. There were, of course, other factors. U-boats did not have so many internal watertight bulkheads (which did not contribute much to a submarine's safety in war) and they did not have special escape hatches (which, anyway, in war were often locked externally in British boats to prevent them jumping when depth-charged). Germany also accepted a lower reserve of surface buoyancy. In other words, in the Royal Navy, unnecessary and unwarlike features which supposedly contributed to safety in peacetime actually militated against effective avoiding action and survival in war. In this and other structural and engineering matters there was reason to think that seamen, constructors and engineers in the Royal Navy found it difficult to communicate with each other; or else the Admiralty failed to set its sights on the right targets and priorities for fighting efficiency. In the latter respect the German Type V11C had only four torpedo tubes forward and they could be included in a circular cross-section of the hull; the six tubes demanded by the British, whether tactically justifiable or not, required an oval bow and hence weakened the structure.

The understanding between operators and technical experts was undoubtedly better in the US Navy where officers were all trained in engineering. However, the USN still did not achieve such effective, practical designs as the Germans who were ruthless in eliminating all but strictly wartime capabilities. The Germans were also prepared to sacrifice long-life economy for immediate operational benefits. Their batteries, for instance, had a short and thus expensive life; but they had an exceptionally high capacity which, although making them rather slow to charge and apt to overheat, endowed the Type V11C with
virtually double the submerged performance of comparable Allied submarines.

There were two very different kinds of diesel-propulsion. The US Navy favoured diesel-electric drive with diesel-generators connected to the battery which in turn drove mechanically independent main motors. The system allowed any number or combination of the four diesel engines in fleet boats to be run at one time and made running maintenance at sea much easier with plenty of power always in hand; the advantages in harbour have already been noted. Moreover all-electric propulsion enabled engines to be built for steady, optimum high-speed running unrelated to propellor-shaft revolutions. American main motors, too, were designed to run at quite high speeds which were electrically efficient; but they carried the penalty of noisy reduction-gearing between them and the propellors. The Royal Navy only adopted a diesel-electric system in the U and V classes although these too could be clutched for direct drive if required. Most other submarines everywhere, including German U-boats, had direct drive. This meant that a common shaft ran from the engine to the propellor through the motor (which doubled as a generator) with or
without the tail shaft connected by a clutch for a running or a standing charge. The principal disadvantages were that the engines had to be clutched in or out when surfacing and diving; and that engine-speeds had to be directly regulated to the required propeller rpm which implied mechanical inefficiency and imposed limitations on the type of diesel engines installed.

There was a simple way of improving efficiency and hence economising on fuel with direct drive; it was almost always used by U-boats but was not appreciated, apparently, by other submariners even when an extended range was badly needed. This was to propel on the surface on one screw at a moderate speed around nine knots with a running charge on one side and a standing charge on the other. This gave the Type VIIIC, helped by twin rudders, a surface endurance 10 per cent greater than at the same speed on both shafts. Pre-war engineering trials by the Royal Navy, conclusively demonstrating this not very difficult concept, were largely disregarded for no known reason by submarine operational staffs.

On balance the German Type VIIIC was thought by many submariners to be the best design anywhere for its purpose: when eventually equipped with a schnorchel it was outstanding. Even critics who said it was cheap and nasty (an unwittingly flattering description) had to admit that going to sea in HMS Graph (ex U-576) was an exhilarating experience which, frankly, was more than most submariners could say about their own boats in World War II. The underlying reason for the Type VIIIC’s comparative excellence was not, however, due to any particular German technological ability; it was simply that this class of submarine was built as a carefully planned ‘package deal’: it was a complete weapon system intended for war and war alone.
Submariners created an artificial world in which they lived for weeks and even months on end. There were few complaints that amounted to anything more than the traditional grumbling enjoyed by seamen everywhere, and even that was overridden by unmistakable pride. Men not only learned to adapt physically; they also, to a greater or lesser degree, reshaped their personalities. It was only the few that were unable to make these changes within themselves who were genuinely unhappy. Submariners were always packed together, frequently exhausted and quite often terrified; but provided they believed they were doing a worthwhile job—as a team—they were content. Habitability, or lack of it, was not a factor that greatly influenced morale; and there was no evidence to suggest that, given equal operational success, the crew of a relatively comfortable American fleet submarine was any happier or more determined than the 'Sea Lords' crowded together amidst the squalor of a German U-boat on a long-range tropical patrol.

Morale depended on success; and success depended, ultimately, upon the captain—far more than the weapons and material under his command. Men were willing to risk their lives with an aggressive, capable captain although they certainly did not think in such straight-forward terms. Danger was not foremost in their thoughts and it was rare, even at the worst period in the British Mediterranean campaign or when the Atlantic tide turned against the U-boats, for anyone to consider that his own boat might not return; or at least that is what most wartime submariners, looking back, say now. It did not matter if the captain was no gentleman (whatever that might have been); or if he drank too much in harbour; or if he brought the wrong girl to a party; or even if he was harsh and overbearing: if he hit the target and brought the boat back intact, his personal qualities were overlooked. But if he was weak or hesitant the discomforts of life below broke surface and the foundations of a unique and demanding form of discipline crumbled.

It was often the case that adversity, which included appallingly bad living conditions and moments of extreme danger, welded a crew so tightly together that, as Theodore Roscoe, the renowned US Naval historian, says of USS Puffer's ordeal on 9 October 1943, 'men who subsequently made several successful patrols on Puffer were still outsiders—not members of the gang. They had not been through the depth-charging.'

Every submarine acquired, one way or another, its own personality but the welding together of a crew still left ample margin for individual eccentricities that varied even more widely than the conditions, internal and external, under which these remarkable men served.

German U-boats were not designed for comfort; they were built for action. Doenitz ensured that his men had the best of everything available but his boats were entirely practical. Everything was subordinated to fighting ability. One boat of a class was mechanically the twin of another which greatly simplified training and maintenance. They were not built for a long life; but that was not because of disregard for life itself. The boats, like their crews, were intended only for war; and no war would last for twenty years—which was the designed life of Allied submarines.

A Type VIIIC U-boat sailing for a long patrol carried the bulk of its provisions stacked along the passageways to form a false deck. Clothing was wedged behind piping and into every corner. There were two heads but one of these was also packed with stores and in no sense could the one remaining be called a convenience, let alone a comfort station. The stench of oil fuel and human bodies pervaded everything and in heavy weather seasickness contributed its own foul odour. Fortunately, a submariner's sense of smell had a knack of deserting him—at least until the conning tower hatch was opened. It would have been pointless, at sea, to insist on uniforms but the German cold-weather leather gear and oilskins were superior, for their purpose, to anything issued in other navies including the USN. After the fall of France, when huge quantities of Allied materials were captured by the advancing German armies, British battledress proved particularly popular in U-boats but the 'Sea Lords' wore what they liked and only the captain was distinguished by the white cap which he donned on formal occasions.

In the bitter Atlantic winter it was impossible to find any clothing that would entirely keep out the cold and wet, especially when a boat was racing at top speed through high seas with the low bridge structure on which Doenitz insisted. The bridge was continually swamped and there was a real danger of being washed off despite safety harnesses: U-706 lost two men overboard on her first patrol. It needed drive, spirit and outstanding leadership to claw ahead of a convoy in the teeth of an Atlantic gale. Cooking, for long periods, was out of the question and it was then that the long, spicy sausages, hanging incongruously from the deckhead amongst the torpedo tubes, were most appreciated.

Kk Wolfgang Lueth told of life below when speaking on the 'Problems of Leadership in a Submarine' to a convention of Naval Officers at Weimar on 17 December 1943. He was talking primarily of his experiences in command of U-181.

'It is my job as a submarine commander to sink ships. To do this I need a co-operative crew so that everything clicks ... life aboard is monotonous for long periods. For many long weeks one must be able to bear failures, and when depth charges are added life becomes a war of nerves ... life aboard a submarine is unnatural and unhealthy ... there is no constant change between day and night for the lights have to burn all the time ... the captain must attempt to compensate for these disadvantages as far as possible ... there is no regular time for sleeping, since most of the fighting is done at night. Continuous responsibility rests with the captain for weeks and he must be alert at all times.'

Most of Lueth's Petty Officers were married and 'the rest were honestly engaged'. He considered that an advantage: 'though I know that a woman can break a man's fighting spirit, I also know that she can give him strength, and I have often observed that married men return from their leave particularly well rested for a new mission.' That was very true and British submariners, more than any, benefited from wives who threw all security to the winds and came to be near them whenever they could guess their port of
The galley in USS Torsk. A typical fleet-class stateroom for three junior officers, these quarters were positively luxurious by comparison with other navies and life was made very much more civilised by an abundance of fresh water.

Top Centre
The officer's territory in a US fleet submarine. The wardroom is on the right with the junior officer's quarters immediately beyond.

Top Right
The wardroom pantry in USS Torsk. US submarines were well supplied with trained stewards and there were usually two or even three of them. In the Royal Navy one steward was included in the complement of T-boats (although technically he was there to serve the captain only) but the smaller submarines simply pressed one of the ship's company, usually a fore-endman, into service as the wardroom 'flunk'.

Centre Left
The wardroom in USS Torsk. The captain's chair was his exclusive right, not only by deference but because it placed him close to the inter-communication system.

return. Indeed, submariners everywhere, in or out of wedlock, drew strength from the girls they left behind—and they were all too often left behind for ever. Those widows, wives and sweethearts deserve to be remembered.

Lueth had his own ideas about punishment. If china was broken the mess attendant had to eat out of a can for three days. Minor misdemeanours resulted in a man being deprived of smoking or, if he was a scat fan (a popular card game) he was forbidden to play for three days. One man who took more than his fair share of the rations was given ‘the silent treatment’ for two weeks. After that period the case was closed.

Lueth stressed the need for a precise routine being adhered to. It was a matter of honour for the watch to be relieved on time. In submarines everywhere, in fact, unpunctual reliefs caused more quarrelling than any other human failing. Waiting an extra three minutes on a sea-swept bridge bordered the bounds of tolerance and reason.

Alcohol was not normally allowed in a U-boat but the crew could ‘take a swig from the bottle now and then on special occasions, as when a steamer is sunk, if it is someone’s birthday or if somebody gets soaked while working on the upper deck.’ During an attack
a 'Victory bottle' was uncorked in anticipation and the Victory March was prepared for playing as the seconds passed. If, after two minutes, there was no explosion the waiting was ended with a crew-chorus of 'Schiet!', unmistakable in any language.

During supper in U-181 there was an evening concert of records. Sundays started with the popular German tune 'Yes, this is my Sunday song, to stay in bed at least till ten'; and if anybody had any clean clothes left he changed into them. The evening concert ended with the Abendländ sung by the Regensburg Domstatzen choir. Before sailing every man brought on board enough illustrated magazines to make up a general pool which distributed six new ones each Sunday.

(Some American boats adopted the same practice; if anyone cheated by looking at the comic strip ahead of time he was treated 'silently' like Lueth's offenders.)

The head, noted Lueth, was sometimes a problem when there were inexperienced hands aboard who did not know how to work it. A notice was installed to 'make it short' and there was a notebook which every visitor had to sign. If the head was not clean, the last man who signed it had to make it so. The little verses in the book gradually became so numerous that they could 'fill half an evening of entertainment'.

There were occasionally cases of venereal disease—by no means limited to German submarines—which might be cured by drastic treatment on board; but in U-181 shore leave was stopped without warning three days before sailing so that men would not 'make a last quick visit to a whore house'. This precaution was probably neglected by another captain who, on return to harbour 'would form up his men and, placing himself at their head, march them to the local brothel'. Lueth forbade nude pictures because 'if you were hungry you should not paint bread on the wall'. Allied submariners might have thought he was worrying too much about sex and submariners; sex reared its head in submarines everywhere but conditions at sea were not suitable for serious lascialness!

In harbour, of course, things were different . . . Venereal disease was always a problem for submariners living in close quarters and symptoms seldom appeared until after a boat had sailed. Prophylactics were issued free but if, as British submariners maintained, they were made from disused, heavy duty bicycle tyres, they may have been discarded with unfortunate results. The German High Command viewed the increasing number of cases in French ports with alarm. By 1942 it was regarded as cowardice before the enemy to become infected and the victim rendered himself liable to hard labour for up to ten years. The logic behind this harsh rule lay in the ease with which those who did not wish to sail in a U-boat could contract the disease; but there was little evidence that the excuse was deliberately sought.

U-boat officers were not allowed to listen to American or British jazz. Whether they liked it or not had nothing to do with the matter; 'they simply must not like it, just as a German man must not like a Jewess. . . .'

Lueth was a devoted Nazi and felt that his men's 'national socialist spirit with revolutionary ardour' gave them an important advantage over the Anglo-Americans; but, that apart, his brand of leadership would have been admirable in any navy.

Not all U-boat captains were like Lueth. One captain of U-606 rewarded a trivial offence, such as the purloining of a packet of cigarettes, with a term in prison or on the Russian Front. This captain, weak and inefficient, was accompanied by a tyrannical First Lieutenant and morale was poor. Shortly before Christmas 1942, U-606 limped into Brest with major defects resulting from a disorganised dive when threatened by a destroyer. On New Year's Eve the petty officers went politely to wish their captain a happy new year. They found that a party was in progress and on opening the wardroom door saw a vast array of bottles, some extremely dishevelled officers and a number of partly or entirely naked women. After a few moments of shocked amazement, one of the petty officers spat out a 'short but vulgar word' and slammed the door. The captain, however, had had the forethought to invite the Flotilla Commander to the party and the affair was eventually hushed up.

The crew of U-606 were not entirely confident when they put to sea for what was to prove their last cruise on 3 January. The First Lieutenant's nerve gave way during a counter-attack when U-606 broke surface after a dangerously deep dive to well beyond 200 metres while avoiding a Polish destroyer: he lost control of himself and ran through the boat, trying to get out through the after hatch. Later, after a bizarre series of incidents on the surface under gunfire from the Polish destroyer Burza and the American Campbell, most of the crew abandoned ship but the First Lieutenant, Engineer Officer and a handful of ratings stayed below until the firing died away; then they came on deck and kept the cold out with a meal of sausages and champagne laced with rum. Just before they were taken off by the Allied ships, a Petty Officer seized the opportunity to pay off old scores. He went up to the First Lieutenant, saying 'I have waited a long time to do this', and hit him hard across the face. He then jumped overboard. One of the other survivors was heard to cry 'What sins have I committed in my life that I should be sent to such a boat.' The story of U-606 was extraordinary and, happily for Doenitz, exceptional.

Much was made by the Allies from 1943 onwards about a supposed decline in U-boat morale. It was wishful thinking. U-boat men, with very few exceptions, continued to live their life below with the same cheerful acceptance of its hardships until the bitter end.

British commanding officers did not air their dedication as openly as Lueth. There were some flamboyant characters amongst them and the best recognised that, like it or not, they were in show business of a kind; but, whether hamming it up or not, a calm confident act (for, often, it was no more than an act) was essential. Usually they advertised their beliefs and successes in rather jerky understatements. It was not customary to extol Winston Churchill or to sing 'Land of Hope and Glory'. In fact, patriotic music and lectures were not considered necessary to enliven the crew in a British submarine which was a little—a very little—more comfortable than a German U-boat except for the tiny British U-class which bore the brunt of the underwater war in the Mediterranean. A good picture of one of these small submarines was painted by Signalman Gus Britton in a letter home from HMS Uproar in the Mediterranean in 1943:

'We have lockers about the size of coffins and also two smaller ones and a small table in the fore-ends. Hanging from the "ceiling" there are about fifteen hammocks so if you want to move about you have to do it in a crouched position. In one corner there is a wash-basin and to use it you have to squeeze behind the tail of a torpedo and put a hand either side of the coxswain's hammock. Potatoes and cabbages are piled in one corner and, as it is as damp as Eastney Beach, after six days there is a horrible smell of rotted vegetables and refuse is only ditched at night and on top of that there is the smell of unwashed bodies. . . . At the moment we are doing about eighteen hours dived every day so you can guess it is pretty thick at night. Before I go any further don't think that I am complaining because I really love submarines and this sort of life and I wouldn't swap it for anything.

'What a blessed relief when, at night, comes the order "dining stations" and about ten minutes later the order "blow one and six". The boat shudders as the air goes into the ballast tanks and then up she goes! I am at the bottom of the ladder in the darkened control room and sing out the depth which I can see on the submarine's gauge—25 feet—20—15—10—5; and then the Captain opens the hatch and up rushes all the foul air just like a London fog and if I don't hang on I would go up
with it as well. Beautiful, marvellous air... we are provided with some top-notch waterproof gear but the water always seems to find a weak spot to trickle into. Upon the swaying bridge, with a pair of binoculars which you try to keep dry to have a look round between deluges of water, soaked and frozen and saying to yourself "why the **** did I join!" Then, when you are relieved, you clamber down the ladder, discard all the wet gear and go into the fore-ends, have a cup of cocoa, turn in, and as you fall asleep, you think 'well its not such a bad life after all.'

During the critical years from January 1940 to November 1942, the British Submarine Service had the good fortune to be commanded by Admiral Max Horton who had had a most distinguished record in submarines during World War I. His intimate understanding of life below conferred a significant advantage over senior commanders in other navies. Max Horton was a well-matched opponent for Karl Doenitz and was ultimately to beat his U-boats when he left submarines and headed the anti-submarine war as Commander-in-Chief Western Approaches from November 1942 onwards. But Horton's ruthless insistence on efficiency did not make him popular. In September 1941 he summarised his ruthlessly high standards in an address to all officers and men in harbour at Malta:

'. . . it is not a kindness to overlook slackness or mistakes. It is really great cruelty to do so—cruelty to wives and relatives of the man you let off and his shipmates and to yourself. There is no margin for mistakes in submarines: you are either alive or dead.'

Like Doenitz, Horton did his best to ensure that his submariners had the best of everything despite wartime difficulties. Admiralty Fleet Order 3072.42, at his insistence, made it clear that no food-rationing for submarines was to be enforced. This worried the Paymasters. The Superintendent of the Malta Victualling Yard observed worriedly that 'the only consideration is presumably that of cost' and a Paymaster Lieutenant noted with alarm that the General Mess Allowance was 'exceeded by some four pence per man per day': it was cheap at the price if the Captain of the First Submarine Flotilla was correct in minuting that 'at a conservative estimate these men (his submariners) eat at least eight pounds daily.'

However, submarine menus were scarcely appetising. The coxswain, who was responsible for messing in British boats, had little or no training in catering (although he was carefully instructed in how to distinguish horseflesh from other meat) and was mainly worried about keeping his books straight. A qualified cook was not always carried; and even if he was, his task was not easy. Night was often turned into day on patrol so that cooking could be done while on the surface; but the heat in the galley at night was still fierce and sweat was freely mixed with other ingredients which included oil fuel and cockroaches. The bread embarked on sailing soon grew stale and after ten days even the most parsimonious coxswain was forced to admit that cutting off successive layers of green mould on the outside of each loaf left too little edible crumb to make the job worthwhile. The solitary chef then added baking to his repertoire and the delicious aroma which resulted almost overcame, for a brief half-hour, the hideous smells that normally pervaded the whole boat. With fresh water strictly rationed and seldom available for washing, except in a communal, greasy bucket, the chef, after a session of
Tomato known leaden ultimate was a cake very form like delicacies seldom found in British boats where the ultimate delicacies were Cheese Oosh (a flat, leaden form of soufflé), HITS (Herrings in Tomato Sauce) and Baked Beans ('Windy Beans', known as Haricots Musicales in French submarines).

A cake like this one, in an American submarine, was very seldom found in British boats where the ultimate delicacies were Cheese Oosh (a flat, leaden form of soufflé), HITS (Herrings in Tomato Sauce) and Baked Beans ('Windy Beans', known as Haricots Musicales in French submarines).

Rum was issued at the rate of one-eighth of a pint per day per man but this did not include officers who never drank at sea (although they made up for it in harbour). It was a constant problem to know when to issue spirits: a tot of 120 proof rum could have an interesting effect on a man already tired, short of oxygen and over-supplied with carbon-dioxide during a long dive. Junior ratings were supposed to have their tot mixed with two parts water to prevent it being kept; but rum was usually issued neat on the questionable grounds of it then being less soporific. Ratings sufficiently removed from the control room sometimes saved up their rum rations in a 'blitz bottle' for consolation during a depth-charge hammering. Since every man, during a submarine's commission, drank seven and three quarter gallons of rum, its transport and storage presented a sizeable security problem. Rum containers suffered an uncommon amount of 'breakage' in transit, and, on board, a generous amount of 'spillage' was allowed for by the Admiralty.

British food was adequate if not imaginative although stewed prunes and kippers for breakfast on the first day out in a list of meals prepared by one Supply Officer was inventive enough; that must have stifled criticism from the start! The principle difficulty lay in getting rid of the waste. Gash of all kinds was pushed into recking buckets and bags and ditched, as a carefully planned evolution, on surfacing. Over-flowing containers were hauled up the swaying conning tower in
The forward mess in HMS Tempest.

The forward torpedo compartment of U-552, the famous Red Devil boat which, under the command of Erich Topp, was the third highest scorer of the war, sinking nearly 200,000 tons of Allied shipping. Turning-in fully dressed was usual in boats everywhere because the crew were liable to be called to diving or action stations at any moment and every second counted.

The crew of HMS Graph (ex U-570) were hand picked, older and more experienced than usual. The mess-traps in this photograph were decidedly British!

The game of avoiders, as played in submarines, was not at all the same as the polite and gentle game of ludo played ashore!

near darkness on the end of a rope and the contents, weighted to make sure they sank quickly, were jettisoned over the side as quickly as possible so as to reduce the period of vulnerability during which the boat might lose valuable seconds in diving. Inevitably, disgusting garbage was spilt as buckets caught on the ladder rungs; it was a messy operation but gave the crew a cathartic feeling of relief when it was over.

The heads were a continual hazard and in some boats they were open to view adjacent to living spaces. Blowing the contents out to sea when submerged required the permission of the officer-of-the-watch because of tell-tale bubbles; and no less than eleven distinct operations were required. A mistake resulted in an unpleasant occurrence known as 'getting your own back'. One German boat, U-1206, was actually lost as a result of the captain himself (Kptlt Schlitt) making an error in the drill which resulted in a flood of seawater penetrating the battery compartment below and generating chlorine gas: U-1206 was depth-charged by an aircraft when it broke surface to ventilate and the boat had to be abandoned.

Life below was similar for most Allied submariners; but the French, particularly, enjoyed something approaching real cuisine despite having to use, for the most part, basic British provisions. Good wine, of course, helped. Perhaps it was for fear of spoiling the palate that smoking was forbidden at all times in French boats. British Liaison Officers, Signalmen and Telegraphists were embarked in Allied boats not to assist in their operations, let alone give advice, but to ensure the security of British signal procedures and ensure that orders and signals in English were properly understood. Sub-Lieutenant Ruari McLean in FF Submarine Rubis reported that 'Rubis is a French submarine, not a Free French one ... patriotism and loyalty is not to de Gaulle (who, however, they admire) but to France and is as strong as an Englishman's to England ... if they are captured by Germans they may not be shot but if they are captured by Vichy Frenchmen they certainly will be shot ... they are fighting Germany for France not for Britain ...'
Life below in Rubis circulated around vigorous arguments and excellent food. The French were constantly critical of all English habits and the Liaison Officer came under fire at every meal for eating from the back of his fork and for drinking soup from the side of a spoon. Spirited discussions included the possibility that the King of England was a Jew and that the papacy was invalid for a number of imaginative reasons. (No serious submarine conversation anywhere was impeded by unnecessary facts or inhibitions).

On one memorable occasion there was a detailed debate on how best to furnish a bedside table for a honeymoon. McLean, who was well liked anyway, was accepted into the company with more interest than had, until then, been evident when he produced a parcel sent from his (maiden) aunt from New York: unwrapped, it proved to be a selection of six celebrated erotic novels. Roussclot, the Captain, claimed he could smell perfume on them.

The chef in Rubis was a genius called Gaston and he had interests ashore outside his galley. He had liquid, pathetic eyes that went down particularly well with the women of Dundee and he was currently sleeping with both a mother and her daughter. Gaston produced his greatest culinary masterpiece in August 1941 when Rubis, badly damaged and unable to dive, had crossed the German minefields in the North Sea and was at last under escort by the Royal Navy and RAF. The whole crew came onto the casing because a battery fire made it impossible to remain below; the upper deck galley fire was lit, and Gaston went to work. The officers very properly took their meals abait the conning tower and the crew were relegated to the casing forward. Dinner started with soup, accompanied by port or sherry, and was followed by cold ham, cucumber and salad on silver dishes, anchovies, spring onions, hard-boiled eggs, hot French tinned peas and new potatoes. Fruit salad and dried apricots washed down with two bottles of white burgundy were offered as a sweet; and the picnic concluded with coffee and cognac as the sun went down. It was an excellent example of how the French were able to put war in its proper perspective.

It is difficult, even now, to form an accurate picture of life below in Soviet submarines. British submariners operating from Polyarnoe found that the base was dismal and certain essentials were lacking. Commander G P S Davies RN begged Admiral Horton on 13 November 1941 for 'a supply of bumph (service brown) to be sent to us as opportunity offers. It is unknown in this country and Admiralty Fleet Orders are liable to give one piles'.

There were frequent air attacks on the base at Polyarnoe and the Russian Commander-in-Chief worked in one of a number of shelters tunnelled into the solid granite rock. Life was hard. It was forbidden to sell liquor to naval officers and ratings on the base but the edict seems to have been avoided because Captain Third Rank Zhukov managed to come by plenty of the hard stuff somehow and was relieved from the command of K-27 for his addiction to the bottle ashore. Red wine was sometimes issued to submariners but the normal ration of alcohol was 100 grams (3.5 ounces) of vodka at noon each day. Food in Russian boats was dull, even by British standards, according to a Royal Navy stoker who was victualled for six months in a Soviet submarine; but he was probably missing the huge family-economy size bottles of tomato ketchup and brown sauce that decorated all British mess tables. Herring figured largely on the menu in Soviet boats but the celebration meal prepared on 5 December 1941, Constitution Day, by the cook of submarine D-3 was special and devoid of fish. The cook, according to the Division Commander, 'went out of his way to turn the ration of greats and canned beef into a dinner worthy of the occasion', while somebody else prepared the traditional borsch.

Electric radiators—30 in the large K-class—were installed for keeping crews warm in winter at sea and steam pipes were led from shore in harbour. These measures did nothing to dispel the chill emanating from commissars who wore uniform similar to other officers but had vermillion between the stripes and no oak leaves on the cap. A commissar was responsible for welfare, food, pay, routine, punishment, requests, advance- ments, leave and, above all, the political instruction of the ship's company. He also kept a fatherly eye on the political leanings of the officers and countersigned orders but not (it was thought) actual operation orders. Captain, later Rear Admiral I Kolyshkin (a submarine Division Commander during the war) made several rather endearingly naive references to commissars in his memoirs, amongst them one who 'gloomily frowning, with brows angrily drawn together, looked as if he were always discontented... in reality he was the kindest of men...'. This commissar (Gusarov) apparently stayed on the bridge 'almost the whole night long'. In this respect he outdid the captain and 'nobody knew when he slept. In the daytime he could be seen... presiding over a short meeting of agitators, having a talk with the editorial board of the wall-newspaper or simply talking to the men in his taciturn but extremely sincere manner.'

The icy cold Soviet winters and the long-lit summer days were far from ideal for submarine operations of any kind. Twelve days on patrol, with a total of seventeen days out, were all a crew could be expected to undertake with reasonable efficiency. Conditions in Russian submarines were probably far worse than those of their Allies but, to Russian sailors, they were so much better than those endured by the civilian population that they may have seemed idyllic. A particular pleasure for Russian crews was to come ashore and watch films like Snow White or Robin Hood (both with Socialist overtones) provided by the British Staff and approved by the Communist Party.

American sailors had the best of everything and would never have tolerated sub-standard conditions although there was a tendency, especially amongst the officers, to adopt a frontiersman attitude to life below to emphasise its ruggedness. Stubble-darkened jowls were, in fact, quite unnecessary: Kleinschmidt electrically operated distillers produced about 700 gallons of water each day and American submariners, unlike those in other navies, were not short of water for washing; many boats carried a commercial washing machine and it was possible to wear clean clothes throughout a long patrol. Efficient Freon air-conditioning plants were also fitted and the British Assistant Naval Attache in Washington remarked that there was a 'noticeable absence of smells from cooking, smoking or other gases' and that 'the well-known submarine fug is never present as long as the plant is kept running'. Smoking was usually controlled but the air conditioning was said (wrongly) to prevent the atmosphere from becoming foul if the crew were only allowed to smoke for twenty minutes in every hour when dived. Air-conditioning had the obvious advantage of keeping the boat cool but, much more importantly, the dehumidifying effect reduced the number of electrical defects suffered in other navies due to damp. This last invaluable advantage was not, however, noted by British visitors—or, at any rate, the submariners amongst them did not think it worth reporting—while American submariners took sound engineering practices for granted and did not trouble to point them out.

After a week at sea, the BNA reported that vitamin pills were issued to the crew every day and 'a noticeable improvement in health has resulted and, in particular, they appear to help in relieving constipation.' That was doubtful: it was the sophisticated heads which helped in relieving this common submarine problem; in the modern boats, instead of
being blown direct to sea whenever used, the heads drained down to a large sewage tank in the forward torpedo room which could be discharged when operationally convenient. It did not always work: in Hawkhill sea pressure leaked into the tank and eventually lifted the relief valve with potentially catastrophic results which were only avoided by the valour of Ensign Rex Murphy who waded into a ‘miasmic fog’ and held the valve shut for one interminable hour until the boat could surface.

In American boats attention was paid to details which other navies did not bother about but which cost little in terms either of space or money. Waterproof bunk covers, for example, enabled men coming down from the bridge or going off watch in dirty clothes to take a rest without soiling the bedding. Decor, too, was given due attention. Sometimes it was startling. At the height of the Pacific war Mare Island Navy Yard despatched the following message requesting the authority to paint the interior compartments of USS Trigger: ‘... Torpedo Rooms light pea green, Wardroom light green, Control Room and Maneuvering Room sky blue, Engine Room dark sky blue, Crew’s Mess Light blue X University of California scientists recommend for morale and psychological reasons X’. Everybody wanted to help US submariners; but it was sheer size—four times the space for only twice the number of men—that made habitability in American submarines so superior by comparison with others.

Most of the US Pacific submarines carried a pharmacists mate and valued him highly. Corpsman ‘Doc’ Lipes in USS Seadragon removed a troublesome appendix after a two-and-a-half hour operation ‘with the help of God and a long-handled spoon’. It was one of three operations of that kind before the doctors ashore stopped what they unkindly called an ‘undesirable medical practice’. One crew, though, faced a far worse prospect than any surgeon’s knife when their captain, determined to cure any submariner’s most usual complaint, marched into the control-room from the engine-room blowing soapy bubbles from a 12-inch grease-gun converted into an enema syringe.

The formal language of wartime patrol reports and the sometimes biting endorsements from above (occasionally abetted by disloyalty from below) gave the impression that American submariners took life too seriously. They certainly worried about the effects that their patrol reports would have; but, inside the boats themselves, a rich, basic and sometimes black humour prevailed. It was typified by the tale of a captain whose idiosyncracy was to demand, with threats, that every cup of coffee delivered to him on the bridge must be completely full. Only one (coloured) steward was able on every occasion to meet his requirements: the rest invariably spilled the contents during the long and difficult journey up the conning tower ladders. At the end of the commission the executive officer at last persuaded the steward to reveal his secret. The huge ebony face split into a grin. ‘Well, ah guess ah can tell you now,’ he beamed, ‘ah always take a good mouthful at the bottom of the tower and spits it right back where it belongs when ah gets to the top—sah!’ Discipline and morale had been properly preserved to the last by a simple expedient which any submariner would have thought entirely sensible—a good example of sound submarine commonsense!

Lieutenant Commander G C Koziolowski — better known as ‘George’ to everyone in the British Submarine Service. This gallant and popular Polish Officer, who succeeded the famous Borys Karnicki, commanded Sokol during her second commission patrolling from Malta 1943-44. Polish Officers and sailors quite often wore something like a hair-net but this habit was most emphatically not indicative of an effeminate nature as their fine war record shows — ashore as well as at sea!
5 Finding the Way

With a potential draught, in effect, of 50 fathoms or more, submarines needed even more careful and precise navigation than surface vessels. They had to operate inshore and close to minefields; they had to keep to narrow safety lanes on passage to avoid attack by friendly forces and stay within strictly delineated patrol areas on arrival so as not to risk mutual interference; and they had to be in the right place at the right time to intercept enemy units.

Unfortunately, submarines were not well equipped to meet these requirements. They did not carry specialised navigating officers like their sisters on the surface and there was neither room nor protection for chartwork on the bridge. When on the surface, bearings from landmarks and sextant readings had to be sung down the voice pipe to the plot in the control room below where they might or might not be heard and written down correctly. The enemy was not so considerate as to tell the world, in war, about changes made to buoys, navigational marks and beacons; and leading lights and lighthouses were usually extinguished except for brief periods when required by his own forces. Radar, from a navigational point of view, was still in its infancy: bearings were inaccurate and ranges from a submarine radar aerial so low down were not dependable; they did not show the nearest point of land but only those peaks which were above the radar horizon, hills or mountains well inland. Gyro compasses were temperamental and easily upset by violent angles, interruptions in electrical supplies and depth-charges. Gyro precession, significant in Northern latitudes following a rapid alteration of course, was not—could not—be allowed for; and navigators, wherever they were, did not, as a rule, appreciate the importance of frequently checking a gyro against the sun.

Even in an ideal position, where shore marks were clearly visible, a three-bearing fix, from which all three lines should have passed through a point, often resulted in a sizeable ‘cocked hat’ due both to gyro error and to the physical difficulty of taking a bearing on the bridge with the sea or spray washing over. Standby magnetic compasses were unreliable and difficult to steer by because the repeaters swung lazily. The compass itself was encased in a brass housing outside the hull, to obviate as far as possible the submarine’s own magnetic effect, and the compass rose was reflected down to the control room by a series of mirrors. The reflection became indistinct or clouded if moisture entered the projector tube, as it often did, and however much care was taken to adjust compass deviation by swinging the boat before sailing on patrol, deviation soon became an unknown factor as the submarine’s inherent magnetism changed, unpredictably, due to the buffeting of the sea.

Speed, and hence distance run, was, in theory, obtainable from log readings but these were notoriously inaccurate. The Chernikeef type log, which slid downwards through the hull, depended upon a small propeller which quickly became decalibrated or choked by weed; and the Pitometer type, fitted in the same way, depended upon the measurement of water flow through an open tube device which was also easily blocked. Even when operating perfectly neither kind of log was trustworthy at all submarine speeds and was only reasonably dependable over a narrow range of, say, five knots at medium speed: either side of this bracket, and particularly at the very low speeds between one and three knots which a submarine used for long periods dived on patrol, the readings could be wildly misleading.

Nonetheless, inexperienced commanding officers and navigators had a touching faith in the navigational sensors at their disposal which sometimes included an automatic plotting table purporting to show the submarine’s position at any moment by a beam of light projected upwards onto a plotting sheet; this instrument had its own deficiencies as well as a facility for compounding compass and log errors. No wonder that submarines so frequently found themselves far removed from their dead-reckoning and estimated positions when their true positions eventually became apparent after a long while, sometimes days on end, without a fix. It is only surprising that submarines did not more often find themselves in serious navigational difficulties, equipped as they were with less than trustworthy instruments and manned by navigational teams who, in many cases, had a lack of training and expertise that would not have been tolerated in an average merchant vessel. The boats which had an officer from the Merchant Navy or Coastguard—the equivalent—did not always realise how lucky they were!

Navigators, like trimming officers, were fair game for the rest of the Wardroom. A favourite ploy (invented quite independently, it seems, in the USN and Royal Navy) was to prime the officer-of-the-watch, in mid-ocean, to call down some imaginary bearing of land. The best results were observed if the navigator was enjoying a quiet nap from which he could be shaken to plot the ‘fix’. His panic-stricken reactions never failed to draw applause from an appreciative audience. It might be said that submariners, as a race, were easily entertained.

Away from land every opportunity for taking sun, moon, planet and star sights had to be snatched. Sight-taking with a sextant was treated as an evolution; if surfacing primarily for that purpose it was combined when possible with ditching gash—which made matters no easier for the navigator competing in the conning tower and on the crowded bridge with a hustling gash party, the lookouts and the sea itself. The smallest drop of water on the sextant mirror made sight-taking impossible and the instrument had to be wrapped tenderly in a towel when not actually bringing the observed body down onto the lurching, irregular horizon which, with so low a height-of-eye, made the task doubly difficult. The ‘exec’ was primarily responsible for navigation in American boats (assisted by excellent quartermasters) but German commanders relied upon the equivalent of a specially trained warrant officer to take sights. Most British captains thought sight-taking far too important to entrust to Vasco (the navigator) and did the sextant work themselves; but they were quite happy to delegate the long and boring working-out of the sights when they were taken! It could easily take an hour to plod through the spherical trigonometry (which actually amounted to no more than straight-
forward arithmetic) before arriving at a solution which almost invariably produced a large cocked hat; this led to thinly veiled hints from Vasco to the effect that the captain was incapable of reading sextant angles, and to more direct accusations from the captain that the navigator was incapable of simple addition and subtraction. Some boats carried rapid reduction tables derived from air navigation manuals which greatly shortened the time required to produce a fix; but the Royal Navy and most other services clung doggedly to Inman's Nautical Tables with their long columns of five-figure logarithms.

It was naturally a temptation to surface at noon for a meridian sun-sight which gave an immediate latitude and a handy gyro-check without lengthy calculations; but the word quickly spread through both German and British submarine services that boats were being caught napping in this way by aircraft who were apt to appear, as an unwelcome interruption, coming out of the sun whose angle the sextant was measuring. It was reluctantly conceded by both sides, quite early in the war, that it was a great deal safer to surface at dawn or dusk for star-sights than to take the easy way out at mid-day. Some submariners brought bubble sextants into use; these, by providing an artificial horizon, obviated the need for taking star-sights at dusk or dawn which were the only times when stars and the true horizon could be seen together. Others were, sensibly, reluctant to use this device which required a stable platform and was intended for less precise aircraft fixes; it was apt to give misleading results on the unsteady bridge of a submarine in heavy weather.

Some USN submariners claimed that they pioneered a way of taking star-sights by night against a dark horizon by using telescopes converted from binoculars cut in half. Apart from involving a lot of explaining to the
The triangular navigational D F aerial on the after casing of HMS Ushaken. It was a doubtful asset, apt to give misleading results and not often used in war.

Wheel, compass and navigational D F aerial on the bridge of HNMS O-16.

‘Faithful Freddy’, the standby magnetic compass, normally stowed below, being ‘swung’ in HMS Stonehenge.
Supply Department, the home-made device must have led to alarmingly inaccurate fixes. It was another of several instances, more noticeable in the USN than elsewhere (although no navies were entirely innocent), of instrument readings being taken at face value and accepted without enough justification.

With all these uncertainties, very careful dead-reckoning was an essential part of submarine navigation and this required particularly careful hand-planning using precise speeds determined against specific shaft revolutions when running over the measured mile on trials. Due allowance had (or should) subsequently been made for speeds being lessened by increasing fouling of the hull. The dead-reckoning (DR) position was then converted to an estimated position (EP) by applying tidal streams and currents predicted by tidal atlases which seldom, however, gave accurate figures (during the war) for currents below the surface: keeping track of the EP, hour by hour, was a painstaking process but was well worth the trouble.

After a prolonged action, when speeds and courses had frequently been altered, it was particularly difficult to reckon the boat's final position from the scribbled log kept in the control room. Submariners who trusted automatic devices, or who believed unquestioningly in hasty unsupported fixes without checking the EP by hand-plotted were soon lost. Keeping the EP up-to-date, though, was sometimes very hard. For instance U-763 (Kptlt Ernst Cordes) was discovered by destroyers off Selsey Bill on 6 July 1944 and forced, blind, to evade their attentions, which included 550 depth-charges, for 30 hours. During this hectic period accurate dead-reckoning, let alone proper allowance for tidal streams and currents, was impossible.

When U-763 finally drew clear the echo-sounder showed depths incompatible with the supposed position some 20 miles north of Cherbourg and navigational D/F bearings made no sense. Cordes concluded that he was probably between the Channel Islands and he steered north towards what he hoped was deeper water because he had already grounded several times. Early in the morning of 8 July he ran aground again. When at last he cautiously came to periscope depth he was faced inescapably with visual proof that he was actually in Spithead, the most famous of all British anchorages! Probably because there was so much shipping and activity in the area, his presence was not suspected and he was able to work his way safely back to Brest. No submarine had adequate navigational facilities to keep track of its movements in circumstances like those in which U-763 found herself and singularly little attention, in any navy, was given during the war to improving them.

Echo-sounding, to compare with the depths shown on the chart, was a help but E/S transmissions were close to the frequencies to which hydrophones and Asdics were tuned; they could be detected unmistakably at long range. It was possible to limit these transmissions by making a 'snap sounding' but the reading given was not then necessarily correct; a shoal of fish below the submarine or even a patch of cold water could give a false depth which might not be recognised as such by one or two transmissions alone.

Medium-frequency direction-finding (D/F) aerials, for use with commercial shore-based M.F.D/F beacons, were fitted in many boats but the line of bearings gave only a vague indication of position due to bearing inaccuracies. The most potentially useful radio aid evolved from a German long-range navigational system with a curious history. In February 1943 British radio monitors detected some strange signals being radiated on a frequency of 316 Kcs from a vast aerial array at Quimper near Brest. They soon discovered that these transmissions were beamed to give bearings of hitherto unknown accuracy out to one thousand miles for German ships, U-boats and aircraft in the Atlantic. No special aerial was needed in a submarine and the radio operator simply had to count a series of dots and dashes which gave the boat's bearing from Quimper when referred to a special chart. Further stations were discovered at Petten in Holland, Stavanger in Norway and then at Lugo in neutral Spain. The British government's first thought was to send a strong protest to Spain but, upon reflection and at the suggestion of Dr R V Jones, Head of the Scientific Intelligence Department at the Air Ministry, it was decided to keep quiet and make use of these transmissions for Allied aircraft. Since the Germans called the system 'Sonne' (Sun) and the Allies were going to find their position 'with sun' the Spanish words con and sol were put together to make the name CONSOL. For Allied use, CONSOL cut air navigation errors down from the customary 30 miles (and sometimes more) over the Atlantic to a mere five, which was the same degree of accuracy as U-boats were now enjoying in their major operating areas against the convoys. Unfortunately, Allied submariners seldom operated in areas where cross-bearings, and hence fixes, could be obtained. LORAN, a more sophisticated radio aid was more useful but was fitted very late in boats outside the USN. Meanwhile, Sonne became invaluable to German submariners and aircrews when, rarely, aircraft were made available to co-operate effectively with U-boats; however, it came too late, like so much German technology, to influence the battle to any real extent. When the Allies came to know about it, it is questionable whether they made the correct decision to let it continue for their own benefit, rather than jam the frequencies or by some means stop the transmissions which were giving Doenitz so much help.

Submarine navigation was, then, generally more of an art than a science although it was a good deal more scientific in some boats than in others! Submariners who admitted to themselves that neither navigational facilities nor training were very good were able to allow for the errors which were bound to occur; and, despite the difficulties, the most successful captains, perhaps more by a submariner's instinct than by calculation, had a knack of turning up at the right place at the right time. It was the navigationally overconfident captains who ran into trouble.
6 Communications

It was seldom possible for a submarine, especially a German or an American boat, to operate effectively without communicating with its shore operating authority. Communications were not welcomed by submariners who preferred to be fully independent; but with a submarine's small radius of search, commanding officers had to be directed towards certain targets or ordered to shift patrol to likely areas; and this involved a good deal of signal traffic.

Broadly speaking, signals were sent to submarines but submarines were only exceptionally expected to send messages to shore. The most important exceptions were enemy reports (to which anything else of immediate interest, such as a weather report, was added); and these were collated at base (e.g. BdU) and broadcast to other units. Any radio transmission from a submarine at sea (necessarily HF as a rule) risked interception by monitoring stations which were able to measure the bearing of the transmission by direction-finding—DF—but not the range. Two widely spaced stations could report cross-bearings which, if plotted on a chart, intercepted at the approximate position of the boat transmitting. However, that position was far less precise than submariners had feared before the war: bearing inaccuracies (according to intelligence reports to BdU) resulted in average errors of 60–80 miles at a range of 300 miles from the intercept stations and often amounted to much more. The least error reported was 30 miles and the largest 325 miles—the latter at 600 miles from the D/F aerials. However, when HFD F (Huff-Duff) came to be fitted in Allied escort vessels towards the end of 1941 the same technique could be used tactically at sea, with much greater accuracy at closer ranges, to pinpoint U-boats passing the reports on convoys which were so essential to Doenitz for homing wolf-packs in to the kill. The use of radio by submarines was always a calculated risk but commanding officers who kept quiet for the sake of safety were not apt to be forgiven.

Submarines could normally only listen to HF traffic on the surface although some boats were equipped with raisable masts which could be used at periscope depth for both transmitting and receiving. Traffic was therefore usually passed from shore on Very Low Frequencies (VLF), typically around 16 kilocycles (16 KHz), whose ground-waves followed the curvature of the earth and enabled submarines to listen at periscope depth virtually worldwide. The wavelengths for such low frequencies required proportionally long transmitting aerials ashore as well as very powerful transmitters. VLF transmitting stations were fundamental to both Axis and Allied submarine operations and it is difficult to understand why greater efforts were not made to render them inactive either by bombing or sabotage. A concerted effort to destroy them, or even put them out of action temporarily, would have had a profound effect and they would have been difficult to replace quickly since the ideal length of VLF aerials was reckoned in kilometres. The reason why short radio installations were not attacked was probably that the enemy codes on all sides were, at one stage or another, broken, and the information gained was decided to be so valuable that highly secret monitoring stations had no wish to halt the flow of intelligence. If this was so, it was arguably a wrong decision and it must have arisen from the security restrictions which enabled code-breakers to deal in very high places without necessarily going through normal military channels.

Since it was extremely undesirable for submarines to acknowledge the receipt of VLF messages, which they would have to do by using HF frequencies vulnerable to DF, they were broadcast and repeated at regular, predetermined times throughout the day to ensure reception. Rugby VLF transmitter, for instance, broadcast routines every four hours and repeated messages at least three times; it was therefore mandatory for submarines to read at least every third routine but they also kept constant watch, when possible, for priority signals which were broadcast at any time. Each signal was numbered and the numbers preceded each routine so that a boat knew if it was missing any of a series. This was important not only to ensure that all relevant messages were received but also to avoid the need to steer an optimum course, towards or away from the transmitter, for long periods at periscope depth when this was not necessary and might well interfere with operations. W/'T routines had a considerable effect upon the conduct of a submerged patrol: the optimum course might drain the battery if it was adverse for maintaining depth in relation to the sea; and if a submarine inadvertently went a few feet deep, even for seconds, vital encoded groups were missed and these could not afterwards be filled in by guesswork.

The commanding officer took a personal interest in radio procedures and no transmission could be made without his authority, confirmed by the officer-of-the-watch on the bridge who ensured that nobody was touching the aerial. Aerials attached to the bridge were a particular hazard, especially for anyone relieving himself over the side (in the absence of a 'pig's ear' funnel inside the bridge); practically any liquid was an excellent conductor of high-voltage electricity!

Radio operators were carefully chosen and felt their responsibilities keenly. They kept long hours on watch and their job required intense concentration, especially in U-boats listening to merchant ship chatter in a foreign language on the 600 metre wave-bands. In many boats radio-men doubled as hydrophone, adic and radar operators until specially trained ratings became available. They worked hard but at least they did not have to endure the rigours of bridge watchkeeping. Like all submariners the men at the Morse-keys were staunch individualists and several had a dangerous weakness: they could not resist adding their personal signature to the signals which they sent. This was easy enough to do by fractionally deviating from the standard length of dots and dashes at the end of a signal; these made the operator (and hence the boat) just as easily recognisable to an enemy interceptor as to a friend at the legitimate receiving station. It was a practise that proved hard to stamp out and resulted in a good many Allied boats being fingerprinted by German monitoring stations.

All except the most urgent enemy reports were encoded. The beginning of each message specified the classification and by whom it should therefore be decoded. The task usually fell to an officer and very highly classified messages were dealt with only by the captain
himself. Before the advent of decryption machines this was a process which could take half-an-hour or more: the groups of figures had to be subtracted from rows of other figures in secret signal publications and then referred to 'dictionaries' to find the words they represented. Signal books were a constant source of anxiety for the unfortunate communications officers. They had to be mustered page-by-page and courts-martial resulting from the loss, or more often mislaying, of a single sheet were common.

The security of codes was obviously paramount but the ability to break them was an even more closely guarded secret. When the German Enigma encryption machine was introduced, Doenitz believed its messages were unbreakable, presumably on the advice of the B-service whose own success in breaking Allied signal traffic told Doenitz most of what he wanted to know about convoy sailings. No form of encryption guaranteed total security although certain one-time-only systems came close to it. However, code-breaking could take an unacceptably long time unless computers like the British Colossus were used. The British knew of the Enigma system as early as July 1939 when a Polish crypto-analyst gave the Admiralty two machines. These, by themselves, were not enough to crack the codes but a windfall occurred on 9 May 1941 when U-110 (Kptlt Julius Lemp) was heavily damaged by depth-charge attacks following an attack on convoy OB318. Lemp blew his disabled boat to the surface and the nearest escort, HMS Bulldog, at first turned to ram but then decided to see what could be recovered from U-110 before finishing her off. The U-boat's crew were taken off and sent below decks, where they could not see what was happening, while a boarding party, painfully conscious of the probability of demolition charges exploding, clambered down the conning tower and into the tiny

Top Right
Radio shack in a US fleet submarine.

Centre Right
HMS Ossur showing her aerials and the mast primarily used for HF communications. Masts of this type were hydraulically raised but were clumsy and gradually phased out.

Bottom Right
HMS Seaog showing aircraft recognition flares on the after periscope standard. These were considered very necessary in the event of 'friendly' aircraft appearing even when the submarine (as seen here) was being closely escorted through Allied-controlled waters.
Radio operator in U-73 (Type VHC). This rating, as in all navies, had to be a cut above the average and in U-boats was expected to gather intelligence from Allied merchant ships 'chatter'.

Opposite Bottom Left
HMS Unbeaten was fitted with aircraft radar and IFF (Interrogation Friend or Foe) in September 1942 but it did not save her from being sunk by an RAF aircraft at 0220 on 11 November well within a bombing restriction area. Airguard radar could by no means be trusted to give certain warning of an approaching aircraft.

Opposite Bottom Right
VHF aerial arrangement on HMS Scythian between the periscopes.

Below:
HMS O-19 surfacing. Like most Allied boats the VLF reception aerial was strung from forward to aft along the length of the jumping wire (port side in this case). radio office opposite the captain's cabin. It is still not known why Lemp's crew were unable to carry out the standard orders for destroying secret equipment and papers; but the search party were able to bring back the Enigma machine with a signal already set up for sending together with associated code books. The settings were valid only until the end of June but the information gained was enough to enable the Allies (including some outside a hitherto tightly-knit group of code-breakers) to decrypt a proportion of the signals passed in Hydro code. The staff at BdU did not realise that the system had been compromised and continued to use it. The men of the powerful code-breaking organisation in America were, incidentally, far from pleased; they already had enough material to solve their puzzles and were afraid that the incident would jeopardise future work. It would, anyway, be wrong to think that the U-110 haul contributed in any major way to the defeat of the U-boats in the Atlantic; breaking down the messages still took a long time and scarcely affected the tactical situation at sea.

The success which American cryptanalysts enjoyed in reading Japanese classified radio traffic was much more significant; it was on the basis of Ultra despatches from the code-breakers (the word itself was given the highest classification) that the direction of US submarines over the vast Pacific largely depended. Whether such dependence was altogether a good thing is debatable; it certainly seems to have distracted submarine operators from the advisability of planning a sound objective strategy. Admiral Fife's description of moving his submarines here and there like 'playing checkers' (in response to Ultra reports) can hardly have been welcomed by submariners.

Despite rigorous security, the American press deduced, from a fairly minor breach in the Navy Department, that the enemy 'mail' was being read and the Chicago Tribune published a story to the effect that the United States knew about Japanese intentions before the Battle of Midway. This caused alarm and despondency amongst the code-breakers and resulted in an intensive witch-hunt, probably emanating from the White House itself; but the Japanese missed the significance and the USN continued to be well briefed about forthcoming operations.

HF, VHF and, exceptionally, LF frequencies were used by American submarines in co-ordinated operations which were closely controlled by a senior commander from one of the boats in a three or four-submarine pack unlike the shore directed German wolf-pack operations. Their susceptibility to D/F was recognised but Japanese intercept capabilities did not constitute much of a threat. The real danger lay in using TBS (Talk Between Ships) VHF sets like telephones; there was a
strong temptation to talk all the time instead of getting on with the job!

The only absolutely secure methods of communication (with automatic discipline built-in) were by directional lamp and semaphore but these were, of course, limited to a few miles. British boats were particularly proud of their signalling (which was frequently misused to send highly personal messages of an inflammatory nature to 'chummy ships') and the qualified signalman in a British boat was seldom left to rest in peace. At any moment on the surface a shout for the 'Signalman on the bridge' brought him racing out of his bunk, often inadequately clad, to grab the Aldis lamp en route from its stowage in the tower and answer a distant flashing light that might be friend or foe. The shout was also the cue for everyone else to flatten themselves against the bulkhead: speed in answering a challenge was vital and the signalman wasted no time on apologies if he knocked somebody flying as he leaped for the ladder to the bridge. Signalmen tended to be well-built—perhaps because one of their jobs was to hold on to the captain's legs in the tower when opening the hatch on surfacing with a pressure in the boat!

Neither normal communications nor code-breaking were glamorous occupations but the radio-warfare experts wielded enormous power at the highest level. However, if communicators in their various ways supplied submariners with the seeds of success they did not themselves reap much reward. They deserved more thanks and recognition than they actually received.
7 Underwater Weapons

'The only use of the Holland', said Admiral O'Neil USN in 1900, 'is to discharge torpedoes, and no weapon is more erratic.' There were plenty of submariners to agree with him forty years later.

Torpedo propulsion was generally based upon the Fiume heater system first introduced in 1909 to supersede compressed air alone. It used fuel oil, which was sprayed into a combustion chamber with compressed air at reduced pressure and ignited; water could also be injected to control the operating temperature and generate steam. The combination of hot gases drove a piston engine. The German Mark G/Ta, the USN Mark 14, the British Mark VIII and the Japanese Types 89/95 were all variants of this basic engine in a 21-inch (530 mm) diameter body.

Payloads were generally six to eight hundred pounds of high explosive (the best was Torpex) and their elegant simplicity thermal propulsion system drove them at about 45 knots to their targets out to about 5,000 yards—provided that they were correctly aimed, kept on course by their gyro mechanisms and maintained at the set depth by a hydrostatic mechanism which Whitehead, who first demonstrated the 'Device of the Devil' in 1867, had called 'The Secret'. Unfortunately, submariners did not understand the secret very well; war was to show all too clearly what peace-time practices had failed to reveal; torpedoes by no means always ran at the desired depth. No navy was wholly exempt from erratic depth-keeping; misses due to torpedoes running too deep were common during the first two or three years of war.

Depth-keeping difficulties were accentuated by the widespread adoption of magnetic exploders. These worked on the principle of a ship's magnetic field abruptly altering the effect of the earth's constant field when a torpedo ran under its target. A warhead had far more effect detonating below the keel than when striking a ship's side; a single torpedo could break the back of a merchant vessel from below and severely damage the strongest warship. The magnetic exploder would, therefore, economise in weapon expenditure; and that was a matter of the utmost importance if numerous targets were expected in areas far distant from bases where further supplies of torpedoes could be embarked. By the middle of 1942 Doenitz was becoming impatient for a reliable magnetic pistol, pointing out that between January and June it had taken 816 torpedo direct hits to sink 404 ships (which was not, in fact, at all bad); but his demands were never met. The British wanted magnetic pistols for a different reason; their principle targets were battleships and cruisers which were difficult to sink with contact heads however many fish struck home.

For a long time a combination of torpedoes running deep and the unreliability of influence pistols denied submariners on all sides the success that they deserved. The underlying reason for these compounding faults was undoubtedly the lack of adequate trials. This was particularly marked in Germany and the United States and both navies found themselves bedevilled by similar problems. It was, of course, costly to carry out test firings; but economies in peace were to prove exceedingly expensive in war. There were other factors, too, which militated against exhaustive proving trials; these included scientific self-assurance backed by commercial interests, secrecy (although this was poorly preserved) and, for Doenitz, political and practical restraints on conducting exercises in the Atlantic where his underwater war was to be fought.

The other trouble in Germany was that the Torpedo Experimental Establishment, in charge of torpedo development, built a torpedo, tested it and then itself decided whether or not it was fit for operational use. Doenitz rightly believed that the whole process 'should never be left in the hands of one single authority'. The situation was somewhat similar in other countries, especially in the United States where the Gun Club (the Bureau of Ordnance) with its Newport Torpedo Station was self-accounting. Much important torpedo research before the war was conducted by Ralph Christie who, later, as a Captain and then an Admiral in the South Pacific war, found himself obliged to defend the torpedoes against outspoken complaints by his commanding officers. Lcdr 'Red' Ramage in Trout told Christie "if I get 25%, reliable performance on your torpedoes I'll be lucky..." and Lcdr 'Moke' Millican in Thresher complained that during an attack on a Japanese submarine his weapons had 'merely clinked 'em with a chunk'. Christie was not prepared for any 'wrangling in print' and said flatly that the torpedoes were 'fine'. Millican was ordered back to the States for rest and new construction. The Gun Club kept close ranks and its members' insistence that torpedoes ran true was backed by a fair number of successes.

It was difficult to account satisfactorily for widely varying performances everywhere: patrol analyses depended almost entirely on the narratives of commanding officers who were understandably subjective and, anyway, found it impossible to maintain a detailed log of fast-moving events. Only the man at the periscope really knew what was happening and he was not going to make himself look a fool. Every submariner realised that there must have been human as well as material faults. On occasions, in all navies, stop valves were not opened; top stops were not checked down; safety devices were not removed; air vessel pressures were wrong; and even propeller clamps were left on. But it was equally clear that the weapons themselves were far from dependable. As Doenitz said about torpedoes in his diary for January 1940, 'we were thus back to where we were in 1914-18...confidence was in every way very much shaken.'

In the U-boat arm, very important strategic opportunities were lost due to faulty torpedo performance, first exemplified by the attacks that failed against HMS Ark Royal on 14 September 1939 and HMS Nelson on 30 November 1939 (although a mine laid by U-31 five weeks earlier seriously damaged Nelson in December). The captain of U-56 (Obt Gunther Zhan) was so depressed after delivering his attack on Nelson through a screen of 12 escorting destroyers and hearing, as he thought, three torpedoes hit but fail to explode that Doenitz 'felt compelled to withdraw him for the time being from active operations and employ him as an instructor at home.' In point of fact, nobody in Nelson heard torpedoes strike and Zahn's account
Top
A torpedo being partially hauled back from the tube for checking in the Netherlands submarine O-14.

Bottom Left
Japanese Type 95 21-inch torpedo tubes. The Automatic Inboard Venting arrangements were in fact semi-automatic but worked well. This six-tube bank was typical of most classes except for the I-400 class which had eight bow tubes forward split into two sets of four tubes located in separate compartments one above the other. The firing gear, using low pressure air, was largely modelled on British systems. The bow caps, however, were worked by an air motor driving a worm and quadrant instead of by a hydraulic ram. As in practically all submarines everywhere following the disaster in HMS Thetis in 1939, positive interlocks prevented a bow cap and rear door being opened at the same time.

Centre Left
The TI (Petty Officer in charge of the torpedo department) of HMS Tabu checks the tubes. Extreme, painstaking care and constant maintenance in very difficult surroundings was essential if the tubes and torpedoes were to function correctly. The personal supervision exercised by the TI was directly reflected by the success of attacks or otherwise; in Tabu, it was not in doubt with 30 torpedo hits on 13 important targets out of 84 torpedoes fired and spread to cover possible errors.

Centre Right
After torpedo room in a US fleet submarine. The amount of water let in to compensate for the difference between the weight of a torpedo and a tube full of water after firing was not automatically compensated as in British boats: an inlet valve was manually opened for a given time according to depth.
was probably not correct; neither for that matter, was the German belief that Winston Churchill was on board at the time. In the case of *Ark Royal* the two torpedoes fired by *U-39* (Kptlt Glattes) both missed astern and exploded in the wake; Glattes had underestimated *Ark Royal*’s speed by four knots and Doenitz was therefore wrong to put all the blame on the torpedo failures for alerting the escort who subsequently sank *U-39*, the first German submarine casualty of the war.5

However, Doenitz was right in believing that the torpedoes fired by *U-27* (Kptlt J Franz) on 19 September 1939 exploded prematurely when fired at what was thought to be a 6000-ton cruiser (actually a Tribal-class destroyer); but it was not prematuresthat brought about the destruction of *U-27* which followed. The U-boat had been seen on the surface before diving for her attack and HMS *Fortune* had already initiated an A/S action before sighting two upheavals on the bearing.1 Notwithstanding tactical errors by commanding officers Doenitz reported to the Naval High Command6 early in 1942 that 40.9 per cent of misses had been caused by mechanical failures and that there was evidence of negligence in the preparation of torpedoes before issue in the Torpedo Department in the Naval Dockyard at Kiel and in the firing trials held by the Torpedo Experimental Establishment.

Four officers and officials were court-martialled and the Naval High Command was assured that the reasons for the court-martial had now been overcome: “that this is so is proven by the successes since achieved against the enemy”.8

One interesting and subtle reason for torpedoes running deep was found during the German enquiries and it may well have been a contributory, undiscovered cause elsewhere. During a prolonged dive, air pressure built up in a boat due to unavoidable small leaks from the HP air lines. The balance chamber of a torpedo was not designed to resist an insidious increase in ambient pressure over a long period; when the fish was fired the hydrostatic valve was thereby already biased and Whitehead’s Secret was unbalanced, taking the torpedo deeper than set. It was a classic example of what could happen when equipment was not tested under realistic operation conditions.

The statement earlier in the war by the captain of *U-35* (Kptlt Ewerth), after his boat was sunk and he was captured on 28 November 1939, to the effect that he was highly satisfied with German torpedoes (which gave the Allies cause for concern) can only have arisen from his wishing to impress the British interrogating team.2 Other captains were not so happy. In *U-47* Gunther Prien, of Scapa Flow fame, complained that he ‘could hardly be expected to fight with a dummy rifle’. He spoke for submariners in most navies: the thought that the extreme risks which they continually ran could prove nugatory was not conducive to good morale. But, nonetheless, attacks on all sides continued to be pressed home.

The Royal Navy suffered comparatively little from poor torpedo performance. This was probably due to the large number of torpedo firings carried out before the war on the China station. Submariners contended that such failures as there were could be excused by bad ‘prepping’ in Depot Ships before the fish were taken on board. For example, unsuccessful salvoes from HMS *Traveller* (Lieutenant M B St John) during a Mediterranean patrol in July and August 1942 ‘may in part be explained by the disorganised base (Haifa) from which the submarine had started’.9

British non-contact CCR pistols, which had been produced 15 years before the war but were brought late into service, were as defective as they were elsewhere and ‘resulted in many otherwise successful attacks being nullified, chiefly by premature firing’.9 They were seldom used after the initial disappointments although the mills of God ground slowly and it was not until the end of 1944 that Flag Officer Submarines formally ordered them to be discontinued.

The Japanese, who had many torpedo setbacks due to poor engineering standards before the war and who were long unable to produce air vessels to withstand the high pressures required for acceptable ranges, improved their technology to such an extent that, by 1940, their weapons were remarkably reliable. Oxygen enriched air was used in some models to avoid tracks, improve engine performance and (because of the smaller air flask) increase the weight of warhead to as much as 880 lbs. Contrary to popular belief amongst the Allies, the Japanese did not equip their submarines with the very long-range 24-inch torpedoes found in their cruisers and destroyers: quite apart from constructional difficulties in the submarines themselves, it is difficult to see how anyone thought a 20,000 metre, straight-running submarine weapon could be exploited except, perhaps, when attacking dense
American Mark XIV Torpedo (Top)
1: Warhead 2: Exloder
Mechanism 3: Air flask
4: Water compartment 5: Fuel flask 6: Engine 7: Depth mechanism 8: Gyro
9: Starting gear 10: Cable connector 11: Tail Assembly 12: Propeller

British Mark VIII Torpedo (centre)
1: Warhead 2: Air bottle
3: Balance chamber 4: Fuel bottle 5: Depth gear 6: Main oil bottle 7: Gab rod
8: Engine 9: Main reducer 10: Air lever 11: Gyro angling
12: Generator 13: Air blast gyro 14: Diving rod 15: Main propeller shaft 16: Safety valve 17: Tail gearing
18: Stabilizing fin 19: Rudder 20: Propellers

German Type V Acoustic Torpedo (Bottom)
1: Tail unit 2: Contra-rotating gear 3: Discriminator box 4: Gyroscope 5: Depth control gear 6: Touching lever switch 7: Motor
German pattern-running torpedoes (FAT).

convoys—and that was not what the Japanese intended. The 24-inch Type 93 Long Lance torpedo was, however, the basis of certain suicide submersibles. Most midget submarines carried 18-inch Type 97 torpedoes with a range of 3,000 metres at 40 knots. The Type 97 was equipped with serrated net-cutters, in the form of a four-armed starfish, on the nose: the device was adopted by the Germans for their own midgets but its efficacy was very doubtful.

Electric torpedoes, which were trackless, had obvious advantages although they were necessarily slower at, typically, 30 knots (against 45 knots) out to 5,400 yards (reduced to 28 knots and 3,300 yards if the battery was not electrically pre-heated). Except in the German Navy, where they had been well proven before the war, submarines were slow to adopt them. U-boats almost always fired electric torpedoes but maintenance and temperature requirements prevented their use in external tubes. Electric torpedoes had the disadvantage of needing to be checked every four or five days: in U-boats one torpedo was hauled back each day so that three were always ready in the tubes.

By far the most significant battery-driven torpedo was the German T5 Zainkoenig (Wren) or Gnat (German Naval Acoustic Torpedo) which was in service by 1943. The T5 had directional transducers in the nose which gave signals to turn the rudders and steer the weapon towards a noise source, predominantly the wide-band frequencies produced by a target’s propellers. It was designed, primarily, for retaliation from deep against A/S vessels who were forced either to stream decoys, noise-making ‘foxers’, astern (which seriously impeded their own Asdic performance) or keep outside the range bracket—about 8 to 18 knots—in which a T5 could both hear and home on its target. Another emerging requirement in the U-boat arm in the face of strengthening A/S opposition was met by pattern-running ‘Curly’ FAT (Feder Apparat Torpedo—Spring Apparatus Torpedo) and LUT (Lageunabhangiger Torpedo—or torpedo independent of target’s inclination) torpedoes to improve the chances of hitting with a browning shot at a convoy or a loose shot from deep against a single ship; but they increased hit probabilities less than Doenitz was informed. The weapons were, anyway, only available in penny numbers at the time when they were most needed although they were sufficiently plentiful by the end of 1944 to allocate five Gnats and three or four ‘Curlies’ to many boats.

Despite engineering and mathematical hopes for something better, torpedoes everywhere were most effective if two or more were fired in a range bracket from 600 to 2,000 yards and set to run at an appropriate depth to hit but not so shallow as to be affected by the sea state. It was fish with these modest settings that achieved most successes.

Quite heavy gun armament was fitted to most submarines. It broke up streamlining, making the boats noisier and slightly slower than they should have been; but, for some unaccountable reason, disappearing guns, which had been invented as far back as 1908, were not introduced. Gunfire was particularly useful for shore bombardment and against small shallow-draught targets. Unlike torpedoes, there were plenty more shots in the locker if the first salvos missed. Two or three hundred rounds of ammunition could be carried and a dozen rounds were enough to settle the fate of most small ships.

The USN opted for the heaviest guns that could be fitted. USS Nautilus had two 6-inch monsters although smaller 4-inch weapons were more usual in most boats. Type VII U-boats had 88 mm and Types IX and X boats had 103 mm weapons, all forward of the conning tower. A 4-inch (100 mm) was found to be the ideal calibre; its ammunition was not too heavy to hand up the tower for quick firing and 35 lb HEDA shells did far more damage than 3-inch and 12-pounder shells. For example, a wooden junk was sunk by two rounds from HMS Thrasher’s 4-inch gun but it took 46 3-inch rounds from HMS Statesman to destroy a similar target. Two British boats, Shalimar and Seadog, innovated a gunnyard wolf-pack patrol in the Far East in July and August 1945. They communicated by VHF voice and used time-of-flight stop-watches to distinguish fall-of-shot for spotting. The results of this experimental operation were impressive with a dozen small vessels sunk; but, between them, they expended 1,075 rounds of 3-inch HEDA which the Captain S.M. Second Submarine Flotilla considered too high. By contrast HMS Thrasher and HMS Sparrow, taking 35 lb 4-inch ammunition, averaged only 21.3 and 12.5 rounds respectively per vessel sunk in individual gun actions against equivalent targets.10

The rate of fire was, incidentally, far less than the 10 or 12 rounds per minute expected. British analysis showed that it varied, in fully worked up boats, from 2.2 rpm to 7.4 rpm. The hitting rate varied from 11 to 53.8 per cent with around 30 per cent at 6 rpm in reasonable weather conditions.

Gunners had, of course, one great disadvantage. It was summed up well in the German Naval High Command’s Handbuch für U-Bootskommandanten issued in 1942 to all U-boats:

‘The U-boat as an armament carrier is fundamentally a contradiction in itself. It is not constructed for gunnery action on account of its limited stability, its low and unsteady gun and observation platforms which are directly exposed to the sea’s motion. Strictly speaking the U-boat is inferior to every surface warship in an artillery battle. For the U-boat, as opposed to its surface opponent, is rendered completely vulnerable in every artillery duel as one hole in the pressure hull can prevent the U-boat from being able to dive and thus easily leads to the loss of the boat.’11

Most boats had light, portable anti-aircraft machine guns which could be brought up to the bridge and fitted on stanchions when needed on the surface. Submarines regarded these as last-ditch weapons; but they were handy for shooting up floating mines, terrifying the occupants of small boats and, sometimes, for relieving the captain’s feelings. They were virtually useless against aircraft although a few were hit by lucky bursts and some may have been put off their aim when coming in to attack.

However, on 31 May 1943, a week after giving the order for U-boats to withdraw from the Battle of the Atlantic, Doenitz discussed with Hitler ways in which the trend (a euphemism for defeat) might be reversed. One proposal, promptly put into effect, was to equip U-boats with four-barrelled 20 mm AA cannons for protection against the clumsy Liberators and Sunderlands which were making the passage through the Bay of Biscay so hazardous. Most U-boats already had 20 mm or 35 mm AA guns on a platform abaft the conning tower but now, especially when transiting in a group, the Flakvierling
Bow-loading a torpedo into a Soviet M-class submarine in the Baltic Sea.

Loading a torpedo into HMS *Umbroken* at Malta. Embarking a full load was not the simple operation it appeared; it could easily occupy an entire day and a conscientious TI would then spend a great deal of time checking and further 'prepping' the fish prepared by the Depot Ship or Base. The USN eventually adopted a policy of recording the men concerned with preparing torpedoes all along the line; this had a most salutary effect on torpedo performance.
Like all Dutch submarine operations, torpedo loading was accomplished with the minimum of fuss and maximum efficiency. Although there seems to be little supervision at this stage of the operation, one can be confident that all was well!

For several excellent reasons Wrens were a welcome addition to the ship’s company of a submarine base. Here they are helping to load torpedoes on board the ex-American HMS O-21 at the Alma Mater of British submarines, Fort Blockhouse, Gosport in 1943.
with armour to protect the bridge and gun-platforms, offered a formidable amount of fire-power. Special 'plane traps', U-211, U-256, U-271, U-441, U-621 and U-973 had, as well as the quadruple mounting, a 37 mm and two 20 mm guns. All this was not enough. It deterred maritime patrol aircraft to some extent but light US aircraft operating from carriers in relays were hard to hit and, attacking continually from different directions, swamped the defences. Bloody battles ensued and U-boat personnel losses were severe.

The lessons learned about gunnery boiled down to one: it was not worth the candle unless it was the only possible method of defence or unless the target was incapable of fighting back. As surface sailors had said about submariners in general a couple of generations earlier, submarine gunnery was 'no occupation for a gentleman'.

Submarines were ideal vehicles for mine-laying. Unlike surface minelaying they laid their fields unseen, and were far more accurate
than aircraft. The disadvantage was that minelaying operations usually involved a long passage to and from the area concerned and detracted from torpedo operations. The United States Navy had only one purpose-built minelaying, the 3,000 ton Argonaut (V4) built in 1925; but in 1942 she was hastily converted to a troop-carrier capable of transporting the 120 marines which she took successfully to Makin Island. When Mark X-1 mines, suitable for discharging through standard torpedo tubes, became available, fleet submarines were dispatched to plant fields at the eastern entrance to the Inland Sea, in the Gulfs of Siam and Tonkin and off Cape Padaran. There was not much enthusiasm amongst the American submariners for minelaying but it was admitted that if all torpedoes were unlikely to be expended during a patrol a submarine could advantageously carry a mixed load.

The German Type XA and XB boats were specifically designed as minelayers with mines stored in vertical shafts in the saddle tanks (like the French Rubis—see Chapter 11) and in the after section of the hull; a few Type IXs were also modified with eight vertical mine shafts in place of torpedo reloads. Up to 66 mines could be carried in a Type X. The Russians probably had a similar system but at least one boat had a roller conveyor system under the casing and the L-class had two stern launchers. Those Japanese boats which retained 21-inch tubes mainly used German tube-laid mines which were magnetic.

German U-boats laid 327 mines off the eastern American coastline resulting in 11 ships being sunk or damaged. However, seven ports also had to be closed for a total of 40 days and this was a significant figure, equivalent in effect to a great deal of tonnage being sunk. No U-boats were lost on these operations. Unfortunately, some deterrent minefields laid by the United States Navy, to keep U-boats clear of anchorages where convoys assembled, resulted in several Allied ships being lost or damaged.

The Royal Navy had six Porpoise-class purpose-built minelayers, each carrying 60 standard Mark VIII moored mines; but only HMS Rorqual survived the war. They had a power chain-conveyor system installed at the stern below the mine rails which were laid along the pressure hull and enclosed by a high casing; the periscopes were moved over to starboard to give a clear run. Mines were usually dropped from 116 to 120 feet apart which, at 2.5 knots, meant a manageable dropping interval of 30 seconds. When submarine mines were built to fit 21-inch torpedo tubes the requirement for special

minelayers lapsed. It seems extraordinary that torpedo armament should willingly have been thereby sacrificed when it had been proved entirely practicable to install mine-chutes for 14 mines in the ballast tanks of E-class submarines during World War I; disregard of this simple, inexpensive type of stowage was probably due to the British insistence on preserving a huge reserve of surface buoyancy, far more than the Germans deemed necessary.

A total of 658 mines were laid by Allied, mainly US, submarines in the Pacific where the minelaying effort came to be concentrated. This resulted in 27 Japanese ships being sunk or damaged beyond repair and another 27 damaged but repairable. Therefore, for each dozen mines laid, one was successful. No submarines in the Pacific were lost while minelaying.

Mines were a very formidable submarine weapon and could be laid as a deterrent to shipping as well as for purely offensive purposes. They were particularly well suited to the Soviet navy where political control did not affect operations as it did with such serious results during torpedo attacks. However, torpedoes, in western navies, excited the public imagination much more than mines which tended, in consequence, to be undervalued and poorly provided for in submarines.
8  Attack

An attack did not start only when mastheads appeared over the horizon. The foundations were laid very much earlier and the whole crew, not just the attack team, were involved. War histories forget to record the enormous amount of preparation needed in harbour before sailing on patrol: huge quantities of stores, exactly accounted for, had to be carried on board and stowed; engineers had to sweat over recalcitrant cylinder heads; seamen had to guide a dozen or more 21-foot, ton-and-a-half torpedoes down through a narrow, circular loading hatch and then attend to their mechanisms with a watchmaker's precision in cramped, cavernous surroundings where garage mechanics would have refused to work on the clumsiest agricultural machinery. Nor could historians have known how it felt to give up the last few precious hours ashore to study charts and operational orders, align the tubes and periscopes, dress out binoculars, work out the trim, muster secret signal publications page by tedious page and carry out a thousand-and-one essential checks on every piece of equipment on board.

Only selfless teamwork made it possible for a captain to bring his boat into a position where the torpedoes could do their work. Ultimate success was due as much to the stokers aft as to the torpedo-men forward and the 'oilies' deserved a lot more credit than they got for successful operations. Good management was needed to direct the many diverse skills in action but it was wrong to call the captain a One Man Band.¹

Nevertheless, the captain was the only man to know everything that was going on in action, and he personally controlled an attack to a much greater degree than in surface ships. The art was to use the members of the attack team as extensions of his own senses and that required—for all concerned—training, training and more training.

Training for submarine command should therefore have been exceptionally thorough, but it was not always so. Wartime pressures shortened the time available and the USN believed anyway that prospective commanding officers learned the trade best on patrol although some (by no means all) went for a few weeks to an Attack Teacher ashore. In retrospect the USN policy seems to have been wrong; American captains were not as well grounded in tactics and periscope usage as their opposite numbers in the Royal Navy who underwent exhaustive (and exhausting) periscope schooling during a mandatory "Perisher" course. Apart from not learning the drill properly it was very difficult for an officer to discover his personal failings—tendencies to under-range and incline wrongly for example—without a Perisher or something like it. Dutch, Polish, Greek and Norwegian officers joined British commanding officers' qualifying courses when they could be spared and coped admirably with the English language; at the height of an attack fundamental expressions proved to be remarkably similar in any language!

It was what Churchill called a commanding officer's 'ice-cold brain in danger' that mattered and (though not admitted in such dramatic words) that was what a Perisher aimed for.

Each officer made twenty-five or thirty dummy attacks in the Attack Teacher followed by as many as possible in a specially assigned submarine at sea. Each attack was analysed in detail and ruthlessly criticised by Teacher, a senior and experienced commanding officer. Torpedo running errors were taken into account by drawing discs from a bag. A black disc signified that the torpedo did not run at all; and although Teacher sometimes unbent sufficiently to sympathise if the dummy fish were unco-operative, it was a salutary reminder of torpedo imperfections and underlined the importance of firing adequate and carefully calculated salvos, spread (with appropriate spacing to avoid 'gapis') so as to allow not only for course and speed errors but also for torpedo anomalies. U-boats, mainly attacking at point-blank range, seldom had to worry much about target estimations or consider spreading: one or two torpedoes usually sufficed. American captains tended to select salvos and spreads rather arbitrarily and without due consideration of hit probabilities. The latter were a good deal lower than might be expected and it was advisable to close the range if possible so that the target's length absorbed miscalculations in aim-off. The Russians did not understand spreading and spacing techniques at all. They generally followed the philosophy of one of the Tsarist captains in 1916 who invariably fired all his fish as quickly as possible on slightly diverging courses: "We just go puff, and some torpedoes must hit."² He was being very optimistic.
A Perisher started in the Attack Teacher with a nice, simple, straight-course, slow-speed target model moving on wires and wheels over a glassy sea against a blue horizon. An artificially focused periscope in a revolving cubicle represented a submarine control room and a Perisher’s attack team was made up of his fellow trainees (who were not over-anxious to see their captain score hits). Zigzags, weaves, higher speeds and escorts were gradually introduced while Teacher laid bare each Perisher’s soul with tigerish licks of his rasping tongue. British torpedoes could not be continually angled before firing so it was necessary to point the submarine’s bows (or stern if stern tubes were being used) ahead of the target and wait for the DA (Director Angle) to come on. Rapid mental arithmetic and nice timing were needed if the submarine was to achieve an ideal firing range of about 1200 yards on the target’s beam and still catch the DA. This required bursts of high speed deep and blind on the best closing track for the target’s last known course; and meanwhile the target might change course radically.

Coming up from deep to periscope depth at the wrong time risked ramming. If Teacher had to take over and order the submarine deep again, the unfortunate Perisher knew that his chances of passing the course were slim. The one-minute rule was strictly observed: that meant going deep when an oncoming ship was one minute away at its maximum speed which, for a destroyer, implied a range of one thousand yards. A decision had to be taken when the ranging height in feet—funnel, mast or bridge—equalled the number of minutes of arc subtended at the periscope which meant the range was 1150 yards. Submariners reckoned rules were meant to be broken but this one was worth remembering even in action.

Some officers had a natural periscope eye. Others never succeeded in acquiring it. The worst got ‘lost in the box’ and were not able to keep a mental track of where targets and escorts were; they were quickly and mercifully weeded out. Attack instruments in British and most European Allied boats were rudimentary but sufficient. A hand plot was the most reliable indication of target speed—the most important parameter—which could be checked by a propeller revolution count or the position of the second bow wave or, often enough, an educated guess! Course was estimated visually from the angle-on-the-bow. It was easy enough to incline when the target presented a fine aspect but much more difficult in the closing stages of the attack when it was nearly beam on: a last minute zig was hard to detect. There was a marked

The control room of HMS Rorqual with plotting table on the right.

A relatively minor penalty of not going deep quickly enough for a destroyer: a bent periscope following a dummy attack by a destroyer with all too realistic results—collision.

After attacking a convoy off Zante in September 1941 and sinking one ship, Rorqual was rammed by another ship and lost both periscopes.
tendency for inexperienced officers to overestimate angle-on-the-bow and hence mislead the plot into giving too slow a speed which resulted, of course, in the DA being too small and the torpedoes missing astern.

British periscopes incorporated a gunnery-type range-finder by which one image could be balanced on another to measure the angle subtended against a known height. The angle was then easily converted into distance. American periscopes, however, only had a graticule lens graduated in minutes of arc; a stadiometer slide-rule was used for translating a comparatively rough angular reading into yards. If (as happened in all navies) a target was thought to be larger than it really was, gross over-ranging as well as over-estimation of target length was bound to result, seriously degrading the fire-control solution. Sonar bearings were another significant source of error in the USN. They were inherently inaccurate (sometimes wildly so) but were trusted implicitly. Mathematical problems aside, blind sonar attacks simply did not work in action.

American fire-control was outstanding in one respect. The angle-solver for calculating DA was broadly similar to the basic Is-Was or slightly more sophisticated Fruit Machine in British boats; but there was also a TDC (Torpedo Data Computer) which continuously generated a firing angle and applied it electrically to the gyros of torpedoes waiting in the tubes. When the fish were fired they automatically turned to the calculated hitting track with an appropriate angular spacing between them. This meant that the boat itself did not have to turn on to a firing track and there was thus no danger of altering course too late and missing the DA. That was the theory and it greatly simplified tactics; but it did not always work out like that. The system sometimes lagged and torpedoes did not always accept large angles—at least, that is what certain post-war trials suggested. It would have been better to restrict angles to near zero or a set 45 degrees or 90 degrees (as the Germans preferred, sometimes, with a

Top Left
The British fruit machine which superseded the 'Iswas'. Although supplied from the gyro this machine did not track continuously and had to be completely reset at each observation.

Bottom Left
The invaluable Greek slide-rule used in British and certain other Allied navies to calculate linear spread and spacing and named for the officer in the Royal Hellenic Navy who markedly improved it, Lt Cdr E P Tsoukalas.
similar system); for otherwise the successive stages of continuously supplying angle-orders to the torpedoes aggregated mechanical, electrical and human errors; and inaccurate ranging accentuated the problem of parallax. It was also possible that some torpedoes fired at short intervals with a narrow spacing collided, causing explosions wrongly taken for hits. Counter-mining by adjacent fish would have resulted in another reason for unjustified celebrations. These possibilities are suggested because they could well account for a number of so-called torpedo malfunctions and at least some of the numerous wrongful claims by American submariners which were illuminated by post-war analysis.

However, whatever its inaccuracies, continuous angling offered a chance of shooting at threatening destroyers which the other Allies were seldom able to do. Down-the-throat shots were sometimes successful at ranges around 1,000 yards and the Submarine Operations Research Group credited US submarines with 104 hits out of 452 torpedoes fired at close range on track angles of less than 20 degrees. This, presumably due to fire-control discrepancies, was less than the mathematical 30-50 per cent probability of one hit on a destroyer with a tight spread of four torpedoes at 1,000 yards. It was a valuable technique; but if, as was said of at least one captain, he deliberately exposed his periscope to entice destroyers into turning towards, he was a very rash submariner indeed. Four torpedoes fired on a broad track (given that course and speed estimations were correct within 20 degrees and two knots) had a 70-90 per cent chance of one hit at the same range on the same target so it was a good deal safer to stick to standard tactics.

Boats in other Allied navies had to fire straight-ahead or straight-astern hosepipe salvos which achieved the effect of spread and spacing by the target's own movement across the single line of torpedo tracks. This method had obvious disadvantages but it ran the least risk of errors arising between the periscope and the torpedoes. British and Allied 'hosepipers' scored 1363 hits out of 3220 attacks (42.3 per cent) and 1040 ships were sunk out of 5121 torpedoes fired (20.3 per cent). In the USN 1314 sinkings were achieved by angled fire with 14,748 torpedoes (8.9 per cent).

The proportion of German hits to torpedoes fired was very much higher because most attacks were made on the surface from only a few hundred metres against slow, steady targets. To achieve results, the instructions given to U-boat captains did not err on the side of caution as the following extracts from the Commanding Officers' Handbook shows:

'...dive only when an immediate hazardous fight is expected on account of an enemy escort's close proximity ... serious miscalculations may occur by night, therefore go in as close as possible ... even if the U-boat is sighted while making its attack it should still be impossible for the enemy to avoid the torpedo [but] even at night minimum range is 300 metres ... do not fire prematurely from an over acute angle, an inexperienced torpedo gunner [presumably referring to the First Lieutenant who worked the bridge torpedo director sight during the usual surface attacks] is inclined to take the angle for more obtrude than it really is. Therefore, keep your nerve and do not fire too soon ... distance is easily underestimated ... one is always further away than one thinks, particularly at night. [Dönitz was assuming that small targets would not be mistaken for large ones.] Stick it out and go nearer ...

Successful attacks were duly rewarded in all navies. It was impossible to be entirely fair but tonnage sunk was generally the dominating factor in the German and United States submarine services. Dönitz checked claims as carefully as possible and there was relatively little exaggeration by U-boat captains despite Allied propaganda to the contrary; but use of the T3 acoustic-homing torpedo, available from 1 August 1943, gave rise to false claims of Allied escorts sunk due to the fact that these weapons were invariably fired amidst 'confused noises in a skirmish which could only be appreciated by one who has experienced it'. These claims, in one convoy battle in September 1943, amounted to 12 destroyers 'definitely sunk' and three 'probably sunk' by Gnats. Analysis shows that only two sinkings, HMS St Croix and HMS Polyanthus, were achieved by U-305 and U-666 during that particular skirmish.

American claims were considerably in excess of actuality throughout; this led to some embarrassment when the JANAC analysts had done their counting which showed a spectacular drop in several scores, the greatest disparity being Cdr Roy M Davenport's credits while commanding Haddock and Trepang. These were reduced from 151,900 to 29,662 tons with eight ships instead of 17 being sunk. There was a natural temptation to exaggerate successes; and in the stress of action or while avoiding counter-attack deep it was easy to think wishfully when explosions of all sorts were clearly heard. Some guidelines for medals were formulated with regard to tonnage but were not strictly adhered to. A US Navy Cross, for instance, was to be awarded for sinking at
Top Left
US fleet submarine conning tower looking forward towards the wheel and showing the access hatch from the control room below.

Top Right
The conning tower attack center in a typical US fleet submarine looking aft.

Bottom Left
Some of the attack instruments in the conning tower of USS *Torsk*. Submariners might argue that far too much reliance was placed on instrumentation in the USN and its dangers are implied by the lettering on the dial at the right—'correct solution'. When dials matched and the solution 'tracked' convincingly, commanding officers had a marked tendency to believe that the settings were correct forgetting sometimes that, as with all computers, it was the original inputs that governed the quality of the solution.

Centre Right
Part of the control room of a US fleet submarine showing the plotting tables.
Speeds
Target: 12 knots
Submarine: 3 knots
Torpedo: 45 knots

First sighting of target, range 7500 yards

Position of submarine on sighting target

Distance off track on sighting 3000 yards

Position of target on firing

Position of target when hit by torpedoes

Track angle

Torpedo track, range 1500 yards

Position of submarine on firing

Time of attack: 20 minutes

Simple attack with straight running torpedoes

Typical spread and spacing of a four-torpedo salvo. This was achieved either by the target's movement across the single track of a hosepipe salvo or by angular spacing.

Advantage of angle fire in a snap attack situation where the submarine would have no time to turn between first sighting the target at S1/T1, three minutes before it is due to reach the optimum firing position at S2/T2.
least three merchant vessels totalling 15,000 tons, a cruiser or above, two destroyers or submarines, or one of each; but individual actions were quite rightly judged according to circumstances. In general, U-boat captains were awarded the Knight’s Cross for 100,000 tons and the Oak Leaves for 200,000 tons. Only one U-boat captain seems to have hoodwinked the High Command; and he was awarded the highest decoration of all, the Knight’s Cross with Oak Leaves, Swords and Diamonds for what later came to be known as unjustified claims. This was Fk Albrecht Brandi (U-617) whose surviving colleagues say he gave a grossly exaggerated account of his exploits in the Mediterranean which included the sinking of HMS Welshman, a fast minelayer wrongly taken for a large cruiser. In the main, though, submariners of one navy did not grudge the medals of another when they compared notes after the war; friends or foes, they knew that they deserved them. The highest decorations were everywhere awarded sparingly but in Germany the modest Iron Cross was liberally handed out to reward ordinary U-boat ‘soldiers’ and it gave them a great deal of pleasure.

Russian medals were difficult to equate with those of the other Allies. They looked splendid but they did not, apparently, confer the same privileges as in the Tsarist days when Lt R W Blacklock RN was awarded the Order of St Vladimir 4th Class with Swords for services rendered during World War I. St Vladimir entitled the wearer, amongst other honours, to visit any state school for girls, taste the food and remark on the quality!

Submarines returning from patrol displayed their results in different ways. A U-boat strung tonnage-pennants from its periscopes and American submarines flew a series of small rising-sun flags for men-of-war sunk and white flags with a red ball in the centre for merchant victims. British submarines hoisted a rather uncharacteristically flamboyant Jolly Roger pirate flag, the first of which had been flown by HMS E-9 (Lt Cdr Max Horton) in September 1914 after sinking the German battlecruiser Hela. On a subsequent patrol after sending the German destroyer S-116 to the bottom, Horton hoisted a second flag on approaching the British base at Harwich. Before long there was no room to fly a separate flag for each sinking and Horton substituted one large Jolly Roger bearing the appropriate number of bars for the total number of enemy vessels he had sent to the bottom. The custom prompted an acid comment from the Admiralty when the Chief of the Russian Naval Staff asked, in 1915, if Max could take over as Senior Naval Officer at the British base in the Baltic. The Second Sea Lord wrote on the document: ‘I understand that Commander Horton is something of a pirate and not at all fitted for the position of SNO . . .’

At least one other British submarine copied Horton’s idea, but it was not until World War II that it caught on; and then it was the submarine Flotilla Commanders in the Mediterranean who instigated what was to become a tradition throughout the second underwater war. It started with HMS Osiris sinking the Italian destroyer Palestro well inside the heavily guarded Adriatic which Mussolini has boasted no enemy could enter. Osiris was told by signal lamp on return to Alexandria that ‘a special recognition signal in a scaled package marked JR to be opened by Commanding Officer only is being sent to you in my motor boat. It will meet you at the boom. Osiris is not to come alongside until this identity signal is showing.’

The captain of Osiris (Lt Cdr Harvey) broke open the package, hauled up the Jolly Roger it contained and carried on in. Thereafter the Captain (SM) of a Flotilla presented each of his submarines with the dreaded skull and crossbones flag of the old-time Spanish Main when the boat had achieved its first success. Not all commanding officers followed the custom. Lt Ian McGeogh in Splendid, for example, felt it was unduly boastful and, anyway, that actual as opposed to hoped-for sinkings were not known. It was up to the submarine itself to keep the record up to date with suitable symbols sewn on by the signalman. The signalman’s needlecraft was sometimes rough and ready. This was noted by the famous and respected Carmela Cassar who kept one of the finest lace shops in Malta. Carmela’s lace was made in the convents of Malta and she decided in 1941 to arrange for the nuns to make beautifully embroidered
Top Left
Lookouts on the bridge of U-552 (Kptlt Eric Topp) known as the Red Devil boat because of its emblem. This boat was the third highest scorer in the German Fleet. Note the wire binding on the periscope to give strength and minimise vibration without periscope standards. The man on the left is using dark glasses for aircraft watch into the sun.

Top Right
The business end of a 1940 British S-class submarine.

Bottom Right
Torpedo firing levers in the Polish Sokol (ex HMS Urchin).
Kptlt Rosenbaum checking target identity with his First Watch Officer, Deckert in U-73.

Japanese 10 cm surface search radar horn (left) and 150 Mcs air-search radar array. The surface horn gave a poor bearing accuracy within no better than 5 degrees and the airguard (very similar to British arrays) was even less accurate but could detect a B-29 bomber at about 80 kms. Some Japanese submarines also had radar search-receivers with an audio-only presentation.

Jolly Rogers, each about 12 by 18 inches, with a realistic skull and cross bones and all the appurtenances to which a particular submarine was entitled; these were presented to the individual commanding officers operating from Malta. Jolly Rogers well illustrated the extraordinary variety of operations carried out by British submarines, and several Allied boats under British control adopted the same idea. The flags displayed a submarine’s exploits in graphic detail as patrol succeeded patrol until, all too often, a boat went out and did not come back. Then Carmela’s little flags, left behind in the Depot Ship or ashore, were all that remained to tell the story.

Success flags of one kind or another gave returning submarines a certain transient glamour which the German Navy amplified with bands, bunches of flowers and glamour-girls at the quayside. But submarine torpedo attacks themselves were far from glamorous. There was no audience to applaud and a long, dangerous haul back to harbour remained before hands could be shaken and medals pinned. Ultimate success depended upon arduous training, ruthless elimination of substandard officers and men, and long periods of wearisome waiting.
However, one kind of attack offered instant rewards for marksmanship with all the fun of the fair thrown in—gun action.

Bringing a gun into action reversed the principles of torpedo fire. American and German boats made comparatively little use of their guns. When they did, they usually stalked their prey on the surface using light conditions to best advantage. The British used guns much more and, with the stated aim of patrolling primarily submerged, perfected a technique of not surfacing until the very last moment and then opening fire immediately. The drill was exciting and several of the crew who did not usually see action were able to lend a hand even if only in the ammunition chain. It was the one time that submariners shouted; and they put their utmost into it in a way that would have gladdened the hearts (if they had any) of the leather-throated instructors on the parade ground at Whale Island, the noisy home of naval gunnery.

On sighting a suitable (unarmed) target through the periscope ‘Stand-by Gun Action’ was ordered and the crew raced to diving stations while the magazine hatch was wrenched off leaving a large open manhole in the centre of the passageway through which many a hastening, sleepy body dropped. It was a painful occurrence, because, usually, only one leg went down through the aperture so that the victim performed a sort of sideways splits.

The Gunlayer and Trainer inspected the target through the periscope while the captain estimated range, angle-on-the-bow and target speed in the usual way so that range and deflection could be set on the control room transmitter (if proper gunnery instruments were available) or passed directly to the sight-setter who was probably the submarine's chef in private life.

With the submarine still at periscope depth, the captain gave the executive order ‘Salvoes shoot’ followed by ‘Man the gun tower’. In U-class submarines, which had no separate gun-tower, the gun's crew had to climb up the conning-tower ladder, and force themselves out of the hatch with the surfacing officer-of-the-watch and the lookouts before flinging themselves over the forward end of the bridge down to the waiting gun.

At ‘Stand-by to surface’ the layer removed both safety pins that secured the upper gun-tower hatch and reported ‘Tower manned, pins out’. Meanwhile, the First Lieutenant bled HP air into the boat until three or four inches above atmospheric pressure showed on the barometer. The motors were put to Half Ahead Group Up (about 6 knots) for the hydroplanes to have maximum effect, and the captain ordered ‘Surface’ and all the tanks were blown. When, despite the hydroplanes, the boat could no longer be held down against the rapidly increasing positive buoyancy and when the depth gauge was passing the 20-foot mark, the First Lieutenant blew a whistle. The gunlayer released the last hatch clip; the planesman put the plane to hard a-bow; the hatch, still under water but very close to the surface now, flung itself open under pressure from inside and the gun's crew followed, jet-propelled, as air whistled out around them. The heavy thud of the first round going away could be heard throughout the submarine before the boat had settled herself properly on the surface.

The first round was unlikely to hit the target because it had to come with a cold gun as well as water and anything else that had found its way into the barrel, factors which affected range unpredictably. The first round cleaned the gun: the second was the one to watch for. A range of one or two thousand yards from just abaft the target's beam was the ideal position to combine surprise with ease of aim. With a shell leaving the barrel every ten seconds or so it was not long before spotting corrections from the Gunnery Officer on the bridge succeeded in putting the target out of action or sinking it outright.

If an aircraft came in sight, the captain simply shouted ‘Down below’ It was an emergency order and the gun's crew, lookouts, officer-of-the-watch and, last, the captain dropped vertically down the ladder irrespective of crushed fingers or the state in which the gun had been left. It was the first lieutenant's job to get the boat under as quickly as possible, not to worry about what was going on up top; and he did not hold up the dive for any concern about whether the captain would make it. With two conning tower hatches, one ten feet below the other, there was always the lower one to be pulled shut if the upper lid was still open when the sea lapped over.

Torpedo attacks were often prolonged and, for most of the crew, boring and frightening by turns. Hits were unpredictable, usually unobserved and all too often followed by a depth-charge hammering. Gun actions, in contrast, offered instant results with little chance of retribution from puny unescorted targets. In this respect, as has already been suggested, submarines which used guns deserved, perhaps, some of the 'unsporting' epithets which had for so long been flung at them since the beginning of the century. But, sporting or not, gunnery was, frankly, a good game.
9 The Enemy Above

The ingenuity, effort and expense in countering the underwater threat was out of all proportion to what was spent on submarines themselves, as submariners well knew. For the Allies, the costly defeat of the U-boats was, as Churchill said, the essential prelude to all effective, aggressive operations. Anti-submarine measures taken by the Axis powers did not inhibit their own offensive capabilities to anything like the same extent; but Germany and Italy were to feel keenly the lack of adequate protection for convoys in the Mediterranean; and Japan was ultimately to collapse due to not having assembled sufficient A/S ships and aircraft to counter the American underwater onslaught on the Empire during the last two years of the war. The Japanese debacle was due primarily to the offensive spirit which entirely dominated the Imperial Navy’s thinking, along Mahanian and Jutland principles, which led to destroyer groups being trained, almost exclusively, to fight a fleet action rather than to escort merchant vessels.

World War II started with the Allies, advised by Britain, enjoying sublime confidence in the effectiveness of Asdic (from the initials of the Allied Submarine Devices Investigation Committee). It was, perhaps sincerely, believed that underwater listening and echo-ranging developments had overcome the submarine menace. This totally false but comforting thought arose from unrealistic peacetime exercises, politicians taking scientific aspirations too literally, a trustful conviction in the United States that any new technology was bound to work and an incorrect appreciation of how German U-boats would go about their business in war. Intelligence reports from the Baltic had indicated that U-boats would attack submerged; but the U-boat arm under Doenitz had no such intention. Doenitz was as impressed as anybody about the supposed capabilities of Asdic and Sonar; he constantly advised his men that diving rendered a boat blind, defenceless and more liable to destruction than when on the surface although that, of course, was before Allied radar became effective. Assuming that German agents told him about exercises in the Royal Navy in the 1930s, his opinion must have been strengthened by reports of British submarines being unable to penetrate the screens formed by escort vessels around capital ships and simulated convoys.

British submariners, or, at least, the Staff of Rear Admiral Submarines, accepted, apparently without demur, some extraordinary conclusions drawn from Fleet manoeuvres to the effect that a submarine would almost always be detected and depth-charged before reaching a firing position. No allowance was made for unwarlike safety restrictions imposed on submarines, nor for the fact that A/S forces knew, pretty well exactly, where the opposing boats would be. It is surprising that submariners took their paper defeat so tamely; but perhaps the notoriously poor promotion prospects for protesters was a taming influence. Whatever the reason for their pre-war silence, submariners began to display (outside the USN where more than a few continued to be unduly cautious) an aggressive disregard for any theoretical potential credited to the enemy above once war broke out and when they were no longer held back by peacetime rules.

Ignorance of the nature of the sea and its effect on underwater sound was a contributory factor in building over-confidence amongst anti-submariners. Sound propagation anomalies, with sound waves deflected and attenuated by temperature and salinity variations, bottom reflections and background noise, were hardly understood. They were learned about, in the main, from negative results when hunting submerged targets; and submariners tended to discover the sea’s peculiarities (and put them to good use) before the hunters. Most sea areas had negative gradients where temperature decreased with depth, bending sound waves downwards by refraction without any indication for Asdic operators that this was happening. A surface vessel might well not be aware that its listening range was being severely curtailed to the point where a submarine could approach undetected by powerful active transmitters or passive, listening hydrophones which should have revealed its presence several thousand yards away.

False Asdic reflections or echoes from 'non subs' abounded and fish-noises—ichthyological goffulles as Captain F J Walker RN, the most successful U-boat hunter of the War, called them—masked submarine screw and machinery and noises and U-boats were able to make their own goffulles by releasing a Pillenwerfer. This was a small metal canister which discharged a dense, chemically generated mass of bubbles as a decoy to reflect Asdic transmissions. It was supposed to keep an attacker busy while the submarine made off; but it only fooled the most inexperienced operators. U-boat men had little faith in it. If very hard pressed it was sometimes more effective to blow main ballast tanks with the vents open or, in extremis, to discharge oil or fire debris through a torpedo tube in the hope that the enemy above would think another U-boat had been killed. In isothermal, well-mixed water it was difficult for a submarine trapped in a sound beam to escape and desperate measures were needed; but even in ideal A/S conditions a boat was seldom detected before it gave the game away by firing fish. Despite his fears about vulnerability submerged, Doenitz advised a U-boat captain not to think that every action by the enemy above applied to him for 'generally it did not'. He was, of course, quite right. Submariners would not have achieved much anywhere if they had paid too much attention to what the forces overhead might or might not do being. Fortune favoured the brave: the so-called lucky ones were those who pressed on regardless. Attack was always the best means of defence. The confusion and noise following a torpedo explosion offered an excellent chance of escape while the targets were trying to avoid another attack and the escorts were milling around and trying to avoid hitting each other. At night, with all ships darkened, violent alterations of course were hazardous around a convoy even when radar was fitted; a submarine with three dimensions at its disposal was much better placed than its pursuers.

When escorting other ships A/S vessels were obliged to sweep out the waters ahead of them with active sound impulses emitted in searchlight beams which could be heard many miles away and used as hailing beacons by submarines. German and Italian forces
more often used sensitive passive hydrophones when looking for a submarine in a restricted area; their own speed, and hence self-noise, could then be low enough to hear sounds from unalerted and unwary submarines. Submarines therefore learned to keep very quiet. But apart from going below a density layer and presenting the smallest possible target by keeping end-on, there was little a submarine could do to avoid its hull returning a detectable echo if caught in an active beam. Experiments were made with sound-absorbent coating but, in most cases, the sea soon tore it off and the added drag cut speed by about 10 per cent. U-boat designers were notably successful, however, in quietening auxiliary machinery by insulating it acoustically from the hull and all captains endeavoured to suppress the unmistakable sound of propellor cavitation—caused by too rapid, inefficient rotation of the screws at shallow depths—by going sufficiently deep when increasing speed. When trying to evade or escape it was, above all, vital not to give away the boat's presence by the sort of easily recognised noise which could be made by a careless member of the crew clattering a bucket, stamping on a deckplate or opening a valve with a spanner which was not rubber-coated. When on the defensive it was also prudent to switch off all unnecessary lighting and machinery to conserve the battery: it was impossible to tell how long a hunt might last although British crews in the Mediterranean, where the going was especially rough for
submarines, found, thankfully, that Italian chasers were apt to give up at dusk.

Just as some submarines were much more efficient than others due entirely to human factors, so certain A/S units stood head and shoulders above the rest. It was a matter of application, determination, and a refusal to ever give up after hours, days or even weeks of fruitless hunting.

Depth charges were the principle weapons used on all sides throughout the war. They were superseded towards the end by head-turning weapons (hedgehog) but it was ‘ash-cans’ in large quantities (at £37 apiece in the Royal Navy) which submariners had to contend with mainly.

Being depth-charged was an experience which no submarine wished to repeat. The commanding officer of HMS J-2 had felt in 1917 that a hammering was a good experience because it ‘added to the keenness and efficiency of a boat’s crew and shortened the time of a crash dive!’ He may have been right (although he must have been almost unique amongst submariners in using the expression ‘crash dive’) but his added prediction that in the next war it would break the nerve of many submarine officers and men did not prove true. A few nerves broke! and there were hardly any cases of claustrophobia (which was not, despite public opinion, a disease endemic to submariners); but there were isolated incidents of boats giving up the fight or surrendering before being damaged beyond hope of recovering the situation. A few captains, too, apparently turned away from heavily defended targets; but they were a very small minority.

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Top

This was U-119, a Type XB minelayer commanded by Kptlt von Kameke, sunk off Cape Ortegal by HMS Sterling.

Bottom

Confusion in the Bay of Biscay! This signal from the famous U-boat killer Captain F J Walker commanding the Second Escort Group captures the excitement of 30 July 1943 when a total of six U-boats were destroyed by air and sea forces. Ironically, U-462 was sunk by aircraft ‘U’ of No 461 Squadron, RAF. This U-boat was a valuable Milch Cow as was U-462 mistakenly referred to as U-411 by Walker. His wording of the signal makes it appear that he was responsible for the sinking but the U-boat had been mortally wounded by the aircraft before he arrived. U-504 was the third U-boat in the signal and was acting as an escort to the other two; it was actually a large 1120-ton Type IXC commanded by a U-boat ace, F K Poekel.
Out of many hundred recorded Allied and Axis submarine attacks there were only a handful of occasions when the threat of depth-charging deterred submarines from obtaining their objective entirely as their captains wished. On the other hand submariners kept their heads down during an actual going-over and were then unable to fire torpedoes (other than Gnants) with any accuracy. It was therefore tactically sound for A/S vessels to plaster the general area even if not in firm contact; but the number of charges which they carried was limited and had to last for the whole period of escort duty. Submariners counted the explosions carefully and were able to judge pretty well when stocks were running low.

The killing range of a standard depth-charge was about 30 feet and its effect increased with depth. It was a prematurely surrendered U-boat, U-570 (Kpflt Hans Rahmlow), later taken into British service as HMS Graph, which in due course provided the most detailed indications of underwater explosive effects. U-570 surfaced off Iceland in misty weather on 27 August 1941 under the nose of a patrolling Lockheed Hudson aircraft from No 269 Squadron, RAF. The Hudson (Squadron Leader Thompson) instantly straddled the target with four depth-charges which so shook the captain and crew that it was decided to surrender without a fight. Subsequent investigation showed that there was nothing in the hull damage which would have made it impossible, or even difficult, to dive the U-boat: nor would cracked battery cells have prevented escape.

Supplies to the main motors, lighting and auxiliaries could have been restored very quickly and the steering and hydroplanes could have been put in hand-control; but no attempt was made to do any of these things. Although the captured crew said chlorine gas was escaping from the batteries no trace of this was found by the party sent by the Royal Navy to take the boat over. It was a case of total surprise leading to panic.

As well as subsequently patrolling usefully under the White Ensign Graph yielded valuable secrets, not least the results of depth-charge trials made against her when she decommissioned. These showed that a charge detonated beneath the hull was the most dangerous: one-third to one-half of its value did the same damage as a charge above the hull; and if a charge was detonated opposite to a transverse bulkhead or a large fitting attached to the pressure hull its effect was considerably magnified. It was therefore correct, when avoiding counter-attack, to go as deep as possible and that is what submariners instinctively, were doing. German
and Italian submarines were helped by being well supplied with information about standard Allied hydrostatic depth-charge settings—which were frequently too shallow. The normal diving depth of a Type VIIC U-boat was 100 metres, well below D/C settings early in the war, and it could go much deeper, although at 200 metres the internal woodwork started to crack (an unpleasant sound) as the hull compressed. The laid-down limit was 230 metres in emergency but that only left a narrow margin of 20 metres before the hull could be expected to collapse. The ultimate collapse depths predicted by designers on all sides were, incidentally, accurate (as proved by post-war trials) to within a few feet.

U-boat men were also aware of another significant advantage of going deep. This arose from the fact that an Asdic sound beam, being conical in shape, covered a narrower and more shallow volume of water as the range closed. An escort therefore lost contact with a U-boat at 200 metres at a range of about half-a-mile even in isothermal water: when running in to carry out an attack on a 'collision' course there was therefore necessarily a brief period during which contact was lost. This, added to the time which depth-charges took to sink to a given depth, allowed a submarine about two minutes to make a radical and undetected alteration of course and speed to place itself some 300 yards outside the lethal range of the pattern. Depth-finding Asdic sets and ahead-throwing weapons to overcome this problem for escorts were not generally available until after the critical part of the Battle of the Atlantic had been fought; at the height of the battle skilled U-boat captains who kept their nerve were able to avoid being sunk by the great majority of surface ships' attacks. However, quite distant depth-charges could damage a boat's equipment to the extent that it could no longer fight. The more delicate, sophisticated fittings were the first to go. Dönitz insisted that equipment be kept

Top Left
Hauling an A/S net aboard a boom vessel.

Centre Left
Submarine surfacing after being caught in an A/S net during trials.

Bottom Left
Japanese search-receiver aerial (70-430 mcs) for giving warning of enemy radar. The antenna was rotated by hand by an operator on the bridge equipped with headphones; audio warning only was given.
simple and easy to repair at sea with 'hands-ralic' alternatives where possible. The best commanding officers in all navies exercised breakdown procedures at every opportunity and constant training paid dividends. A lazy commanding officer who did not bother to keep his crew at the peak of efficiency during slack periods on passage or patrol may have enjoyed some superficial popularity but it was apt to be, literally, short-lived.

When below periscope depth a submarine had to rely on its hydrophones which were directional but, at best, only accurate to within one degree of bearing. Range could only be guessed. Submarine hydrophone operators had some indication when escorts were in contact from the way in which their transmissions remained constant (searching) or started to shorten (attacking). However, shouts of 'in contact' and 'attacking' were discouraged because they did little to help morale. It was usually obvious enough, from propellor noises throbbing through the hull, when depth-charges were about to rain down. The attacking ship could plainly be heard speeding up on a steady bearing and that was the moment for the submarine to start energetic evasive action. A brief but hideous pause was followed, audibly, by the faint click of pistols striking before the successive sledge-hammer blows of explosions hit the hollow hull and overcame all rational thought. Gauge-glasses shattered, lights went out and the boat was thrown about uncontrollably by the colossal force of pressure waves at depth. If a sea-water connection fractured it did not just leak; the resulting water jet at, say 200 metres was like a bar of steel, quite strong enough to break a limb.

Amidst the damage and the darkness it was imperative to remain quiet and that made essential repairs difficult and trimming more so, for the ballast pump and high pressure blows were clearly audible to the enemy above. Any tendency to over-react, let alone panic, was bound to make the situation worse. But a well-drilled crew who were able to keep calm stood a far better chance of escape than anti-submarine forces reckoned. The prize for maintaining the will to win under depth-charge attack must have gone to an American coloured boy who, somehow, failed to appreciate the significance of Japanese 'ash-cans' exploding all around his boat: his enthusiastic cry of 'give 'em hell' came as a welcome relief. It was only equalled, perhaps, by the Coxswain of a British boat being hammered from all sides who drily reassured everybody: 'It's alright men, we've got them surrounded.' Possibly the coloured boy had just knocked back one of the little two-ounce bottles of Scotch that, with the tacit connivance of certain captains, appeared on these occasions despite the US Navy being strictly dry. As for the Coxswain, he would not have been a Coxswain if he did not have access to some private hoard of refreshment. A little Dutch courage could be very helpful on occasions.

It was aircraft, though, with their much more limited attacking ability, that submariners—especially U-boat men—came most to dread. The impact of A/S aircraft on the underwater world was enormous but they were not always as effective as submariners feared. Allied aircraft were considerably

USS England was only commissioned in December 1943 and was new to the business of war, but under the command of Lcdr W R Pendleton she quickly became the top scoring submarine killer in any navy. Between 19 and 26 May 1944 the England sank the Japanese submarines I-16, Ro-104, Ro-105, Ro-106 and Ro-108; and on 30 May, in company with other destroyers, her hedgehog projectiles sent Ro-105 to the bottom.
Top

AA armament strengthened in a Type VII C U-boat to one 37 mm and two twin 20 mm guns

Centre Left

U-79 going down, with two survivors still waiting on the stern, after being depth-charge by HMS Hasty and Hotspur off Bardia on 23 December 1941.

Bottom Left

U-977 hit by a test torpedo fired by USS Atule on 13 November 1946. U-977 commanded by Obi Heinz Schaeffer, was at sea when the cease-fire was ordered. Schaeffer decided to make for the Argentine but first landed, by dinghy, 16 of the crew in Norway who wanted to return home. He used his schnorchel for most of the way and arrived on the 17 August 1945, the boat being interned on arrival. U-977 was subsequently handed over to the USN for use as a torpedo target.

more skilled in anti-submarine operations than their Axis counterparts; but out of 767 attacks delivered on U-boats between September 1939 and December 1942 only 31 were lethal, although a further 73 resulted in serious damage. The main effect of A/S air operations, from a submariner's point of view, was to make surface-running exhausting and dispiriting. Boats had constantly to be alert to dive for any aircraft, whether or not it seemed to be an immediate danger. Crews were continually dragged from their bunks by the diving klaxon in an area of high
 Allied submariners also learned to their cost that there was no such thing as a friendly aircraft; they were frequently bombed in ‘safe’ zones by over-sanguine aircrews. Rear Admiral Lockwood USN was prompted to remark that he was ‘not impressed with the earnest desire of the Army Air Force to co-operate with other forces.’ Wise submariners dove for anything with wings and were not ashamed if, later, it turned out to be a seagull.

The nets and obstacles that had been so extensively used from 1914–1918 were seldom employed in the second underwater war except in the Baltic; but the inherited World War I concept of laying anti-submarine mines proved disturbingly effective and a number of submarines on all sides were lost because of them. If sent to a mined area, which might or might not be known by its operating authority, a submarine depended largely on luck. In good conditions a submarine sonar set fitted with a short transmission unit was theoretically able to detect a moored mine at about 1,500 yards, but negotiating a minefield with this device was not a proposition that submariners welcomed. It was better to go below the expected depth of the minefield and hope for the best. Magnetic mines on the sea bottom could not, in any event, be detected; nor was degaussing and wiping (to neutralise the permanent magnetism of the hull) a sure defence. American operators in the Pacific insisted on rigorous demagnetising procedures before a boat sailed on patrol, only to declare (wrongly) after the war that the Japanese had no magnetic mines; but other Allied submarines suffered heavily, especially in the shallow waters around the Mediterranean. Some 26 out of 82 British submarines lost between 1939 and 1945 were reckoned to have succumbed to mine warfare (although, statistically, a small proportion of these were probably lost by accident, for the sea itself was more powerful than any devices of the enemy and accidents due to human error were not unknown).

Deliberate ramming, another tactic from World War I, sent a number of boats to the bottom. Two ramming incidents deserve mention. The first was an unrelieved moral tragedy resulting in the loss of HMS Oswald at midnight on 1 August 1940 off Cape Spartivento. It was a dark night and Oswald was on the surface charging batteries when a lookout sighted an Italian destroyer one-and-a-half miles on the starboard quarter. The officer-of-the-watch sounded the night alarm but when the captain climbed to the bridge he was unable to see because he had been deciphering a signal in the wardroom without wearing night-adaption red goggles. The destroyer, Vivaldi, turned to ram and increased speed but Oswald took no avoiding action and no effort was made to man the gun or bring the torpedo tubes to bear. The subsequent investigation established beyond reasonable doubt that the captain ordered ‘Abandon ship’ before the submarine was struck.

When the collision came it was only a
During the period 1904 to 1930, for which international figures are fairly reliable, 181 men in sunken submarines were rescued by salvage, thirty-three by bell (USS \\emph{Squalus}); sixteen escaped and survived using breathing sets and two escaped but did not survive. During the same period over two thousand men died in submarine accidents. Whether some of them tried to escape and failed will never be known. The chances of escape in war, especially in deep water, were very slight and submariners in all navies took little comfort from the escape sets carried; the emphasis on escape throughout submarine history resulted from the pressure of public opinion and the press and not from submariners themselves who preferred to concentrate on not having an accident in the first place!

Submariners learning to use DSEA (Davis Submerged Escape Apparatus) sets in the escape tank at HMS \\emph{Dolphins}. All navies used broadly similar apparatus which supplied pure oxygen, dangers of which were only fully appreciated long after the war although K E Donald fully reported 'the affects of Oxygen under pressure on Man' in 1943. Men were taught to clear their lungs completely before breathing from the oxygen bag but, in fact, it was probably those who neglected to do so and hence breathed a lesser concentration of oxygen during their escape, who fared best. However dangerous it may have been during an actual escape, the inflated bag was invaluable for support on the surface. Note the instructions at top!

Glancing blow and the depth-charges that followed were not particularly close. However, the submarine was scuttled by the captain's order. The chief ERA opened main vents when all the men were out of her. Fifty-two very unhappy members of the crew were rescued and made prisoner. The Commander-in-Chief, Levant was able to say that commendable courage and devotion to duty was displayed by many of the ship's company, notably by Lieutenants Pope and Hodson, but the affair was not one to be proud of.

The other incident, concerning HMS \\emph{Proteus} (Lt Cdr P S Francis), was much more enlivening and creditable. \\emph{Proteus}, with a number of successes already embroidered on her Jolly Roger, was patrolling on the surface during the night of 8 February 1942 when Francis thought he saw a U-boat; he immediately turned towards in order to attack, but the target turned out to be the Italian torpedo boat \\emph{Sagittario}. The two antagonists met head on, causing considerable damage to \\emph{Sagittario}'s port side which was ripped open by the submarine's forward hydroplane. But the collision started several rivets in \\emph{Proteus} who had, reluctantly, to abandon the patrol. Both sides retired gracefully from the arena.

It was astonishing how much punishment a submarine could take and still survive. When a boat did give up the fight—and that was not often—it was men, badly led, who cracked before the pressure hull. It is, of course, easy enough now to criticise the few who went under when they might have finally escaped. But when tired—and submariners were often very, very tired after days or weeks in action—or when confused by what Nelson had called the fog of war and when concerned for the lives of shipmates, prospects sometimes simply looked too bleak to carry on. Nonetheless, so long as a boat could somehow stay submerged in one piece, however battered, submariners came to learn that they always had the edge on the enemy above.

\textit{Left}

The engine room hatch of a British S-boat. Note the external securing bolts which made it impossible to open from the inside; it was usual to secure hatches in this way to prevent their jumping under depth-charge attack but they were, of course, thereby rendered useless for escape.
With such a formidable array of Italian submarines at the starting line it was reasonable to expect the Axis powers to take the lead in the underwater Mediterranean war. They did no such thing. The Italian High Command was timorous and examined risks too closely to permit a positive strategy for the submarine force. Caution bred more caution and brought about a conviction, which spread rapidly downwards through the ranks, that risks could not be tolerated. Submariners in other navies regarded their Italian counterparts with more liking than professional respect. In many cases that attitude was justified, but certainly not in all.

Italian strategy decreed that the surface fleet should look to Italy’s defence while the underwater fleet took the war to the enemy; but the submariners were scarcely cheered on in battle. When the war began 55 boats were already stationed in various areas of the Mediterranean with a vague hope of their ambushing unspecified targets. Two boats, *Finzi* and *Cappellini* were heartlessly sent through the perilous and heavily patrolled Straits of Gibraltar into the Atlantic but they, too, lacked any clear directive. Three days after the beginning of hostilities half the boats at sea returned to their bases with one problem or another and thereafter there were never more than 25 to 30 submarines on patrol. The boats that stayed out were pushing their luck: no less than ten were sunk during June 1940, the first month of the war for Italy. Losses thereafter declined to about ten boats every six months but this was only because there were less boats at sea. A schnorchel device would have done much to reduce losses: a prototype had in fact been successfully tested in the Italian submarine *H-3* in 1926 but the project had been abandoned, for no given reason. Italian submarines found themselves exposed to concerted attacks in the Mediterranean by British submarines, ships and aircraft and their slow reactions, both in human terms and diving performance, rendered them frighteningly vulnerable. The 32 boats transferred to German control at Bordeaux, primarily for Atlantic operations, from September 1940 to February 1943, with the majority arriving in France at the beginning of this period, fared, for the most part, no better; worse, they suffered humiliating criticism from the German U-boat Staff. Nor did the half-dozen Italian boats in the Red Sea and Indian Ocean enjoy success and several crews in these areas were incapacitated (they said) by an illness caused by faulty air-conditioning. Morale in the Italian submarine service was, with notable exceptions, not good.

Against the 79 Italian boats lost on operations, the principal successes achieved were three British cruisers, one destroyer, one corvette, one minesweeper, and about half-a-million tons of merchant shipping. However, the figures quoted in various sources vary widely and many original records were destroyed.

To be fair, the German U-boats despatched to the Mediterranean in 1941 and again in 1943 and 1944 did not find their task easy in those generally calm, clear and confined waters. Nor, for that matter, did the British boats. But U-boats were much smaller and handier than their Italian counterparts and, although Doenitz was reluctant to take any boats away from the Atlantic convoy battles, the handful that operated in these unfamiliar conditions so far removed from
the Atlantic caused more than sufficient havoc to justify their presence. In November and December 1941 they sent the aircraft carrier Ark Royal, the battleship Barham and the cruiser Galatea to the bottom. In the first six months of 1942 the cruisers Naiad and Hermione were sunk by U-365 (Kptlt Jebsen) and U-205 (Kptlt Reschke) respectively; and the submarine depot ship Medway, five destroyers and 12 assorted transports and tankers were also torpedoed. The loss of HMS Medway, the largest and best depot ship afloat, was a severe blow to the British Flotillas. The aircraft carrier Eagle, escorting a convoy, went down to U-73 (Kptlt Rosenbaum) in August 1942 and towards the end of the year U-boats opposing the Allied landings at Algiers and Oran sank six transports totalling 66,000 tons and four destroyers. In 1943 and 1944 they followed these successes, whilst attempting to dislocate Allied sea lines of communication, by sinking a fast minelaying vessel (see also Chapter 8) and about 30 merchant vessels. These achievements went some way towards offsetting Italian failures but they did not count for nearly as much, strategically, as the destruction wrought upon Rommel's supply lines by British boats.

The Mediterranean saw submarine activity of every kind and it was here that the most advanced tactics in the underwater war were developed, practised and perfected, particularly by the British and the two Polish and three Dutch boats under British control. Submariners, especially those operating from Malta, struggled under conditions which were more testing than in any other theatre; but with typical perversity they performed even better as the difficulties became greater.

The Royal Navy's Mediterranean flotillas enjoyed outstanding leadership and no better than that of Captain 'Shrimp' Simpson commanding the Tenth Flotilla in Malta and backed to the hilt by the forceful, implacable Max Horton, Vice Admiral (Submarines) from his London Submarine Headquarters at Northw;

Politics in the Mediterranean were traditionally a national pastime and it was always difficult to know who was on what side. When Italy entered the war and when the collapse of France in Europe followed ten days later, the situation was, to say the least, confused. But the Middle East was such a vital area that one thing was clear to all: the Mediterranean sea lanes would be challenged by both sides and the victor in that dispute at sea would gain final victory. Simpson grasped the point immediately.

Shrimp was junior for the job. He was only a commander when appointed Senior Officer Submarines, Malta in August 1940 and had only recently been promoted to a Captain when his group was established as the Tenth Flotilla. At the far end of the Mediterranean submarines from the Far East had been transferred to the First Flotilla at Alexandria and were by now patrolling against the enemy ships supplying North African possessions and armies; but the old O, P and R class boats were not suitable for inshore operations and suffered heavy losses; nine out of 15 were sunk in the last half of 1940. At the end of the year some of the new U-class submarines were sent out from England destined for Alexandria but were ordered to Malta where these small, handy craft quickly showed their worth in the Tenth Flotilla. Their endurance was short but Malta was ideally situated for them. From Lazaretto harbour they sailed principally to strike at the Sicily-Tripoli-Tunisia route favoured by Axis shipping; but they were also sent to patrol off the main Italian naval bases in South Italy in the hope of attacking heavy enemy units, for at that stage the British Mediterranean surface fleet was numerically at a disadvantage.

The early Italian air attacks on Malta
scarcely dentet the island's defences; submarines were able to return in relative peace for rest and repair at the improvised base on Manos Island. That state of affairs was not to last. At the end of 1940 German forces entered the Mediterranean battle and the effect was soon felt. Air attacks on Malta were stepped up and soon the surface units based on Malta had to be withdrawn. The submarines remained: they were the island's only offensive force. There was now little rest for the crews between patrols. Workshops and accommodation were heavily damaged in air raids and submarines in harbour were themselves bombed making it necessary for them to spend daylight hours submerged which did nothing to assist maintenance and relaxation.

However, Rommel's Afrika Corps was building up for an assault: it was imperative that the Malta submarine base kept going as usual. Although false economy before the war had prevented submarine underground pens from being built, the Maltese limestone was easy to burrow into. Shelters and makeshift workshops were rapidly excavated. In matters of maintenance and making-do the Flotilla was fortunate in having an outstanding Engineer Officer in Commander Sam MacGregor who was resourcefulness and improvisation personified. MacGregor's determination to avoid all paper work was helped by a fortuitous Luftwaffe bomb on the Naval Store Officer's records. As a cloud of paper forms and flimsies floated away on an easterly breeze at the height of the bombardment in February 1941, Sam was heard to remark with satisfaction: 'I reckon that must have loosened things up a bit.' Thereafter submariners helped themselves to whatever stores they needed without formality.

The German and Italian Commands were unaccountably rigid in their routing of convoys between Italy and North Africa. They adhered to similar routes for as much as three months at a stretch. This oblique consistency favoured the submarine onslaught on Rommel's supply lines and useful guidance was also obtained from intelligence reports which did not, in the garrulous Mediterranean, depend wholly on intercepted radio traffic. Thus, submarine operators, who at various times controlled boats from Gibraltar, Algiers, Alexandria, Beirut, and Maddalena as well as Malta, were able to concentrate the very limited number of submarines available at the most favourable positions. From January 1941 until February 1943 it was usually possible to maintain four submarines, including Polish and Greek boats, on patrol. During these
Commissioning ceremony for the Greek submarine Pipinos at the Vickers yard, Barrow-in-Furness. Despite arriving late in the war Pipinos under the command of Lt Kallal, and later, Lt Loundras carried out several aggressive patrols in the Aegean Sea during one of which the German controlled ex-Italian destroyer Calypso was torpedoed and sunk. Although hampered by political problems and outdated weapons the Greek submarine service embodied the fine fighting spirit of that country with its determination to attack its enemies.

Top Right
U-32 survivors coming ashore after being sunk by the Dutch submarine O-21, east of Gibraltar. U-32 had sunk over 50,000 tons of shipping.

Centre Right
The Dutch submarine HNMS O-21 (Lt Cdr J F van Dulm HNN) returning from patrol off Naples encountered the U-32 in the Gibraltar area at night. The Dutchman was keeping a better lookout and sunk the U-boat, rescuing the German captain, Kptlt Gert Schreiber, four officers and seven ratings. Some of the survivors from U-32 are pictured, still carrying their excellent U-boat clothing, leaving HNMS O-21.

Bottom Right
HNMS O-21 arriving at Gibraltar with German prisoners from U-32 which she had sunk on 28 November 1941 just off Gibraltar.
I

During a working-up patrol in UK waters, Dolfijn was fired at by "an area of total attack range to both petrol and torpedo by 47 torpedoes, out of the 90 carried, floating clear and being recovered.

Centre Left
HMS Unseen (Lt M. C. Crawford) alongside survivors of the 85-ton Raawin, which she sank off Bari, 21 August 1943. Four survivors were taken on board Unseen and food and morphine tablets were given to the remainder on the raft.

Bottom Left
Caught at night on the surface, the Italian submarine Uarsciek dived to escape the Greek destroyer Queen Olga and the British destroyer Petard but a severe depth-charging forced her to the surface where she was engaged by gunfire. Under tow by Petard for eleven hours the submarine finally floundered on 13 December 1942. Despite having 25 patrols to her credit the Uarsciek had sunk no enemy ships.
critical two years more than 600 torpedoes were fired and about 100 enemy vessels were sunk by torpedoes and gunfire, varying from small schooners to liners of 20,000 tons. Warship casualties inflicted by the Tenth Flotilla alone included two cruisers, four U-boats and several destroyers. Meanwhile Malta suffered some 2,000 air-raids resulting, in just over a week from 26 March to 4 April 1942, in the loss of four submarines in harbour including the Greek Glaukos. Losses were correspondingly heavy at sea in 1941 and 1942; a dozen boats failed to return to Malta from patrol, half of them being sunk by mines.

On the success side of the scales, HMS Utmost (Lt Cdr R D Cayley) started the count in February 1941 with a ship north of Tripoli, followed by Upholder (Lt Cdr M D Wanklyn) who got two a week later. In March, Upright (Lt E D Norman) carried out a brilliantly executed night attack, on the surface, against two Italian cruisers, hitting and sinking the Armando Diaz, going very fast, with a salvo fired fine on the bow at short range. This particular sinking gave the Flotilla confidence and a much needed boost to morale. It also fully justified the intensive ‘Perisher’ training back at home!

Successes mounted during the summer and reached a peak during the Autumn of 1941. HMS Upholder sank the large liners Conte Rosso in May and Oceania and Neptune in September. They were all southbound full of troops and their loss significantly curtailed shipborne troop movements. In five hours the last two attacks accounted for as many enemy men as the total number of Allied submariners employed during the whole Mediterranean war. Oceania and Neptune were hit at night with Upholder rolling heavily on the surface and the gyro-compass out of action. Wanklyn did not trouble, in his patrol report, to make the point that the attack was exceptionally tricky with the helmsman steering erratically by magnetic compass and the boat yawing several degrees either side of the true course; he simply remarked that he had to spread his torpedoes over the full length of both targets by anticipating the amount of swing between the order to fire and the torpedo leaving the tube. The first torpedo was aimed, as normal, at the target’s bow; a violent yaw to starboard obliged him to fire the second where his fourth would normally have been aimed; and
Kptlt. Helmut Rosenbaum (U-73) with the customary floral tribute given to U-boat commanders after a successful patrol.

numbers three and four tubes were fired to fill in the gap on the swing back to port. This skilful timing covered the combined targets with accuracy and resulted in two torpedo hits, one on each ship. The attack took place on 18 September 1941 and was the culmination of a carefully planned operation involving four submarines placed across the probable line of advance of the convoy as it approached Tripoli. Unbeaten, Upholder and Upright were positioned ten miles apart on a line drawn 30 degrees off the expected enemy course and Ursula was stationed some 50 miles closer to Tripoli where it was expected she would have an opportunity to attack soon after dawn, Simpson reckoning that the convoy would aim to arrive at Tripoli at 0900. A strong air escort was expected and it was therefore planned that the other three boats should make their attack by night which is exactly what Upholder did, firing soon after 0400. It was an exemplary engagement.

Wanklyn had already been awarded the
Victoria Cross, one of five Mediterranean submariners who received the highest decoration, some four months earlier, following his fourteenth patrol. It was nominally given for sinking the liner Conte Rosso (17,879 tons) in tailing light with the Asdic gear out of action and a very real risk of being rammed inadvertently by one of the numerous escorts; but submariners preferred to think of the award being made for Wanklyn's ability, during a long series of patrols, to assess chances quickly and accurately and take calculated risks when there was a proper, if very narrow, margin in his favour. He had a brilliant mathematical brain which served him perfectly, however fraught the situation was; and, above all, he had the knack of inspiring his crew into being a cut above average. His success did not, however, come easily: his first four patrols had been failures to the point that Simpson began to wonder if he could retain a commanding officer who was using up valuable torpedoes with no result. But Wanklyn studied the circumstances which had caused him to miss and meticulously set out to polish the techniques necessary to succeed. And succeed he did: in the 16 months that Upholder operated in the Mediterranean Wanklyn sank two U-boats and one destroyer, damaged a cruiser and another destroyer and sank or damaged 19 of Rommel's supply ships totalling 119,000 tons. (A third U-boat on Upholder's Jolly Roger was subsequently disallowed.)

Upholder failed to return from her twenty-fifth patrol, falling victim to the small Italian torpedo boat Pegaso off Tripoli on 14 April 1942. Pegaso carried out an urgent attack on a smoke-float datum dropped by an escorting seaplane and then gained an unclear sonar contact. When she had depth-charged the position with no apparent result and lost contact after two hours the little A/S vessel modestly made no firm claim for having destroyed anything. But she had sunk the Royal Navy's finest submarine. It was a sadly low-key ending to Upholder's career. It may well be that Wanklyn and his crew had simply done one patrol too many and were mentally and physically burned out by the strain. Full alertness was not limitless.

Returning to the attack on Neptune and Oceania, which showed submarine strategy and tactics at their best, it is worth noting that Captain S M Raw, in his covering letter on Upholder's patrol report considered that the principal credit for the operation 'must be accorded to Captain S 10 (Simpson) not only for his most excellent and intelligent appreciation of the enemies' probable movements—which proved to be uncannily accurate—and the subsequent dispositions, but also for the
very high state of efficiency of the submarines under his command. A better *esprit de corps* than that prevailing in the Tenth Submarine Flotilla could not be found...

Neither Simpson nor his commanding officers were prone to exaggerating their successes; claims by nearly all submarines were correctly assessed. Between January 1941 and August 1944 an attack success rate of 28 per cent was achieved and a torpedo hitting rate of 53 per cent, much higher than elsewhere and almost exactly what was forecast by submariners in certain uniquely realistic Spring Exercises of 1939. With the experience of attacking fast, zigzagging, heavily escorted ships behind them, the Tenth Flotilla boats, commanded from January 1943 by Captain G.C. Phillips and operating towards the end of the war from a new base at Maddalena in Northern Sardinia, found coastal targets and transiting U-boats were easy game off Toulon and along the Riviera coast. The rate of hitting here rose as high as 64 per cent. It was an unequalled example of professionalism and precision.

Gunnery, however, was not always the Tenth Flotilla's strong point. When HMS *Unbending* (Lt E.T. Stanley) encountered a schooner full of mule and camel fodder in the Gulf of Sfax and went to gun-action stations it was the gunlayer's first war experience. At 1,000 yards he was wide of the target so Stanley closed to 500 yards and then to 100 yards. The gunlayer missed. So the Torpedo Petty Officer (T1) was summoned to see what he could do. *Unbending* went alongside the target, the T1 jumped on board with a can of shale oil and the schooner was soon blazing. It took the arrival of *Safari* (Cdr Ben Bryant), on loan from the Third Flotilla, to show what a three-inch gun in competent hands could achieve. Bryant favoured gun actions and calculated that he averaged ten tons of enemy shipping sunk for every 16-pound round fired. Guns came to be used extensively, especially in the Mediterranean backwaters where the air threat was less and shore bombardment was a popular pastime when sea-borne targets failed to appear. Gunnery targets were usually small, of course, but sinking caiques and schooners, which often carried valuable stores and troops, was undoubtedly bad for the enemy's morale even if the steady rate of attrition did not amount to a formidable tonnage in comparison with torpedo sinkings.

At the end of his time in the Mediterranean, Simpson suffered the infuriating experience of having the ship in which he was taking passage, HMS *Welshman*, sunk under him by U-617 but he survived to take command of the Western Approaches Escort Group from Londonderry. It was largely because of 'Shrimp' that Rommel's Chief of *Parthian* is firing at the caique visible behind the smoke. Both this and the one in front of the smoke were sunk; and fire was then shifted to the railway tracks on the left, all of which were hit. The railway embankment can be seen stretching across the picture behind the houses, but the signal box, water tower and station (all of which were hit) are not visible. All the tracks were damaged and set on fire; about thirty hits were registered on, or very near, the line in the gaps between the houses before *Parthian* was forced to dive by machine-gun fire from the right of the picture. Only one dwelling was hit, the fourth from the left, whose roof appears damaged in this picture. One man of the submarine's gun crew was killed by machine-gun fire. This was *Parthian's* third Mediterranean war patrol from 30 April to 12 May 1943.

Staff was moved to say 'we should have taken Alexandria and reached the Suez Canal if it had not been for the work of your submarines on our lines of communications.' This tribute from an enemy is fully substantiated by history but historians have seldom given Allied submarines in the Mediterranean the full credit for victory in an area where, as the Commander-in-chief Mediterranean wrote to the Admiralty on 17 September 1941, 'every submarine which could be spared was worth its weight in gold.' Even at 540 tons apiece, he may have been right.
German U-boats were intermittently active in UK home waters and the Norwegian Sea—witness Gunther Prien's brilliant attack on HMS *Royal Oak* in Scapa Flow on 14 October 1939 and the (largely abortive) shots at British transports and naval vessels during the German invasion of Norway in April 1940—but German preoccupation with the Atlantic left the field open, for the most part, to RN submarines and Allied boats under British control.

The seas around England were often shallow, treacherous, heavily mined and beset by violent bouts of bad weather and poor visibility. In summer months the hours of darkness in the northern areas were short, which made battery-charging hazardous. Sea-water densities changed abruptly from place to place and at different depths, especially off Norway where the density could be 1.022 at periscope depth and 1.025 a little deeper which made it necessary to reverse normal trimming procedures and flood water into the compensating tanks to get below the layer around 60 feet. A/S defences were concentrated in focal areas and the Skagerrak, in particular, was 'alive with escorts'.

Floating mines were a serious threat and a dozen or more might be sighted every day on patrol along the Norwegian coastline: HMS *Sturgeon*, for instance, encountered 73 on passage to and from Lerwick between 25 June and 12 July 1942.

The battle commenced tragically when, on 10 September 1939, HMS *Triton* and HMS *Oxley*, patrolling off Oprestad, encountered each other on the surface with the result that *Oxley* was sunk with only two survivors. *Oxley* was out of position and replied to *Triton*’s challenge with an ineffective signal lamp but, *de mortuis nil nisi bonum*, *Oxley*’s captain was absolved from blame.

One result of this accident was to increase the spacing between submarines on patrol, but before this could be done *Sturgeon* fired three torpedoes at *Swordfish*, happily without result. On 17 September HMS *Seahorse* managed to survive bombing by an RAF aircraft which heralded a long series of attacks on submarines in all areas by 'friendly' aircraft. Notoriously inaccurate air navigation and lack of adequate co-operation and co-ordination between submariners and airmen at Staff level was to become horrifyingly evident throughout the war.

HMS *L27* (launched in 1919 but completed many years later) got three hits on a 7000-ton merchant ship on 15 October 1940 off Cherbourg, passing through a screen of seven A/S trawlers to do so. But on the next patrol inshore the old lady hit what was probably a fixed defensive mine off Fécamp with the result shown here.
Above
HMS Sunfish in dry dock at Wallsend after a near miss from a 250 kg bomb in the River Tyne on 2 October 1941. She was later transferred to the Soviet Navy.

Below
A triumphant German procession. A S trawler UF-128 towing HMS Seal into Friedrichshafen. Seal, a minelayer, was too large for the task allocated — the laying of a minefield in a particularly restricted part of the Kattegat. Herself falling victim to a German mine on 4 May 1940 and badly damaged, Seal managed to struggle off the bottom but while striving to make for neutral Sweden, and unable to scuttle herself, she was taken by German forces which could hardly have failed to find her when daylight came at 0250 on the next day.
The British submarine Seal, flying the Swastika (above). Seal was renamed UB. Of little use to her captors, Seal-UB was eventually scuttled in Keil harbour at the end of the war. One young German rating, fed up with boring trials in UB was drafted to U-170 which was captured by the British on her first patrol; thus he served in a British submarine captured by the Germans, and a German submarine captured by the British.
Submarine War Orders were indicative of the British Admiralty's poor appreciation of submarine capabilities: 'the primary object... is to report movements of German war vessels but no favourable opportunity of attacking them should be neglected, providing that this can be done without prejudice to the primary object...'. The old, first war Mahanian concept of bringing about a major Fleet action was firmly at work. Enemy reports were by no means easy to pass in the face of enemy air cover and the War Orders hedged instructions in a curiously unaggressive, unctuous way: 'Commanding officers must decide for themselves, according to circumstances, whether the importance of the enemy to be reported and the possibility of the submarine being detected by enemy surface ships or aircraft, justifies surfacing to pass a report, if necessary flying a kite or waiting until more suitable opportunities exist.' Even on the distant China Station, where there was no air threat, British submarines were ordered 'to report not attack'. The War Orders were, therefore, not inspiring at the start; but on 20 September 1939 they were drastically amended to say that 'the object of all submarines is to attack enemy war vessels.' Commanding officers were duly thankful!

However, the Government was determined to adhere to international law and attacks on all merchant shipping were restricted just as in the German Navy. This led to a loudly-voiced uneasiness in the minds of submariners who were unsure about their aim and object, particularly after the sinking of MV Hedernheim on 19 March 1940 by HMS Ursula (Cdr G C Phillips) and the attack on MV Edmond Hugo Stinnes (subsequently scuttled) on 23 March by HMS Truant (Lt Cdr C H Hutchinson). Both attacks took place in the Kattegat and the

Top Left
HMS Sealion (Lt Cdr Ben Bryant — in the Sou’wester) returning from patrol in the Kattegat. Note the White Ensign laid over the bridge for identification from the air. The small box-like instrument on the side of the bridge is the port emergency navigation light.

Centre Left
Note the HMS Sealion cap-tallies. For security reasons the names of boats were not usually worn; 'H M Submarines' was the general rule as the war progressed.

Bottom Left
Submarines based in the UK did not have to go to the Arctic to find ice — HMS Sealion at Parkstone Quay, Harwich in 1939 or 1940.
safety of the crews was ensured; but it was held that the commanding officers had exceeded their orders. Nonetheless, Vice Admiral (Submarines), by now Max Horton, decided not to restrain other submarines from following these examples, as ‘neutrals’ were unlikely to be offended so long as territorial waters were respected’. The correctness of this view was borne out by a report from the Military Attaché at Copenhagen which stated that the sinking of these ships had a ‘splendid effect upon the Danes’. On 4 April, with the Norwegian invasion imminent, commanding officers were ordered to give priority to transports over warships. This important signal was the forerunner of the Polish submarine Orzel’s sinking of the transport Rio de Janeiro east of Kristiansund on 8 April and the Cabinet decision approving the first of several ‘free for all areas’ whereby all German merchants would be treated as transports and sunk without warning. Thereafter, restrictions were lifted along a pattern similar to that of the German Navy but, if anything, preceding it. Doenitz pointed out that, by April 1940, British submarines were permitted to attack all German ships by day and ships of any kind without warning by night, even if sailing with full lights, in the ‘free for all’ areas in the Kattegat and Skaggerak. He also argued that Allied merchant ships making the signal ‘SSS’ together with their position on sighting a U-boat, could only have resulted from general instructions issued by the British Admiralty contrary to the provisions of the 1936 London Submarine Agreement. His suspicion was entirely confirmed by the ‘Defence of Merchant Shipping Handbook 1938’ which enjoined merchant vessels to send enemy reports and never ‘tamely surrender to a submarine’ but to ‘open fire if fitted with defensive armament.’ The claim by Doenitz that the German Naval High Command reacted only with extreme caution, and step by step, to British measures constituting a breach of Agreement was without foundation.

Operations around the United Kingdom and northwards into the Norwegian Sea were so scattered that no clear pattern emerged which could tidily be summarised. An international mixture of submarines were employed including French, Dutch, Polish and Norwegian boats as well as British. The French submarines were not up to Allied standards of mechanical efficiency and their crews were not contented, which was hardly surprising in view of the condition of France; most French boats returned to France at the end of May 1940 leaving, however, Rubis (CC Georges Cabanier and later CC Rousselot) who performed outstandingly as a minelayer throughout the war. Her early operations had clearly shown her usefulness and the British Admiralty were insistent that she remained behind to continue minelaying operations (minelayers being short in the Royal Navy) when the other French submarines were recalled.

When the Armistice talks between France and Germany began on 18 June, Rubis, at Dundee, had taken aboard a complete new outfit of mines and the British Admiralty urgently requested the French Vice Admiral Jean Odend’hal to allow the boat to sail for a last patrol on 21 June; a promise was made that when the Armistice went into effect Rubis would be recalled. The Armistice was signed on 25 June but Rubis continued in accordance with her orders, which were not revoked by the British, and laid mines in the approaches to Trondheim on 26 June. After returning to Dundee she was formally taken over (the French said ‘seized’) on 3 July. The appropriation went smoothly because most of the crew were on leave ashore but, in any case, Cabanier and his men decided, after a week’s deliberation, to continue the fight.
Above
The ill-starred giant French submarine Surcouf tragically sunk when rammed by the American merchant ship Thompson Lykes in the Caribbean on 19 February 1942.

Centre Left
Under the Lend-Lease scheme several submarines were loaned to Great Britain by the US but they proved too elderly and unfit for patrol work and were relegated to training duties. P412 (Ex-USN KI) seen here survived the war and was returned to the USA and scrapped in 1945.

Bottom Left
HMS Shark was forced to surface after being bombed whilst diving. So severe was the damage that Shark could not dive and fought it out on the surface. She was finally scuttled by her crew after shooting down one of the attacking aircraft.

Taking over the giant Surcouf at dawn on the same day at Portsmouth did not go so smoothly: some of the French crew fought back with revolvers and four men were killed, three of them British.

Vague accusations were subsequently to be made about Surcouf carrying out some kind of Fifth Column activity off Bermuda, but claims that she torpedoed Allied vessels were not upheld by the records. She was, however, politically unpopular and eyebrows were raised on all sides when she reinforced, with her 8-inch guns, Admiral Muselier's annexation of the Saint Pierre and Miquelon Islands on 24 December 1941, an event which stirred up considerable controversy in the American hemisphere and imperilled the US State Department's agreement with Vichy. Surcouf had the knack of being at the centre of political trouble. Her unhappy career was terminated when she was rammed on 19 February 1942 by the American merchant ship Thompson Lykes seven days
HMS Triumph in dock after her bow had been blown off by a mine off the Norwegian coast on 26 December 1939 — a very lucky escape indeed. Two (live!) torpedoes can just be seen. The shock inside the boat was amazingly light: half a dozen lights forward went out but no glass was broken anywhere and a rating in his hammock in the fore-end remained peacefully asleep.

Belozv
HMS Sceptre (Lt I S McIntosh) sinking the 3,594-ton German iron-ore carrier Baldur alongside a jetty at an embarrassingly neutral Spanish anchorage near Castro Urdiales at 1407 on 23 May 1944. By that stage of the war the Spanish government was able to ignore the incident without loss of face or cash to the German Government. It was not, anyway, without relevance that the Spaniards had earlier afforded, clandestinely, fuelling facilities to U-boats.

after leaving Bermuda for the Pacific where she was due to reinforce French forces after the declaration of war on Japan. Despite rumours to the contrary, there is no reason to believe that this ramming was anything but accidental; but 159 men went down in her, the greatest number ever to be lost in any one submarine until USS Thresher was accidentally lost 21 years later.

The total of 12 Dutch submarines (including three transferred from the Royal Navy) enjoyed exceptionally high morale but achieved no sinkings, in contrast to the marked success of Dutch boats operating in the Far East. The three Norwegian boats operating from the UK sank eight vessels between them including U-974; they benefitted from an intimate knowledge of Norwegian waters and, despite the small size of the Norwegian Navy and the comparatively limited training available, their crews were notably efficient.

In August 1942, the planners of Operation Torch, the Joint North African landings, wanted more submarines in the western Mediterranean. Six Gato-class boats were therefore sent with USS Beaver, an old depot ship, to form Subron 50 operating primarily from the Gareloch in Scotland;
these submarines would hopefully release some smaller British boats for use in the Mediterranean. They achieved no success during 27 patrols and none of their four claimed sinkings, which included a U-boat, was substantiated. Nonetheless, Anglo-American co-operation took a turn for the better and the Royal Navy grasped the opportunity of studying American men, methods and material at first hand. Furthermore, operations in European waters enabled the USN to overcome a number of teething troubles and useful experience was gained. Subron 50 remained on the eastern side of the Atlantic until in June 1943, Admiral H R Stark USN, commanding the American naval forces in Europe, stated that these boats were required in the Pacific. They left during June and July carrying out uneventful patrols in mid-Atlantic on the way back.

On their departure Flag Officer Submarines stated, with necessary politeness but evident sincerity, that Subron 50 had been invaluable to the submarine campaign during the winter and spring of 1942 to 1943: 'without them it would not have been possible to have staged operations on anything like the scale we have. It is pure bad luck that they have not achieved more successes, especially so in the case of USS Shad who carried out one of the most outstanding attacks that have ever come to my notice,' The latter remark was prompted by Shad (Lcdr MacGregor) detecting, by radar, an inward-bound blockade runner escorted by three destroyers off Bilbao on 1 April 1943 at a range of about six miles. MacGregor handled his submarine expertly and fired three torpedoes at 0342. When the torpedoes exploded everything on the radar screen was blotted out; it was conjectured that the

Top Left
HMS Sturgeon ('a virgin sturgeon needs no urging' according to the ribald ditty) at Blyth. Under three captains, Sturgeon certainly needed no urging to sink 24,000 tons of shipping, operating from the UK.

Centre Left
Lt. M R Wingfield at Sturgeon's periscope. The boat was evidently shallow, hence the crouch, but the picture may have been posed because the foreplanes should certainly have been to dive — which they are not!

Bottom Left
The Norwegian submarine Ula (ex-HMS Vane), seen post-war, which had a successful war and sank U-574 on 19 April 1944 off Stavanger. Like other Norwegian boats she gained much from an intimate knowledge of the difficult home waters.
blockade runner and at least two of the escorting destroyers had been sunk—hence Flag Officer Submarines' congratulations. But analysis showed that the target, *Pietro Orssole*, was only damaged by a torpedo in number one hold which threw most of her cargo of rubber into the sea (and may have caused radar blanketing) while one of the escorting, Z-23 was struck by a torpedo which failed to explode. It was, despite the relatively disappointing results, 'a masterly attack and deserved better success.'

Torpedo successes by submarines based on the United Kingdom amounted to 89 enemy ships destroyed, including the cruiser *Karlsruhe* and eight U-boats with a further 15 vessels damaged including the battle-cruiser *Gneisenau*, the pocket battleship *Lutzow*, which was put out of action for 12 months, and the cruisers *Leipzig, Nuremberg* and *Prince Eugen*. Magnetic torpedo exploders, detonating the warheads beneath the targets, would have achieved greater damage and more sinkings. These figures do not include the heavy damage done by X-craft whose charges detonated under the ships attacked (see Chapter 16).

Minelaying was an important function and the fighting French *Rubis* easily led the field with 683 mines laid in a record-breaking 28 patrols which resulted in the sinking of 14 supply ships (totalling 21,410 tons), seven A/S ships and minesweepers and damage to one supply ship and a U-boat.

The specialised British minelayers were also kept busy although they were not confined to minelaying operations. *National's* fields claimed 12 victims, *Rorqual's* one and *Seal's* four. After *Seal* (Lt Cdr R P Lonsdale) had completed a lay at 0945 on 4 May 1940 in a very dangerous position inside the Kattegat (which Max Horton had approved against the advice of his Staff, although this statement is based upon verbal evidence only) she started to retire westwards, with German E-boats threatening from the North East, between two unsuspected lines of German mines laid, respectively, at a depth of 15 and 30 metres. By 1600 the E-boats had not been shaken off so *Seal* went to 70 feet and stopped all auxiliary machinery. Half an hour later, nine miles east of Skagen lighthouse, there was a heavy explosion forcing *Seal* to bottom in 22 fathoms. The mining compartment, part of the crew space, the auxiliary machinery space and the motor room were flooded and the submarine lay on the bottom at an angle of 18 degrees bow up. *Seal* had picked up and towed one of the German mines earlier in the day and this had finally detonated. At 2300 Lonsdale endeavoured to pump the boat off the bottom to escape under cover of darkness; but it was not until 0100 on the next morning that she broke surface when she proved completely uncontrollable. It was decided to try to make for Swedish territorial waters, stern first if necessary, which was the only way in which the submarine appeared manageable. But daylight came early and at 0250 *Seal* was sighted by German aircraft and attacked. Fire was returned until the Lewis gun jammed and no further retaliation was possible. A German seaplane then landed near *Seal*, held up the crew with its guns and took the captain prisoner. The officers remaining on board were loath to sink the boat with the crew, including two badly wounded men, still on board and, anyway, by the time a German trawler *UJ-128* arrived *Seal* appeared to be sinking gradually by the stern of her own accord. She was towed to Friedrikshavn still sinking gradually—but not fast enough. Fortunately the damage caused by the mine and the destruction of secret apparatus by the crew prevented the German Navy from reconditioning the boat.

The *Seal* (*UB—not numbered for there was only one U-Boat, British*) was laid up in June 1941 but not before Doenitz had sarcastically asked the German Torpedo Department why they could not copy *Seal’s* British torpedoes which had *working* detonators.

When the crew were freed from their prisoner-of-war camp at the end of the war, Lonsdale was court-martialled but honourably acquitted, The Admiral (Submarines) of the time wrote to the Admiralty: '... it must be remembered that the officers and men must have been suffering from the mental after-effects of their prolonged dive without the modern assistance of oxygen and CO₂ absorbent which may well have clouded their judgement. In actual fact the task of sinking the submarine, with all pressure gone in the telemotor (hydraulic) system would have offered some difficulty to men in an exhausted condition.'

The least popular occupation for submariners in these waters, and one for which they had absolutely no training in peace or war, was escorting convoys. The reason for employing submarines in this role, mainly between Britain and Russia, was to provide protection against German surface raiders. The French had advocated submarines for escort duty from the beginning of the war and it may have been politically expedient, even if tactically imprudent, to use British submarines for the same purpose. Submariners heartily disliked the idea, although Lieut R P Raikes (HMS *Seawolf*) did his best to justify two periods of Russian convoy duty in May and June 1942. *Seawolf’s* presence, said Raikes, materially assisted the Merchant Navy’s morale, and that was borne out by the boat's enthusiastic reception at Murmansk when she passed along the line of merchant ships on her way up harbour to Polyarnoe. It cannot, however, have been much compensation for being so wastefully employed when submarines were in such short supply.
The U-boats which fought the Battle of the Atlantic have usually been regarded, outside Germany, as an anonymous menace reduced to cold statistics, an impersonal war-machine which, set into motion, advanced and then, finally, retired. It was not like that at all. U-boats were manned by individuals. Each boat had its own distinctive character and its own individual problems, often even harder to overcome than those faced by submariners in other navies.

A few figures set the scene in inescapable. During the 51 months of the 1914-1918 war Germany had built 365 U-boats, lost 178 and sank 4,837 Allied merchant vessels totalling over 11 million tons. In the second underwater war, covering 68 months, 2,775 Allied merchant ships, amounting to 14,573,000 tons, were sent to the bottom for the appallingly high number of 784 U-boats lost from all causes. The great majority of these losses, on both sides, were incurred in the Atlantic.

Doenitz held, quite contrary to American, British and Japanese thinking, that submarine operations against naval vessels promised little hope of success. Even on the surface, he said, a U-boat had no margin of speed to haul ahead for an attack and enemy aircraft were expected to forestall such action anyway. The low underwater speed of a U-boat would not permit it to attack fast warships except when it was directly in their path and 'that happens very seldom.' Nor did Doenitz believe that U-boat operations in support of German surface forces would be a profitable proposition. Hence, from the start, U-boat captains devoted almost their entire attention to the destruction of Allied merchant shipping and formulated their individual standing orders and domestic arrangements accordingly.

In September 1939, the first wave of U-boats was ordered to wage war against merchant shipping 'in accordance with the revised issue of the Prize Regulations until such time as danger areas are declared.' The regulations were those of the London Protocol (1936) whereby merchant ships (other than those on military service, resisting inspection or under escort) could be sunk only after being stopped and searched and after steps had been taken to ensure the safety of their crews. This would clearly be impossible in many cases, particularly near an enemy coast.

Nonetheless, Doenitz stuck to the rules although he pointed out that the British Admiralty were breaking them by instructions (issued in 1938) to Merchant Vessels to the effect that they were not to submit tamely and should signal reports of U-boats sighted.

Unfortunately, on 4 September, the day after war was declared, Oblt F J Lemp in U-36 torpedoed the liner Athena in the belief that she was an auxiliary cruiser. A thorough enquiry was held and Lemp was exonerated (and told to improve his ship recognition). The mistake was almost certainly genuine but it caused the Fuehrer—who was trying to avoid any extensions of the war—to order that no liners whatever were to be attacked, whether sailing independently or in convoy. The incident did not help Doenitz in his struggle with the politicians for more freedom of action; but he succeeded, step by step, in getting the U-boat restrictions lifted; and there was some justification in his claim, already noted in Chapter 11, that he only did so successively in response to breaches of the Agreement by the British Admiralty. However, from the outset tankers were considered separately. They were of such importance to Britain's war effort that U-boats were permitted to attack neutral tankers (other than American, Russian, Japanese, Spanish and Italian ships) but were to 'remain unobserved and use electric (trackless) torpedoes in order that the illusion of an internal explosion may be created.'

With certain restrictions, which were fairly easy to observe, U-boats in most vital areas were, by May 1940, no longer significantly hindered by the provisions of the London Protocol and were able to concentrate uninhibitedly on the destruction of Atlantic shipping. They flung themselves into the task with grim enthusiasm.

The German radio interception, code-breaking and intelligence services provided a great deal of information but there was still the problem of location. On the face of it, a large number of ships ploughing smokily along at eight or ten knots would seem easy to discover but that was not true in practise. Doenitz remarked in his War Diary for December 1940 that the first contact was a matter of chance. Unfortunately for the Allies chance chose to favour the U-boats.

Doenitz never succeeded in getting adequate air reconnaissance from Reichsmarschall Goering who disliked the Navy and was jealous of his own powers, but, amongst other measures, U-boat men devised a sort of do-it-yourself autogyro, a rotary winged kite which, in the South Atlantic outside Allied air cover, could be used for reconnaissance. It was primitive but more effective than the alternative of a collapsible mast. It consisted simply of a metal tube frame mounting a pilot's seat, a conventional autogyro head rotor and a foot-operated rudder. The whole kite could be dismantled and stowed very quickly in the Type IX boats which carried them. The machine was launched at the end of a cable with a slight backward tilt when an air speed of 25 kms per hour had been attained: the minimum airspeed to maintain it in flight was about 17 kms per hour. Up to 165 metres of cable could be veered to give the autogyro a height of about 100 metres above sea level and enabling the pilot to search over a distance of 60 to 70 miles. Reports were made down a telephone to the submarine bridge. It was found that ordinary German seamen could easily learn to handle these kites, which could be recovered safely: one U-boat launched its machine no less than 80 times without mishap. However, the pilot was in danger if he reported an enemy warship necessitating a rapid dive by his parent submarine: he was then supposed to jettison the rotor and descend by parachute into the sea where, according to a laconic report circulated in the Royal Navy, 'he drowned in the normal way'.

Autogyros apart, initial detection usually depended on binoculars or a periscope sighting. Even with advanced underwater sonic equipment such as Balkon and Nibelung the human eye was always the most reliable sensor by day or night. An unlit ship was no more than the faintest shadow against a dark horizon; the trick was not to look directly at it...
but a little above. Not everybody had good night vision, the few that did were prized members of the crew and were apt to be hauled up to the bridge as lookouts whatever their proper jobs were.

Although the principle of concentration was all important, U-boats making up a wolf-pack did not act as a team, as commonly supposed, and they were never intended to. Boats were drawn, usually, from a patrol line strung across likely convoy routes through the Atlantic and directed onto a convoy by signals from U-boat Headquarters (BdU) situated for most of the battle near Lorient. They did not communicate between themselves (other than, exceptionally, by signal lamp) and only signalled their intentions and convoy positions by short two or four-letter HF radio signals to shore to minimise the chances of being pinpointed by Allied DF stations. Co-ordinated attacks were launched in 1940. The first spectacular success came when, over a two day period, 20 out of 34 ships in Convoy SC 7 were sunk, most of them during the dark and rainy 'Night of the Long Knives' off the Rockall Bank, on the night of 18-19 October.

Kptlt Otto Kretschmer's War Diary for U-99 told of his part in the action:

18 October

0200 On receipt of urgent radio message "To U-100, U-28, U-123, U-101, U-99 and U-46. Be in position in patrol line from naval grid square 2745 to naval grid square 0125 AM by 0800," I proceed to my position at maximum speed, although I cannot arrive until 1100. I therefore report by short signal to FO U-boats: "Owing to position, cannot comply with dispositional order. My position is naval grid square 41 AM." [Some 100 miles southwest of the new patrol line position.]

0903 Sight a U-boat conning-tower, bearing 060. Shortly afterwards a medium boat appears on the horizon, proceeding in a north westerly direction. It must be U-46, the boat on the left flank of the patrol line.

1128 In position. Proceed up and down across the patrol line. Medium U-boat in sight, bearing north. It must be U-101, which is proceeding up and down along the patrol line.

Radio message received at 1208: "... To FO U-boats from U-38: Convoy in 1539 AM at 0200 [some 100 miles northwest of the patrol line] course 110, no contact..." That means that the convoy will pass the patrol line to the north. At 1530 the patrol line is cancelled by radio from FO U-boats: "... U-100, U-123, U-101, U-46: Operate on U-38's report. Convoy probably in 2580 at 1400." [Some 30 miles north of the north end of the patrol line.] Flag Officer U-boats cannot suppose U-99 to be in the patrol line. I proceed in an east-north-easterly direction.

1745 Wind south-east, force 3; sea 3; moderate cloud. U-101, which is two or three miles north, signals by light: "Enemy sighted to port."

1749 A warship is sighted, bearing 030, steering east. Soon afterwards, smoke to left of her. Finally the convoy. While hauling ahead to attack, we sight a steamship to the southeast, apparently on a westerly course.

1928 Submerge for attack. [These were early days. It was much more usual to remain on the surface.]

1950 Surface, as the ship is making off slowly to the east. Haul further ahead: at 2000 pass within a few hundred metres of a U-boat on the surface, apparently U-101 again.
German Type VIID

German Type XB
Assembling and launching a Focke-Achgelis Fa 330 rotary-winged kite—the "U-Bootsauge" (U-boat's eye)—in the South Atlantic. Assembly from the pressure-tight storage tubes could take four men as little as three minutes. The 180 lb kite was placed on a platform abaft the conning tower and the 12 ft blades were spun by hand until the U-boat's own speed ahead kept them rotating. The field of vision was, of course, greatly extended by this device but there is no firm evidence of it contributing greatly to sinkings.
Another U-boat has torpedoed the ship. Shortly afterwards exchange recognition signals with U-123. Convoy again in sight. I am ahead of it, so allow my boat to drop back, avoiding the leading destroyer. The destroyers are constantly firing star-shells. From outside, I attack the right flank of the first formation.


Fire stern torpedo by director. At 700 metres, hit forward of amidships. Vessel of some 6,500 tons sinks within 20 seconds. I now proceed head on into the convoy. All ships are zig-zagging independently.

Fire bow torpedo by director. Miss because of error in calculation of gyro-angle. I therefore decide to fire the rest of the torpedoes without the director, especially as the installation has still not been accepted and adjusted by the Torpedo Testing Department. Boat is soon sighted by a ship which fires a white star and turns towards us at full speed, continuing even after we alter course. I have to make off with engines all out. Eventually the ship turns off, fires one of her guns and again takes her place in the convoy. I now attack the right flank of the last formation but one.

Fire bow torpedo at a large freighter. As the ship turns towards us, the torpedo passes ahead of her and hits an even larger ship after a run of 1,740 metres. This ship of some 7,000 tons is hit abreast the foremost, and the bow quickly sinks below the surface, and two holds are apparently flooded.

Fire a bow torpedo at a large freighter of some 6,000 tons, at a range of 750 metres. Hit abreast foremost. Immediately after the torpedo explosion, there is another explosion with a high column of flame from the bow to the bridge. The smoke rises some 200 metres. Bow apparently shattered. Ship continues to burn with a green flame.

Further devastating wolf-pack attacks quickly followed. The extraordinarily efficient organisation at BdU, run by only a handful of watchkeepers, enabled Dönitz and his brilliant Staff to wield units at sea almost as though they themselves were sharing the crowded, sea-swept bridges of the boats as they raced through the Atlantic gales ahead of the convoys to be in position for attack when darkness fell. U-boat captains knew that their signals back to Dönitz—essential for a pack to gather—forewarned the enemy of his fate; but they also knew that there was very little a lumbering convoy could do except make drastic alterations of course which seldom took it wholly out of reach. It was more important to achieve concentration than surprise. Each captain aimed, quite independently, to penetrate the protective screen, diving only if immediately threatened and then only for 20 minutes or so, and make for the heart of the convoy. Once inside, between the convoy lines, a boat was fairly secure because, as ObLt Otto Westfalen (U-968) explained, even if the boat was glimpsed and the escorts were alerted, the convoy had to stay together and were too close to make independent course alterations without risk of collision. Nor was it then possible for escort or merchant ships to use guns with safety. A U-boat captain was therefore able to select one target after another and fire deliberate salvos of one, two or (rarely) three torpedoes at each. If convoy ships were at their usual spacing, one thousand yards in line abreast and five hundred yards in line astern, it was usually best to maintain the same course as the convoy and angle torpedoes right or left when the bridge-director sights came on. In these conditions the First Lieutenant looked through the sights and directed fire-control while the Captain acted as General Manager and took his boat into the right positions for successive attacks. It was almost impossible to miss such large, steady targets at a few hundred metres. Allied submariners, on the relatively few occasions when they acted in groups, invariably sought to establish each other's positions by radio or underwater signalling for safety but Dönitz considered this unnecessary. In fact (probably unknown to BdU) two out of 17 U-boat collisions were directly due to pack tactics. The worst, which sank two boats, occurred in pitch darkness during the early morning of 4 May 1943 off Cape Ortegal. May was, anyway, a disastrous month with 41 U-boats lost; but there was a certain uniquely hideous nightmare quality about the disaster which overtook U-459 (Oblt H von Tippelskirch) and U-659 (Kptlt W Sporn).

The two boats were hotly pursuing a pair of adjacent south-bound convoys. By about 0130 they had unknowingly come very close to another while steering to head off their targets. Meanwhile, another U-boat had
Atlantic convoy seen from HMS Thunderbolt in the Atlantic acting as an escort in early 1941. A recognition grenade is prudently loaded and ready to fire. Convoy duties were understandably unpopular: a submarine was not suited for the task, could achieve little in the event of attack by German surface units (which they were supposed to guard against) and was itself in danger of being rammed or mistaken by Allied units for a U-boat.

Obit V Varendorf, who had been Gunther Prien’s Second Watch Officer in U-47 during the spectacular Scapa Flow attack, thanking the Bandmaster who provided the customary martial music for a send-off in July 1942. It was to be the last patrol for Varendorf, now commanding U-213 which was lost with all hands after depth-charging off the Azores a few days later on 3 July.
launched its attack. The First Lieutenant of U-439, reported to be by nature lazy and easy-going, became so interested in the resulting display of starshell that he neglected to look out on the port bow (which was his sector). Then, not knowing it was exactly the wrong moment, the captain ordered a slight alteration of course to port. There was not merely a glancing collision: U-439, making 7 knots, squarely struck U-659, travelling at full speed, in the control room. Water poured in. A few minutes later a huge wave swept over U-659 and sent her to the bottom.

U-439 went full astern after the impact but her torpedo space was flooded and an attempt to compensate the bow-down angle by flooding the after tanks only settled the boat deeper in the water. In the end, a wave down her conning tower sent her down in the same way as her sister. She may have drifted helplessly just below the surface because, two hours later, HMS Coverley struck a submerged object, probably the doomed U-boat. If so, she put out of their misery any men who may still have been alive.

Even if the incident had happened three years earlier and been reported to Doenitz, it is most unlikely that he would have imposed safety restrictions on the pack tactics which he so rightly believed were essential to success. Certain risks had to be accepted.

U-boats did, of course, take any opportunity of torpedoing capital ships that offered themselves as targets and, occasionally, deliberate operations were mounted against them; but Doenitz refused to be deflected from his main aim. He also strenuously resisted untrue propaganda put out by Goebbels whose purpose was better suited by
capital ship sinkings, even if only imagined, than by merchant tonnage on the bottom. 'We are', said Doenitz 'a reputable firm.' He was right, whatever the propaganda machines on both sides had to say; and his U-boat men were proud to be employees of the company. Their orders were clear and unambiguous (except when the politicians interfered); their direction from shore was skilled and purposeful; and yet their captains retained freedom of action.

The loyalty of U-boat captains to Doenitz was understandably absolute. It became strikingly obvious in early 1940 when torpedo failures were nullifying hazardous attacks. He interviewed all crews after unsuccessful operations and fully restored confidence when morale might, without his personality, have reached a dangerously low level. The remarkable bond between the Admiral and his captains was unique; it explained the exceptional determination and confidence displayed in U-boats throughout a long and gruelling war right up to the moment of final defeat.

Pearl Harbor took Germany completely by surprise. Operation Paukenschlag, the first sortie by a group of five U-boats against American shipping between the Saint Lawrence and Cape Hatteras, was not launched until five weeks after Germany and America were at war. The object was to sink vessels over 10,000 tons. Despite the delayed start and the small number of attackers, the 'Roll on the Kettledrums' was highly profitable. The traffic was so dense that it was impossible to seize all opportunities. Targets were often
The Battle of the Atlantic is being lost!

The reasons why:

1. German U-boats, German bombers and the German fleet sink and seriously damage between them every month a total of 700,000 to 1 million tons of British and allied shipping.
2. All attempts at finding a satisfactory means of defence against the German U-boats or the German bombers have failed disastrously.
3. Even President Roosevelt has openly stated that for every five ships sunk by Germany, Britain and America between them can only build two new ones. All attempts to launch a larger shipbuilding programme in America have failed.
4. Britain is no longer in a position to secure her avenues of supplies. The population of Britain has to do with about half the ration that the population of Germany gets. Britain, herself, can only support 40% of her population from her own resources in spite of the attempts made to increase the amount of land under cultivation. If the war is continued until 1942, 60% of the population of Britain will starve!

All this means that starvation in Britain is not to be staved off. At the most it can be postponed, but whether starvation comes this year or at the beginning of next doesn't make a h'porth of difference. Britain must starve because she is being cut off from her supplies.

Britain's losing the Battle of the Atlantic means Britain's losing the war!

Propaganda leaflet dropped by German aircraft over Britain in 1941. Its predictions came perilously close to the truth.

Bottom Left
Kptlt Topp drafting a sinking signal to BdU in his cabin in U-552 with the Fuehrer's portrait in the background.

Bottom Right
SS Beacon Grange (10,160 tons) hit by three torpedoes abreast No 2 hatch, the engine-room, and No 4 hatch at about 1430 on 27 April 1941. When a U-boat broke surface, moments later, 500 yards on the starboard beam, the Master was able to see a red devil painted on the conning tower - Kpt Erich Topp's U-552. When the stricken ship's crew had pulled clear in lifeboats (Beacon Grange had been proceeding independently) Topp fired a fourth fish but still, apparently, had to finish off his victim with gunfire that evening.
lit and held straight courses against the brightly illuminated background of the shore where there was no blackout. The only problem for the U-boats was an insufficiency of fuel and torpedoes. Trimming tanks, washing-water tanks and even drinking-water tanks were used for extra fuel and every compartment was filled with spares, stores and provisions. In the early weeks of these long-ranging patrols there was no seating accommodation for the crew in the bow or stern compartments and there was no room anywhere to stand upright. Messes and bunks were stacked with cases, leaving only a narrow gangway between them. But the crews made no complaint. The enormous successes achieved off the eastern American coastline and, later, in other distant areas off South America, the West Indies, West Africa and in the Indian Ocean were adequate compensation for discomfort.

Allied submariners could look forward to a triumphal return to base when the fuel or torpedoes were expended. The U-boat men were not always so lucky. Kk Eitel-Friedrich Kenet, for example, commanding U-196, was at sea continuously for seven months from 13 March to 28 October 1943, taking in fresh supplies and torpedoes at sea. Even if torpedoes were expended and could not be replenished a boat was liable to be kept out to act as a weather station; and as for fuel running out, one captain who reported that he had not many litres left was told by Doenitz to carry on regardless: 'Attack and sink. I never abandon a U-boat.'

Long patrols were made possible by a number of supply ships which waited at secret rendezvous (several were sunk when their rendezvous was compromised) and by 'Milch-Cows'—specially adapted Type IX and Type X U-boats. These replenishment boats could resupply up to a dozen U-boats with spare fuel and torpedoes. Transfers on the surface, in anything other than flat calm, demanded good seamanship and when there was a possibility of attack from the air they were hazardous. The first refuelling operations were started on 22 April 1942 by U-459 about 500 miles off Bermuda but it was not until 12 June 1943 that the first Milch-Cow fell victim to aircraft (from USS Bogue). From this time, greatly assisted by code-breaking, Allied air attacks on Milch-Cows became very damaging to the U-boat campaign. The cumbersome grocers suffered heavily and so did a number of shoppers making for the market place. The concentration of U-boats around a replenishment submarine would, of course, have been a rich target for A/S units; but it was important not to indicate that the position of a Milch-Cow was known until the time was ripe to strike. The Allies grew cunning and feints were made by American forces in the hope that a Milch-Cow would think itself safe and gather a valuable herd around it; but a herd was never actually discovered when A/S forces came to attack.

U-boat losses had amounted to 152 in all areas from September 1939 to the end of 1942 and, during the same period, 3,862 merchant vessels had been sunk—a profitable exchange rate. But in the following year the tide turned. Long-range maritime-patrol aircraft with centimetric radar, carrier-based aircraft, overwhelmingly powerful A/S escorts fitted with HF/DF, improved A/S tactics and weapons forced U-boats to patrol and attack, for the most part, submerged: from that time the Battle of the Atlantic was lost. The month of May 1943 saw the beginning of the end of the U-boat arm. The fatal date could, however, have been advanced considerably if Fleet Admiral Ernest J King USN (C-in-C Atlantic) had agreed to an earlier proposal for basing a couple of US Navy Consolidated Liberator squadrons on Newfoundland to close the mid-Atlantic gap and, equally, if more British air effort had been directed towards maritime operations instead of being concentrated on bombing Germany and German-Occupied territories which, in the long term, was a much less effective occupation.

The U-boats struggled on with successive improvements to radar-warning devices, AA armament and schnorchels but they never succeeded in regaining the initiative. During the full year of 1943, 237 U-boats went to the bottom in exchange for only 597 merchant ships. They continued thereafter to achieve isolated sinkings in all areas but there was no longer any hope of bringing the British war effort to a halt by breaking the supply chain from America. Towards the end, in 1944, Kptlt Siegfried Koitschka, a most experienced commanding officer, reluctantly arrived at the conclusion, shared by others, that none of the standard wartime U-boats had any chance of success in action and little chance of survival. None of the planned new generation of Type XXI U-boats was ready in time to affect events.

As it was, the U-boat arm was fighting a continually losing battle during the last two years of the war. A final, desperate effort was made to stem the flood of invasion forces between 6 June and the end of August 1944; but, of the schnorchel boats taking part in 45 sorties, 36 were destroyed. However, against these heavy losses, a number of escorts and landing craft as well as 12 very valuable supply ships were sunk. The latter totalled 56,845 tons—a paltry amount, it seemed, to what had gone before. But a close look at what a dozen supply vessels could carry (assuming they were all loaded with military cargoes) shows the sort of Allied losses entailed (their actual cargoes are not known; the figures given have been extrapolated from a US Army Air Force manual of the time):

- 105 tanks
- 36 6-inch howitzers
- 400 25-pounder guns
- 180 40 mm guns
- 110 armoured patrol vehicles
- 225 Bren guns
- 25,000 tons of munitions
- 2,700 rifles
- 1,1750 tons of tank spare-parts
- 4,500 drums of petrol
- 10,000 tons of rations

About 9,000 aircraft sorties would have been needed to destroy that quantity of stores on land: the comparative economy of submarine warfare is clear. Although Allied merchant ships in the Atlantic were certainly not all loaded with munitions, the figures, in relation to the Atlantic losses, indicate how close the U-boat campaign came to winning the war for Germany. No wonder that Churchill said it was the only thing that really frightened him.

On 4 May 1945, Grand Admiral Doenitz, signalling his boats to cease hostilities, issued the following Order of the Day:

'My U-boat men, six years of U-boat warfare lies behind us. You have fought like lions. A crushing superiority has compressed us into a very narrow area. The continuation of the struggle is impossible from the bases which remain. Unbroken in your warlike courage, you are laying down your arms after a heroic fight which knows no equal. In reverent memory we think of our comrades who have died. Comrades, maintain in the future your U-boat spirit with which you have fought most bravely and unflinchingly during the long years . . .'

Nearly 30,000 U-boat men went down with their boats, ten times the number of submariners lost both in the Royal Navy, and in the United States Navy. Whatever prejudices and memories remain, it would surely be difficult for submariners on any side to refute the spirit of that final message.
German underwater operations in the Indian Ocean arose from an exceptionally high number of 30 new U-boats being made ready for operational duties in each successive month of July, August and September 1942. Doenitz was always reluctant to undertake any operations which detracted from his main objective in the Atlantic but he was ready to make thrusts further afield if these would contribute significantly to the tonnage war on merchant shipping bound for British ports. Hence, when an accumulation of Allied shipping was reported in the Cape Town area and when Type IXC boats and replenishment facilities by submarine tankers became available to make possible the 6,000-mile transit, he despatched the Polar Bear Group (Type IXCs) followed by three long-range Type IXD2 boats. Between them, in October alone, they sank three large and irreplaceable British troopships and 27 cargo vessels, many of which were loaded with important military stores.

Doenitz was well pleased. His boats had done more damage than the disguised German surface raiders, their predecessors in piracy in these waters, at far less cost to the Navy's resources. The three Type IXD2 boats further extended their operations into the Indian Ocean itself and sank a further 20 ships off Lourenço Marques before the year was out. Besides their immediate consequences, widely separated lunge of this sort had the far reaching effect of forcing the Allies to disperse their already inadequate anti-submarine resources as the British Admiralty ruefully recognised.  

When the Battle of the Atlantic started to go against Germany in the spring of 1943, Doenitz agreed to send more Type IXC and IXD2 boats to the Indian Ocean where the German Naval Attache in Tokyo, Admiral Wenneker, had been trying to organise co-ordination between the German and Japanese war efforts. When Doenitz was satisfied that the new Japanese base at Penang could provide suitable fuel and lubricants as well as European food (something he insisted upon) he guardedly accepted the Japanese plans for co-operation and at the end of June 1943 started to sail long-range U-boats to Penang, intercepting targets of opportunity en route.

Submarine tankers were essential for the long transit but by now, their security having been breached by code-breaking, they had become vulnerable priority targets. The tanker U-462, which was to have proceeded in company to refuel Group Monsun comprising nine Type IXC and two Type IXD boats, failed in two attempts to break through the Biscay Blockade; U-487 was ordered to take her place and be ready to refuel the Group by 14 July in a position 700 miles south of the Azores. But U-487 had replenished eight Type VII C U-boats since 6 July and was 120 tons of fuel short of the requirement to provide each boat in Group Monsun with 40 tons. U-160, an outward bound Type IXC, was therefore directed to transfer the bulk of her fuel to the tanker leaving only enough to return to base. However, U-487 succumbed to attacks by aircraft from USS Core on 13 July and U-160 was sunk by aircraft from USS Santee the next day. Meanwhile, two of the transiting U-boats had also been sunk by aircraft while proceeding independently through the Bay of Biscay. The replenishment was eventually carried out by U-155 and U-516 600 miles west of the Cape Verde Islands; but of the 11 boats of Group Monsun only five remained to continue their passage through the South Atlantic to the Indian Ocean. In June and July 1943 Allied carrierborne aircraft accounted for two more U-tankers and six operational boats in the Azores area while seven operational boats, who in consequence had to be used as tankers, could no longer be employed in the distant areas for which they were destined. Furthermore, six Type VII boats destined for the Atlantic areas were unable to refuel and had to be diverted to the vicinity of Freetown contrary to the original intention. One way and another, Group Monsun's passage to Penang proved expensive.

The remnants of Group Monsun refuelled from the surface tanker Brake on 11 September and commenced operations in the northern part of the Indian Ocean; but the strain of the long voyage had evidently taken its toll and opportunities of attack were not seized with great vigour. Moreover, although it was not realised at the time, the hot climate caused the batteries of electric torpedoes to deteriorate with the result that the torpedoes ran slow. Reinforcements for Group Monsun, all Type IXD boats commanded by highly decorated and experienced officers who had distinguished themselves in the North Atlantic or the Mediterranean, also suffered severely on passage. By the end of the war no less than 22 of these boats sent to the Indian Ocean had been lost, 16 being sunk by aircraft. The majority were sunk long before rounding the Cape of Good Hope. The Indian Ocean offered splendid opportunities for independent U-cruiser interceptions but the comparatively clumsy Type IX boats were obliged to traverse the same exceedingly dangerous seas of the Bay of Biscay and Eastern Atlantic as the much handier Type VII's; the fact, therefore, that the big boats were quite well suited to long-range and tropical operations was not (apart from their torpedoes) very relevant.

U-177 (Kk R Gysae) made two particularly noteworthy patrols in the South Atlantic and Indian Ocean between November 1942 and October 1943. U-177 was a happy boat and Gysae was an outstanding captain and sank over 88,000 tons of shipping during two cruises. These lasted four-and-a-half months and six months respectively under very trying conditions, but morale stayed high and Gysae never resorted to punishment. Temperatures inside the boat were commonly 35 to 45 degrees Centigrade rising to 80 degrees in the engine room. Gysae was not only a skilful tactician; he was an excellent psychologist. With very limited facilities, he took care to provide plenty of entertainment: when no targets were in sight, competitions of every kind were held. There were painting, chess and card competitions and a singing contest was held over the loudspeaker system. Appropriate privileges were awarded as prizes; for example, the captain might keep a winner's watch. Gysae's personality, as much as his submarine expertise, kept the boat safe on passage and successful on patrol. But he did make one mistake. On 28 November 1942 he sighted a steamship and, through the periscope, took her for an Armed Merchant Cruiser. She went down to three torpedoes fired from dived. When he surfaced and closed the few lifeboats and rafts
found floating, he found to his horror that his victim had been the Nova Scotia carrying some 500 Italian prisoners-of-war and internees from Abyssinia to South Africa. Gysae did what he could to redeem the error, signalling for the Portuguese authorities to send assistance; but he felt so ashamed, although he really had no need to be so, that before returning to Bordeaux he made every member of the crew give a written promise never to mention the incident. When he closed the survivors of his next victim, the Greek Saroukos, he did his utmost to make sure of their safety and gave them bandages and other medical supplies.

When Gysae left U-177 he was relieved by a man with a totally different idea of discipline who handed out frequent punishments. U-177's third cruise would probably, according to survivors from the crew, have ended in mutiny had not the U-boat been destroyed after she had been at sea for five weeks. The new captain's disciplinary measures included daily emergency gun-drills and these were so frequent that they eventually dulled the alertness of the crew. On 6 February 1944 a US aircraft from Ascension was allowed, in good visibility, to get within a mile of the U-boat before being spotted. It was too late. Accurately bombed, U-177 sank in a few moments, taking with her two thirds of the crew.

Top Right
HNMS K.XVIII at Soerabaja before the war (1934). Submarines contributed significantly to the defence of the Dutch East Indies.

Centre Right
HNMS O-26, one of two submarines based on the design for two minelayers built for Poland. The mines were stored in vertical shafts amidships in the saddle tanks with two mines in each shaft. The experimental schnorchel mast can be seen in the retracted position at the after end of the bridge superstructure. O-26 was sunk by Japanese destroyers in the Gulf of Siam on 19 December 1941. By Christmas, little more than two weeks after commencing hostilities with Japan, only three out of seven Dutch boats under British Control in the Far East remained in service. Their determination in the face of impossible odds resulted in two being lost in minefields, and one (O-26) being sunk by A/S vessels; K-XIII was at the same time put out of action by a battery explosion.

Bottom Right
HNMS O-23. This Netherlands submarine made seven patrols off Penang, Sabang and in the Andamans area between July 1942 and August 1943 before returning to the UK for refit. She sank two large Japanese passenger-cargo ships on her first patrol. The large hatch abaft the bridge covers a hydraulically raised 20 mm AA gun.
Kpth Eck commanding U-852 did not have the same attitude towards survivors as Gysae. On 13 March 1944 en route to the Indian Ocean he sank the Greek ship Peleus (4,695 tons) off the west coast of Africa. Fearful that the presence of wreckage and survivors would betray his position to Allied air patrols, he opened fire on the floating remains but in fact failed to kill all the crew, three of whom were rescued. They reported what he had done. It was the only known case in World War II of a U-boat captain deliberately setting out to kill survivors. Other U-boats had endeavoured to complete a sinking by opening fire on ships that refused to go down after being hit by torpedoes; but Eck went an important step further than that. He and those of his officers who shared the responsibility were condemned to death by a British court-martial and shot on 30 November 1945. Doenitz himself by no means approved Eck’s action but remarked that ‘a U-boat captain was responsible for the safety of his boat . . . in an area where at least four boats had recently been bombed.’ Submariners may have felt bound to compare Eck’s fate with undeniable, unpunished, Japanese submarine atrocities and the blandly ignored shooting of Japanese survivors in the water by Lcdr ‘Much’ Morton in USS Wahoo (see Chapter 14).

The Japanese attached great importance to their strategic underwater offensive against Allied sea communications in the Indian Ocean and, hence, to the establishment of Penang as a base for the Eleventh Submarine Flotilla in February 1942 and as a Headquarters for the Eighth Submarine Squadron from April 1943. At the end of that month, I-10, I-16, I-18, I-20 and I-30 sailed to carry out a reconnaissance of important points on the African coast. Rear Admiral Ishizaki controlled the operation from I-10 following the Japanese decision to use command submarines for the direction of certain operations, a concept which had been rejected by Doenitz before the war. I-10’s aircraft reported a Queen Elizabeth class battleship, one cruiser and other ships at anchor in Diego Suarez on 30 May and at midnight I-16 and I-20 launched midget submarines ten miles from the harbour entrance. The midgets failed to return but one large tanker, the
HMS Shakespeare (Lt D Swanston) was hit by gunfire from a merchant ship which was being attacked in the Andaman area on 3 January 1945. The Engine Room and Control Room were partially flooded, making diving impossible, and the steering was damaged. One main engine and both motors were put out of action. Throughout the day, Shakespeare fought off 25 air attacks, shooting down one aircraft but suffering fifteen casualties (two killed). The 3-inch gun’s crew are here enjoying a well-deserved smoke between attacks. Shakespeare eventually reached Trincomalee under tow assisted by two destroyers sent out to meet her.

Top Right
Medical supplies from HMS Styxian being ferried by canoe to the crippled Shakespeare.

Centre Left
Lt Cdr E P Young, the outstandingly successful RNVR captain of HMS Storm whose story is told in what is probably the best personal account of a submarine’s exploits ever written in his book One of Our Submarines.

Bottom Left
Torpedo tracks viewed through the periscope. It can be seen that HMS Trenchant’s full salvo fired at the Japanese cruiser Akigare would indeed have looked like ‘an arterial road’.
British Loyalty, was sunk and the battleship Ramillies was hit by one torpedo which made it necessary for her to disembark oil and ammunition and go to Durban for extensive repairs. These First Division submarines enjoyed considerable success and sank some 20 merchant vessels totalling 120,000 tons during a month of operating unescorted by anti-submarine vessels or aircraft.

Japanese boats, mainly those from Penang, continued to amass impressive totals of tonnage sunk during the remainder of 1942; and they planned heavier attacks for 1943. The latter, however, did not materialise in full because Pacific victories by the US Navy drew Japanese submarines out of the Indian Ocean to Pacific waters where they proved no match for the rapidly increasing skill of American A/S forces. The boats left in the Indian Ocean also felt the weight of improved Allied defences and started to suffer heavily. Penang-based Japanese submarines lost 19 of their number between February 1943 and June 1945.

British submarines operated from Depot Ships lying at Trincomalee. At one time or another there were eight T-boats, eight S-boats, Porpoise and Severn patrolling from this base. The operating areas were mainly in the Malacca Straits, off Java and the South China Sea. Worthwhile targets were not plentiful; the deployment of such a substantial submarine force in south-east Asia resulted from a political desire to show, quite late in the war, that the Royal Navy was undertaking its fair share of work in the Far East while the United States Navy was so clearly dominating the Pacific. By 1944 there were not, anyway, many other areas where British boats could usefully be employed and they did not have the range to operate further afield in the Pacific.

*Top Right*
HMS Tally Ho returning to Trincomalee after sinking the Japanese cruiser Kuma on 11 January 1944 with two hits from a seven-torpedo salvo at 9000 yards on a 95 degree track angle on 11 January 1944.

*Bottom Right*
HMS Tally Ho (Lt Cdr J W A Bennington) sank U 18-23 (ex-Giulian) with a three-torpedo salvo on a 120 degree track angle at 3500 yards in a brilliant snap attack in the Malacca Straits at 0525 on 15 February 1944. Going on to pick up secret agents on 17-19 February she was unsuccessful in doing so because no contact could be made with them; and Bennington, in a mood of frustration which was scarcely justified (he had sunk the cruiser Kuma only a month before) fired five torpedoes at the unescorted 510-ton Dangen Maru and hit with one. On 24 February he encountered a Japanese torpedo boat at night, too close to take avoiding action by diving. The enemy’s attempt at ramming ripped open the port main ballast tanks as shown here; but Tally Ho made it safely back to base with a heavy list.
Patrols in these inshore and often very shallow waters were testing and frequently fraught with undue interest. But, surprisingly, the lack of air-conditioning in the relatively small submarines, which were grossly overcrowded when carrying landing parties, did not detract from efficiency although prickly heat and heat-exhaustion were a continual problem.

Japanese A/S activity was sparse, sporadic and inefficient. Submarine chasers were apt to work singly and submarine commanding officers quickly realised that the poorly protected little vessels were vulnerable to gunfire. HMS Tally Ho (Cdr L W A Bennington), rather than submit to a hammering in shallow water where she could not even go below periscope depth, surfaced and demolished Chaser No 2 with five four-inch rounds out of 19 fired on 6 October 1944 in the southern part of the Malacca Strait. The geographical restrictions under which boats operated in these waters were well illustrated by an earlier torpedo attack by Tally Ho against a coaster which failed due to the torpedo hitting native fishing stakes set up parallel with the beach. Tally Ho had a particularly successful war in the area and her victims included the ex-Italian UIT 23 and the Japanese cruiser Kuma. All of Bennington’s six torpedo salvos sank their targets and nine hits were registered for 33 torpedoes fired. Nor did any of his 14 gunnery targets escape entirely although one merchant ship made off damaged and another ran aground: a total of only 204 four-inch shells were expended on these targets. Tally Ho had one narrow escape, however, when an enemy torpedo boat was encountered at night too close to avoid by diving. Drastic avoiding action on the surface prevented direct ramming but a glancing collision ripped open the port main ballast tanks. This did not prevent the submarine from diving to shake off her pursuer but the return passage was made on the surface, in bad weather, with a heavy list to port.

Cdr A R Hezlet in Trenchant made what may rank, for a submarine tactical purist, as the most brilliant attack of the war on 8 June 1945 when, off the Sumatran coast, he sank the heavy cruiser Ashigara bound for Singapore and carrying a large number of Japanese troops from Batavia. The target’s masts were sighted through the periscope at 1148 at a range of about six miles and it was soon clear that Hezlet could not improve his firing position to better than 4,000 yards off track. At this long range it was essential to optimise target estimations and Hezlet made his calculations with cold precision during the 21 minutes which elapsed before the DA came on. He fired a full bow salvo of eight torpedoes aimed individually from a quarter of a length ahead to a quarter of a length astern. To avoid breaking surface in the flat calm sea on firing, speed was increased to five knots and the foremost trim tank and Q tank were temporarily flooded at the critical moment. The correct depth was thereby held within four feet. Complete control was regained within three minutes when a quick look through the periscope revealed the torpedo tracks stretching towards the target ‘like an arterial road’.

Because of the shoreline to port the target could only alter to starboard, towards Trenchant, which was the worst possible avoiding action with torpedoes approaching from just abaft her starboard beam. At 1212 five torpedoes hit, over a period of seconds, along the length of the ship while Hezlet’s ship’s company queued up to watch through the search periscope, a luxury which attracted retaliatory fire from the cruiser’s AA battery. Meanwhile Hezlet was turning fast to bring the stern tubes to bear. He fired two more torpedoes at 1244 using the DA for a reduced speed of five knots. While these last two torpedoes were running Ashigara altered further round to starboard, probably in an attempt to beach on a nearby shoal, and the torpedoes missed astern. They were not, in any case, necessary: the cruiser capsized under the effect of the initial salvo while a destroyer patrolling in the vicinity dropped three ‘face-saving’ patterns of depth charges at least three miles from Trenchant. Hezlet remarked modestly in his patrol report on ‘the ease with which the cruiser was sunk’ but it was an exceptionally expert piece of work.

Dutch submarines also achieved notable successes running from Ceylon in, for them, familiar waters. They included the sinking of U-168 which went down to Zwaardvisch (ex-HMS Talent) commanded by Lt Cdr Hans Goossens. There were not enough opportunities for the Dutch to show their paces properly with such a paucity of targets; but it was very clear that their submariners were very professional and proficient.

Three British and four Dutch submarines were lost on operations in the Far East for two cruisers, two destroyers, five U-boats, 13 minor naval vessels, 47 sizeable merchant ships and numerous junks and other small vessels. These figures include seven ships known to have been sunk as a result of 30 mine-laying operations (640 mines) and the cargo vessel Sumatra Maru (4,859 tons), which was sunk in Puket Harbour by Charlots launched from HMS Trenchant. All these sinkings were positively confirmed and amounted to about 130,000 tons, a figure which, by the end of the war, virtually exhausted target opportunities.
By the time that Japan and America went to war in December 1941, the niceties of submarine attack restrictions were sensibly forgotten. It would have been absurd to have observed them in what was undeniably a total war. The United States declared the whole Pacific to be an operational area—which meant unrestricted warfare. This declaration did not, however, lead to an immediate wholesale onslaught on merchant shipping or even to a long-term war of attrition (although that, for the USN, was to develop); on the contrary, both sides concentrated their attention, initially, on naval vessels and neither formulated a clear-cut strategic policy to cover the vast expanse of the Pacific Ocean.

The Japanese submariners were confused. The Imperial Navy had spent the pre-war years endeavouring to assimilate and adopt whatever lessons were to be learned from the European powers, notably Britain and Germany, as well as from the United States Navy who had long been seen as the inevitable enemy. Since these powers were by no means sure themselves about their underwater objectives the Japanese were presented with a welter of conflicting evidence. This led to changeable and insecure doctrines which, in turn, made it difficult for their large and increasingly varied submarine force to adopt a coherent strategy although individual units developed rational submarine tactics. It remained to be seen whether these tactics would succeed within the framework of the Japanese naval plans as a whole.

In December 1941 the organisation of the Japanese Submarine Fleet consisted of squadrons comprising between two and four divisions of two or three units each. Most squadrons had an old light cruiser of the Kuma or Nagara class as a flagship (an old idea derived from the disastrous British K-class plans in World War I) and each submarine division had its own submarine flagship to co-ordinate operations. Pre-war exercises showed that the standard of the force was high and morale was certainly excellent, the force being composed entirely of volunteers. However, the concept of direct command being exercised by these submersible flagships was not proven in realistic manoeuvres.
On 18 November 1941 I-24 slipped her moorings at Kune and, carrying a midget submarine, headed out into the Pacific. Within a few days the rest of the Sixth Submarine Fleet set out towards their assigned patrol stations to await the dawn of Sunday, 8 December. By the time that Admiral Nagumo's carrier strike force had reached its launching point some 275 miles due north of Pearl Harbor, 27 submarines were in position around Oahu. Five of the newly constructed I-16 class submarines carried midget submarines which, it was hoped, would be able to penetrate the harbour defences and be able to inflict further damage upon the American warships at anchor. Although Admiral Yamamoto doubted whether the midgets would make any impact on the American defences, believing that they could never return and were in any event unnecessary, he let them go ahead. Yamamoto's doubts were justified. However, Imperial HQ was confident that the larger submarines could carry out their principal task of preventing reinforcements reaching Pearl Harbor. More was expected from submarine warfare than the immediate strike.

As things worked out, only one submarine succeeded in making an attack: all of the five midgets which were launched and one large submarine were lost without sinking a single American ship. The Japanese boats were packed into a dense patrol zone more than 60 miles from the harbour entrance where they were wasted; but, even if they had been free
to move, the hornet's nest of American destroyers which had been stirred up would have interposed a formidable barrier between them and their targets. When it was clear that the underwater part of the Pearl Harbor operation had failed the Japanese ruefully revised their ideas and gave belated thought to attacking supply ships; but advanced bases were needed for that—and there were none.

So far as their dispositions allowed, the Japanese submarines were well handled on reconnaissance and raiding operations for which they were well-suited. Submarine I-156, for example, on patrol off Malaya, was responsible for making the crucial enemy report which sealed the fate of HMS Prince of Wales and HMS Repulse; and several of the large boats which carried seaplanes carried out a valuable reconnaissance of Allied bases. Other boats conducted spectacular night bombardments on Johnston Island, Palmyra, the Hawaiian Islands and Midway; I-17 even attacked shore installations near Santa Barbara on 24 February 1942, while I-25 was ordered to despatch her seaplane to start a forest fire in Oregon with incendiary bombs in August. None of these operations affected the course of the war but they helped to make American citizens realise that the Imperial Navy was 'for real', a counter-productive result so far as Japan was concerned.

On patrol duties the Japanese performance was patchy. On 10 December, two days after Pearl Harbor, five submarines were detached to patrol off the western seaboard of the United States. On the way I-6 was responsible for the first major Japanese submarine success of the war when she succeeded in putting the aircraft carrier Saratoga out of action for three months. By mid-December there were nine submarines off the west coast of America but by the end of the month they were forced to return to Japan for replenishment. They had achieved very little but their presence had forced the United States Navy to adopt a comprehensive convoy system with extensive AS patrols in the Pacific at a time when every available escort was needed in the Atlantic.

On 1 March 1942 Naval Directive No 60 called for 'the utmost efforts [to secure] the destruction of enemy lines of communication throughout the Pacific and Indian Oceans.' All vessels were to be sunk on sight with the exception of those flying Axis, Soviet or Swiss(!) flags.

The directive was duly and successfully implemented in the Indian Ocean from April 1942; but Admiral Yamamoto in the Pacific was still intent on bringing the United States Fleet to battle and, preparing for the Coral Sea and Midway offensives, he kept a tight rein on the Sixth Fleet submarines to back up these operations.

At Midway both the Japanese and United States Navies employed large numbers of submarines in almost identical roles. The Japanese disposed 16 boats in two patrol lines north and south of French Frigate Shoals and the Americans disposed 19 submarines near or around Midway itself. In each case the aim was to intercept the enemy's advancing carriers and in each case the submarines failed to inflict any damage on enemy forces at any crucial stage of the action. The Japanese patrol line was late in getting into position and, having missed the American Task Force at the start, was unable to catch up with them before Admiral Nagumo's carriers were already sunk by US carrier aircraft. Meanwhile, American submarines, despite being geographically in position to meet the Japanese forces, found themselves unable to bring their torpedoes to bear on the fast warships speeding by while being constantly harassed by Japanese destroyers. Some face was saved on both sides by I-168 sinking the already crippled carrier Yorktown and the destroyer Hamman and the claim of Lcdr W Brockman, commanding USS Nautillus, that he had finished off the carrier Soryu, already severely damaged by bombing. Post-war analysis determined that Brockman actually fired at Kaga: of the four torpedoes fired, one failed to leave the tube, two missed and the fourth struck amidships but failed to explode. Kaga was already sinking and the air-vessel which was thrown loose by the last torpedo served as a welcome life preserver for several of Kaga's crew.

Their catastrophic naval defeat at Midway halted Japanese plans for further expansion. Imperial HQ rescinded Directive No 60 and on 22 June 1942 substituted Directive No 107 which again called for unrestricted
Top Left
The conning tower of I-153. This boat, completed in 1926, had some remarkably modern features but normal diving depth was limited to 80 metres (262 ft) and, with the rest of its class, was relegated to a training role in 1942.

Top Right
The Control Room of an old (1923) Japanese Ro-class training submarine showing a marked similarity, except for the periscope, to the British L-class on which the design was based.

Centre Right
The crew's mess table in I-169. The Japanese Navy made every effort to ensure that submarines were provided with good food but it was not easy amidst wartime privations.

Bottom Right
Tube space in I-153. Note the absence of the tube space bulkhead separating the tubes from the torpedo stowage compartment common to all British boats. Several early Japanese boats owed their layout to British L-class design but I-153 and her sisters were based on the German U-125 (World War I) and U-boats did not have this compartmentation which was instituted in the Royal Navy to minimise risk of serious flooding following a collision: it was expected that, in extremis, a submarine would endeavour to ram rather than be rammed in a peacetime collision situation, hence the provision of a bulkhead forward.
Sonar operator in I-169. Japanese sonar gear was not up to the standard of USN equivalents but I-169 was equipped with quite reliable Type 93 hydrophones and Type 91 echo-ranging equipment. Data was adequate for evasion but not for accurate blind attack.

Hydroplane operators in I-169. This large fleet boat (1785 2440 tons) was to be lost at Truk on 4 April 1944 due to flooding after an air raid.

Main ballast LP blowing manifold in I-153. In submarines of all navies high pressure air from bottles was only used to blow sufficient water out of selected main ballast tanks to achieve the minimum positive buoyancy for surfacing. The remaining water was blown out by a low-pressure system using either the exhaust gases from the diesels, as in German U-boats, or a large rotary eccentric air-pump known as the blower in British and related designs.

Tubes crew in a Japanese training submarine (possibly Ro.27). The Petty Officer on the left of this posed photograph is probably working the forward hydroplane hand emergency control.
submarine attacks on Allied commerce but deleted the central Pacific as an area of operations and disposed all submarines around Australasia and in the Indian Ocean. If all Japanese boats had indeed been transferred to the Indian Ocean they might have had a most serious effect on the Allied war effort in the west. It is conceivable that they could have prevented the Suez Canal being used as a supply route to Egypt with incalculable consequences on the outcome of the war in North Africa.

As it was, the split force achieved little; but in the Pacific, during the long and bitter struggle for Guadalcanal, Japanese submarines fought savagely, particularly in the narrow waters at the eastern end of the passage between the Solomon Islands which became known as 'Torpedo Junction'. Here, I-boat disposed of the US carrier Wasp, the cruiser Juneau and two destroyers and inflicted further heavy damage on the luckless Saratoga and the battleships North Carolina and South Dakota. At the same time they succeeded in sinking or damaging several merchant ships and smaller warships and obliged the Americans to make a number of supply runs with their large fleet submarines.

After the defeat of the combined Japanese Fleet during a three-day battle from 12 to 15 November 1942 and the steady deterioration of the Japanese position on Guadalcanal itself, the positions of the two submarine forces were reversed. Now, because of the alarming losses of surface ships on the nightly 'Tokyo Express' run to the beleaguered island, the Japanese resorted to submarines as blockade-runners. The decision was not popular with Japanese submariners but the plight of the Japanese soldiers was so dreadful they felt obliged to do their utmost in the new unwelcome role. They did their best, but by the end of 1943 no less than 14 submarines had been lost on transport duties in the Solomons area. The evacuation of Guadalcanal by the Japanese was optimistically seen, by those who still clung to the original concept, as the beginning of the expected Third Phase (see Chapter 2) when the hopefully weakened United States Fleet would be brought to battle in Japanese controlled waters. Even if really believed, it bore the markings of a desultorist policy but the Japanese did not view it as such. On 25 March 1943 Directive No 209 laid down still more fresh instructions for the future conduct of submarine operations. It included a reversion to traditional Japanese submarine doctrine and ordered that 'in the event of an attack by the main strength of the enemy fleet the submarine force will maintain contact with it and endeavour to reduce the enemy's strength.'

The diminishing submarine force was not capable of fulfilling the directive. By the beginning of 1944 it was fully occupied in transport duties and desperate, ineffectual attempts to halt the steady American advance across the Pacific. Supply and transport duties came to be seen as all-important. A programme was launched to build a permanent force of transport submarines consisting of very simply constructed boats, without offensive armament, which could be used exclusively for what submariners themselves regarded as a thankless, fruitless task. Two new classes for the purpose were initiated by the Japanese Army who by now had great influence over submarine operations.

By the middle of 1944 great advances in American anti-submarine equipment, developed from experience in the Atlantic, made Japanese submarine attacks even more hazardous. Few boats were fitted with effective radar and submarine sonar was rudimentary. Throughout 1944 and the first half of 1945, ill-equipped and ill-prepared forces were initiated by the Japanese Army who by now had great influence over submarine operations.

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By the middle of 1944 great advances in American anti-submarine equipment, developed from experience in the Atlantic, made Japanese submarine attacks even more hazardous. Few boats were fitted with effective radar and submarine sonar was rudimentary. Throughout 1944 and the first half of 1945, ill-equipped and ill-prepared forces were initiated by the Japanese Army who by now had great influence over submarine operations. Amidst the disintegration of their force and the ominous threat posed by Germany's surrender, the Japanese submariners planned a dramatic raid on the Panama Canal using Seiran aircraft to be launched from the gigantic 4,550-ton I-400 class submarines which had been laid down early in 1943. Two of these were ready for service by the beginning of 1945 and each carried three of the Seiran single-engined acrobones capable of dropping either torpedoes or bombs. The aim was to block the Panama Canal and hold back the tidal wave of Allied forces now pouring into the Pacific. Captain Ariaizumi, commanding the First Submarine Flotilla with its underwater aircraft carriers, was confident of success and the pilots were thoroughly well trained. The suicidal nature of the mission was accepted but by the middle of June a crippling attack against Allied Forces, already within striking distance of the homeland, was more urgent than this further-reaching strategic mission. Order No 95 therefore directed the First Submarine Flotilla to expend their Seiran's in a suicide attack against US Navy aircraft carriers at Ulithi Atoll. If the invasion of Japan could somehow be delayed there would be more time to prepare defences.

This attack, Operacion Hikari, called for prior reconnaissance so I-13 and I-14 went ahead of the flagship I-401 and its sister ship I-400 intending to launch reconnaissance aircraft on 16 August. I-13 was sunk by US carrier aircraft on route but I-14 succeeded in reaching a point off Truk and its aircraft duly reported that the United States Fleet was still at anchor. However, on 15 August the Emperor announced Japan's surrender which, for some reason, only resulted in Naval Headquarters postponing the attack until 25 August although this last order was countermanded on the following day when all submarines were called back. Captain Ariaizumi was instructed to destroy all offensive weapons and important documents. In the last order to fire torpedoes in the Imperial Japanese Navy, one torpedo circled and actively pursed I-400, passing dangerously close although it was set to safe. The Seiran aircraft themselves were either cap-a-pulted pilotless or punctured and dropped overboard. On 31 August, just before I-401 entered Tokyo Bay, Captain Ariaizumi placed a service pistol to his head and shot himself.

In a last letter he expressed remorse for subjecting the men under his command to the shameful situation of surrender which Imperial Navy men and ships had never before experienced.

Japanese submariners had, for nearly four years, suffered from misemployment. When,
Torpedoed Japanese destroyer photographed through the periscope of USS Wahoo.

Lt J P Biena USNR, Engineer Officer of USS Silversides receives the Navy and Marine Corps Medal from VADM Charles Lockwood on 21 March 1943 for his work in keeping the submarine going when she suffered a spate of problems on her fourth war patrol. Reservists performed outstandingly well, both in the USN and RN.

Unusual photograph taken at Brisbane, Australia of damage sustained by USS Growler during her action with the Japanese supply ship Hayasaka (900 tons) off the Bismark Archipelago on the night of 7 February 1943 (see text). The effect of the Japanese machine-gun fire which seriously wounded Growler’s Captain, Lcdr Howard Gilmore, and killed two others on the bridge, can clearly be seen, as can the damage to the bow which resulted from Growler unintentionally ramming her adversary. It was on this bridge that Gilmore gave the most famous and selfless order in US submarine history—‘Take her down’.
the United States Navy in the Pacific also had problems at the beginning of the war; but it was to overcome them magnificently. The period from December 1941 until the end of 1942 saw the US submarine force hampered and dogged by torpedo defects and by command weaknesses at sea and on shore. Submariners elsewhere could only admire the way in which fresh, younger commanding officers and overdue dynamic leadership from above revitalised the force from the beginning of 1943 and led it to final victory.

During 1942 American submarines sank 180 Japanese ships for a total of 72,500 tons: this was unfairly compared with the 1,160 Allied ships totalling 6 million tons destroyed by U-boats during the same 12 months. Without question, more reliable torpedoes and more skilled, aggressive commanding officers could have achieved much more than they did; but it was poor training, leading to over-caution and unskilled direction from force commanders, as well as unreliable torpedoes, that were to blame. If commanding officers were wrongly selected, wrongly employed and poorly equipped that was not their fault. There were blatant cases where submarine captains did not carry out their orders properly but, in the main, the fault lay fairly and squarely on the shoulders of senior officers ashore. Time and again throughout the undersea war good leadership and skilful direction were seen to count for much more than material; poor leadership and lack of loyalty downwards affected submarine operations to a greater extent than in any other kind of ship. Although moderate in terms of tonnage, the 1942 sinkings were creditable in the circumstances; and targets in the Pacific were nothing like so plentiful, where the submarines were sent, as those which U-boats were offered on a plate in the Atlantic.

The continuous angling applied to torpedoes in the tubes was much envied, especially by the British; but it was all too easy to fire from the hip without accurately determining the target's course, speed and range. Periscope ranging must have been haphazard for reasons discussed earlier in Chapter 8. Unavoidable radar vagaries were not taken into account when radar bearings were used and it is doubtful whether the sets were calibrated for range as carefully as they should have been. Reports from sonar were apt to be believed implicitly: and sonar inaccuracies, both with regard to bearing and turn-count, were not allowed for. The impressive quality of the equipment in American boats was such that a US submariner might well not question the answers it supplied; but its very excellence militated against surety of success. Over-credulity was almost certainly responsible for many failures when other problems of command and weaponry had eventually been solved. Fortunately, during the successful campaign against Japanese merchant shipping during the latter part of the war most targets were simple to attack and inadequately escorted so that approaches did not necessarily call for the same degree of skill and precision as that required in, for example, the Mediterranean. If comparisons have to be made, these rather unflattering generalisations are unavoidable; but they in no way detract either from the gallantry so frequently displayed throughout the United States submarine force nor from the conclusive and decisive result which it ultimately achieved.

The first commanding officer to complain about faulty torpedo performance was Lcdr Tyrell Jacobs of Sargo, himself a torpedo expert. The first fish fired by Sargo exploded prematurely, so Jacobs disconnected the magnetic feature on his remaining torpedoes and altered their depth-setting to hit with contact exploders. During six successive attacks he fired a further 14 torpedoes readjusted in this way and still none exploded. Jacobs reasonably concluded that Mark XIV torpedoes either ran deep or that the contact as well as the magnetic exploders were faulty, or both. He was rewarded by ComSubAsiatic (Captain John Wilkes) with a severe reprimand and a refusal, reportedly due to a shortage of torpedoes, to allow a test firing through a fishnet. However, a representative from the Bureau of Ordnance was flown out to investigate. The expert busied himself in ensuring that Sargo's crew were following the correct drills and maintenance procedures. In so doing he turned a gyro back to front. That scarcely gave submariners confidence in the Bureau of Ordnance; but somehow the Bureau managed to blame the crew of Sargo for all the failures.

This habit of blaming the boats was to continue in varying degrees until Rear Admiral Charles Lockwood arrived to command the Asiatic Fleet submarines in June 1942. Besides relieving one quarter of his commanding officers immediately and bestowing some of those remaining for lack of aggressiveness, Lockwood soon applied himself to the torpedo problem. It was Lcdr Dan Daspit in Timosa who decided Lockwood to make some thorough tests. Daspit was an exceptionally skilled attacker. When homed by Ultra radio intelligence onto a 19,000-ton floating whale factory on 24 July, his target estimations were, by any standards, good. He fired no less than 15 torpedoes in conditions that were nearly perfect, despite a Japanese destroyer which tried to interfere. Eleven fish failed to explode although hits were clearly observed. The subsequent trials arranged by Lockwood proved that when a warhead hit at an ideal 90-degree angle the exploder mechanism was invariably crushed before it struck the detonating cap. At a smaller angle of 45-degrees, which could only result from a less favourable firing position, the failure rate was about 50 per cent. That was still alarmingly bad but Lockwood had no alternative, while modifications were urgently being carried out, than to tell his commanding officers to shoot on fine track angles, a tactic which all their training had taught them to avoid. It took no less than 21 months of war to end the sorry saga and provide American submariners with reasonably reliable weapons.

Not all the American boats were modern. The S-boats sent to the Alaskan area to oppose the Japanese landings on Kiska and Attu found it hard enough to survive, let alone defend the islands. The weather was atrocious and the charts were unreliable.

Navigation was difficult and S-27 (Lcdr H L. Jukes) ran aground on Amchitka Island on 19 June 1942. S-27 was abandoned and the crew, sheltering on the deserted island, were not found for six days. During the next few weeks seven fleet boats were sent to the area and one was lost. Despite a generally poor showing by most boats, Growler (Lcdr Howard Gilmore) gained distinction by attacking three destroyers anchored off Kiska; two were damaged and one sunk. During this spirited action Gilmore showed initiative not common amongst CO's at that time. It was perhaps significant that he was an enlisted man and had won his way to the Naval Academy by competitive examinations. After a distinguished but short career he died on Growler's bridge during a surface action against the Hayasaki, a 900-ton provision ship, on the night of 7 February 1943. Hayasaki sighted Growler a mile away and turned to ram. Growler was slow to detect the course alteration (inevitably, if the control party was depending on radar) and when Gilmore realised what was happening his use of full rudder only resulted in the submarine hitting the target amidships at 17 knots. The Japanese ship opened fire on Growler's bridge killing or wounding the exposed personnel. Gilmore, wounded, ordered the bridge to be cleared and then, unable to climb down the hatch himself, gave his last order—
"Take her down". His Executive Officer, Arnold S Schade, reluctantly obeyed. Gilmore, posthumously, became the first submariner to be awarded the Medal of Honor.

Despite more energetic and loyal support from shore, the Asiatic Fleet submarines were still not directed to focal points and bottle-necks where, as in the Luzon Strait, traffic crossed and was often heavy. In any case, by early 1943 interest was focused on the island-hopping campaign in the central Pacific and submarines which had been operating from Australia were transferred back to Pearl Harbor to participate. One of these was Wahoo (Lcdr 'Mush' Morton) who, in his first patrol, transformed a formerly discontented crew into an effective fighting unit. He took chances and pressed home attacks relentlessly, making in all six patrols in which he sank 19 ships totalling 55,000 tons (but claiming 17 for 100,500 tons). Morton told his crew before sailing from Brisbane for the first patrol that Wahoo was expendable. It was this sort of talk in a Kentucky accent that had earned him the nickname 'Mushmouth' and it was natural to wonder whether his performance would match his words: generally it did although, like other submarine captains, he was apt to put his tonnage figures on the high side. He was fortunate in having a brilliant Executive Officer in Lieutenant Dick O'Kane who was himself to win fame and the Medal of Honor later in command of Tang, although he also caught the habit of overestimating sinkings which, in his case, turned out to be 41 per cent of what he claimed. Morton gave O'Kane the periscope during attacks and concerned himself with getting Wahoo into the right position. This arrangement re-
sembled the practise usual in German U-boats making surface attacks. In Wahoo it worked for submerged approaches; but it is doubtful whether it would have succeeded with lesser men than O’Kane. One unpleasant incident is recorded in Clay Blair’s Silent Victory although other histories gloss it over.1 On the convoy route between Wewak and Palau, Morton found himself in the path of a four-ship convoy. He hit one freighter, damaged a second and stopped a large troop transport dead in the water. A second torpedo fired at the latter failed to detonate but a third resulted in a massive explosion and Morton watched large numbers of Japanese soldiers—he said thousands—jumping over the side. Unable to pursue the other targets submerged with the battery low, Wahoo surfaced in the midst of ‘a sea of Japanese’. Morton is then said to have ordered the guns to be manned and turned on the survivors. His patrol report (apparently) described their killing during a nightmare hour of carnage. Some of the survivors returned the fire with ineffective pistol shots; Morton may have felt that this justified an action which most submariners would find repugnant.

No comment seems to have been made on this incident by Morton’s superiors who endorsed Wahoo’s patrol report in glowing terms.2 The appalling treatment meted out by the Japanese to submariners taken prisoner, exceeding anything experienced in European theatres of war, may have been held to offset a murderous act; but it was still, at the very least, distasteful. If there was lack of comment by senior officers, one way or the other, they were scarcely gifted with moral courage.

Wahoo, with O’Kane no longer on board and evidently missed by Morton, was lost in October 1943 on her way out of the Sea of Japan where Lockwood had started to send his boats into the busy shipping lanes. Meanwhile, submarines were being sent hither and thither to follow Ultra intelligence reports. These enabled force commanders to predict Japanese naval movements with reasonable certainty; but a natural desire to home submarines onto glamorous warship targets blinded the Admirals for a long time to the strategic advantage of concentrating submarines against the merchant shipping on which Japan was wholly dependent for survival. On a wall-chart, Ultra findings and interceptions looked good but in practice navigational discrepancies, common both to hunters and hunted, quite often resulted in a top secret rendezvous being missed. Warships steamed at high speed and a submarine could easily find itself separated by a tantalising score of miles from a target which swept past and offered no second opportunity for attack. The total dedication of Commander J P Cromwell, commanding Division 43 and riding in Sculpin with a detailed knowledge of Ultra abilities, resulted in his refusing to leave the sinking boat with the rest of the crew after a devastating series of attacks by the singularly capable destroyer Yamagumo on 19 November 1943. Cromwell knew only too well that code-breaking secrets might be forced out of him if the Japanese took him prisoner. He elected to ride the boat down to the finish and richly deserved his posthumous Medal of Honor. Half of the surviving crew, who had been put about the carrier Chuyo, were killed when the carrier was torpedoed in the middle of a typhoon by Sailfish (Lcdr Bob Ward). It was bitter irony because Sculpin had found and stood by Sailfish, then Squalus but renamed, when she had sunk accidentally off Portsmouth, New Hampshire on 23 May 1939.

October 1943 saw the first attempt at wolf-pack tactics. Captain ‘Swede’ Momsen, commanding Squadron 2 selected Cero (Lcdr Dave White) as his flagship taking Shad and Grayback with him to the East China Sea near Okinawa. The idea was not for the three boats to attack a convoy simultaneously, because of the danger of hitting each other (a risk which Doenitz had discounted in the Atlantic where there was no case of torpedoes hitting another U-boat although there were collisions). Instead they were to co-ordinate their approaches for maximum effect. However, rather than finding themselves stationed as planned, on either flank and astern of a convoy, the three boats scattered while chasing contacts and at best the pack could be described as a joint search unit rather than a joint attack unit. With all the Ultra information available it might have been better to control attacks from shore like Doenitz. It would have avoided unsatisfactory communications between the boats on TBS (Talk Between Ships) radio although it would, on the other hand, have risked boats being located by D/F and code-breaking which the USN, because of their own ability, were sensitive about. Teething problems were surmounted in due course and wolf-packs were to achieve notable successes after a few months of trial and error; but it is hard, in retrospect, to believe that formal co-ordination between submarines at sea was any real improvement over what would have been accomplished by totally independent but concentrated operations, even at the risk of mutual interference and enemy radio interception, against designated convoys.

Ultra intelligence reports continued to dominate the positing of submarines whether in packs or operating singly; and they still pointed primarily to naval rather than merchant targets until 1944. Then, in the third year of the Pacific war, US policy changed radically and Japanese shipping began to be devastated by submarine attacks. Although the Japanese building programme managed to keep up with the tanker losses during 1944, one half of its other merchant vessels went to the bottom virtually without replacement during the year. From September to December oil imports were cut by more than two-thirds and reserve stocks were at a dangerously low level. 1944 also saw the loss of one Japanese battleship, seven aircraft carriers, two heavy cruisers, seven light cruisers, about 30 destroyers and seven submarines with another carrier and four heavy cruisers severely damaged. All these fell victim to what had now become an extremely agressive and effective submarine force, well led and amply supplied both with Mark XIV steam and Mark XVIII electric torpedoes. It had taken a long time to learn the lessons leading to success but now the General Instructions for Seventh Fleet boats typified the new approach:

‘The primary mission of submarines is to torpedo and destroy enemy men-of-war and shipping. As the war progresses, the attrition of his ships and shipping is causing the enemy to employ anything that floats to transport important cargoes.

Press home all attacks. Long-range shots offer too little chance of hitting and too much chance for the target to maneuver to avoid... Pursue relentlessly... do not let cripples escape or leave them to sink—make sure they do sink...’

The mission and the method were now both clear. A new generation of commanding officers took their submarines into action with daring and skill. John Paul Jones and Nelson would have approved their efforts to engage the enemy more closely! Criticism has been implied by figures showing that, on average, it took ten torpedoes to sink a ship that was high in comparison with other navies; but the fact is that large salvos were fully justified while torpedoes were plentiful. The important thing was that enemy ships were sunk. If the warheads had been larger or if magnetic pistols had detonated them beneath their targets, the sinkings would have been much higher; as it was a large number of Japanese vessels escaped with only moderate damage.

The total tonnage claimed by American submarines in the Pacific amounted to 16,657,800 tons which was reduced by post-war analysis to 5,325,208 tons. The discrepancy was held by Commander Roy M Davenport (Haddock, Trepass) whose war-
time assessments were 17 ships for 151,900 tons brought down to 8 ships for 29,662 tons by JANAC.

These exaggerated claims, exceeding actuality in total by almost 100 per cent, call for some explanation. They were common in the USN but, except in a few cases, they were not likely to have been made wilfully or knowingly. Of course, optimism and wishful thinking played their part; but there must have been other factors at work for American submariners, as individuals, were not prone like the Russians to deliberate falsification for political reasons even if lack of success was seen to doom promotion prospects. The real culprits were almost certainly the fire-control angling system and the torpedoes themselves, as suggested in Chapter 8, together with the inevitable tendency of sonar operators to register each and every explosion as being on the target’s bearing when it was, in fact, extremely difficult to determine the bearing of any short burst of noise, however loud. Torpedoes hitting the bottom, colliding, exploding in a wake, exploding prematurely or for no particular reason all gave rise to high hopes of success when nothing actually happened to the enemy.

For comparison, a thorough review of German claims and a random check of British successes has been made. It suggests that the majority matched contemporary assessments quite well although even the most cautiously compiled reports occasionally proved, after the war, to have been over optimistic. It was, though, fairly easy for German and British successes to be checked at the time: merchant vessels torpedoed by U-boats in the Atlantic almost invariably announced the fact on the distress frequency; and excellent intelligence sources gave Simpson, and others, in the Mediterranean the information they needed to compile an accurate list of British sinkings. Furthermore, both the German and Royal Navy were well practised in analysing attacks critically, mathematically and in detail. This was not true of the United States Navy which, frankly, preferred to hope for the best.

The loss of 19 American boats in 1944 was small in relation to their achievements which ensured, as early as December 1944, that the war against Japan was won. By that time the merchant shipping left to the Empire was plying its trade almost wholly in the confined waters of the Sea of Japan and the Yellow Sea, keeping close to the coast where the American submarines, neither designed for nor practised in operations inshore, would, the Japanese hoped, be unable to reach them. But, singly and in packs, the US submarines probed deep into Japanese home waters. The Inland Sea had not been exploited since October 1943 and, besides heavy air and surface A/S cover, it was known to be guarded by new minefields. However, sensitive, short-pulse FM active sonar was now available and was capable of detecting moored mines at, submariners were assured, a suitably safe distance. Six boats were sent in April and May 1945, to locate and plot the minefields with this gear. That they succeeded in doing so, apparently producing comprehensive charts, is remarkable: following experience elsewhere with mine-detection gear and knowing how imprecise navigation could be even within sight of the land, it is difficult to believe that their plots were trustworthy. No submariner cared for this kind of work which was hazardous in the extreme and promised no rewards. Lcdr WJ Germershausen in Spadefish was admired for confining himself to the remark that ‘mine hunting was dull and unrewarding .’. Spadefish had incidentally, another unrewarding experience when, on the night of 13 June, Germershausen sank an 11,000 ton Russian ship in error. Earlier in the war this would have rated a court-martial in which three other Russian-sinking captains would have joined him; but in 1945 loyalty downwards was abundant; neither Lockwood nor Nimitz prosecuted.

As the war at sea gradually petered out during the first few months of 1945 targets became scarce. With the minefields (supposedly) known, nine FM-equipped boats, ‘the Hellcats’, were fitted with clearing wires, to prevent mine cables from being caught by bow or stern planes, and were sent (‘Damn the torpedoes’) into the Sea of Japan. The Hellcats aimed to pass beneath any uncharted fields and managed to do so safely although on two occasions wires were heard scraping down the sides of Skate and Tinosa. For some reason the Japanese did not lay deep fields. At depths below 120 feet boats were relatively safe from the buoyant mines and the Japanese only laid ground magnetic mines in enemy waters. Getting out again, with the Japanese fully alerted by the havoc of the Hellcats, promised to be difficult. It was decided to make an exit through the La Perouse Strait at night on the surface. Lockwood sent Trutta (Lcdr F P Hoskins) to divert the enemy by shelling an island in the Tsushima Strait to the south in ‘a purposely conspicuous manner’ and this served its purpose. Some hours later on 24 June eight submarines assembled in darkness just inside the La Perouse Strait and then, in line ahead at 18 knots, made for the open sea encountering fog but no obstructions on the way. A second wave repeated the operation in July and August and mopped up what was left. On 14 August 1945 Torsk (Lcdr B Lewellen) sank coastal defence vessels 13 and 47. They were the last Japanese ships to be sunk and Torsk fired the last torpedoes anywhere in World War II.

The ‘Third Phase’ of the war at sea, during which the Japanese High Command had planned to annihilate an exhausted American Fleet approaching the mainland of Japan, was entirely reversed by the United States Submarine Force who fought their way to the homeland quite unexhausted and at remarkably little cost in either men or materials. Submarines were long denied public recognition of their major share in victory, in part because of inter-service rivalries but also because their operations had depended so heavily on Top Secret Ultra radio intelligence that they were little known outside a relatively small circle of submariners. However prejudiced a historian may be in favour of the other services, it would be difficult now to deny that submarines, quite apart from sinking a significant proportion of the Japanese Navy, brought the island nation of Japan to a standstill by virtually destroying the merchant marine upon which its livelihood and war-making potential depended. All this was achieved for the loss of 49 Pacific submarines. Notwithstanding mines laid by aircraft, which took a heavy toll around Japan during Operation Starvation from March to August 1945, it is arguable that it was the submarine force which finally won the war and that the two atom bombs dropped on Hiroshima and Nagasaki were superfluous.3
15 Soviet Submarines

When Germany invaded Russia on 22 June 1941, 35 boats were at sea or ready, by Soviet standards, for operations in the Baltic; a further 50 boats, approximately, were refitting or obsolete, and it may be that as many as 65 boats, in all, were theoretically available in the Baltic. However, the principal base at Libau had to be evacuated three days after the start of hostilities. The boats which could not move were scuttled and the others retired to Riga and then, when that was threatened, moved to Reval where they were joined by boats of the Second Flotilla when these were forced to leave their base at Hango in the Gulf of Finland. They were only able to remain at Reval until August when they had to withdraw still further to Leningrad and Kronstadt—and both these ports were under siege. The rapid succession of moves must have been disastrous for maintenance, logistics and operational control to say nothing of facilities for submariners themselves. Nor were matters made easier by mines, which the Germans laid from every available craft in the Baltic, and by the energetic activities of German air and sea AS forces in an area which it was extremely important for Hitler’s Navy to control—not least for U-boat training and trials.

Shch-307 enjoyed the only notable confirmed success in the first year of the Baltic war when she torpedoed U-144 on 9 August although three merchant ships were to be sunk by torpedoes or submarine-laid mines before ice conditions from December prevented any further submarine operations. The Soviet submarine effort in the Baltic had, in fact, so little effect that the Germans reopened normal shipping routes on 12 July after three weeks of no underwater action being apparent and soon afterwards decided that escorts were unnecessary. With little on the credit side, no less than 27 Soviet submarines were lost in the Baltic or destroyed in harbour before the end of 1941.

In the Spring of 1942, when the ice had cleared, the Red Banner Fleet prepared its submarines for a breakout through the Finnish-German minefields and AS patrols into the open Baltic. The boats were thickly painted, presumably in a vague hope that this would give some protection against magnetic mines and sound detection apparatus, and wooden frames around hydroplanes and other projections were fitted to supplement the standard jumping wires for brushing aside mine-mooring wires. Commanding officers were directed to try and avoid minefields altogether by keeping to shallow water and, when that was not possible, to pass beneath suspected minefields at as great a depth as possible. When the noise of a mooring wire was heard scraping along the hull, they were to 'stop motors until the sound ceased, indicating that the wire had slipped past.' Soviet submariners left no record of their reaction to this bland instruction!

Despite the mines, between 12 and 19 June, eight submarines traversed the first barrier in the vicinity of Lavansaari Island losing only M-95 on the way. They then roamed the eastern Baltic sinking a dozen fair-sized merchant ships, S-7 and Shch-317 accounting for four ships each. The Soviet government had not declared a zone of blockade and three neutral Swedish ships, torpedoed without warning, were amongst the victims. Despite Soviet commanding officers being ordered not to attack Swedish vessels, 17 attacks were made on them and a total of five Swedish ships were sunk in 1942. The Swedish government thereupon introduced a convoy system and did not hesitate to use depth-charges if they suspected the presence of a submarine (the habit has continued in recent years). Over-statement of Soviet submarine successes, against declared enemies of course, became habitual from this time as the difficulties of making successful attacks mounted and underwater explosions of one kind and another became more frequent. Shch-317, for example, with Captain Second Rank V A Jegorov commanding the Submarine Division on board, claimed five ships for 46,000 tons when the actual figure was four ships for 8,000 tons. Ship identification was not a strong point. Shch-320 claimed the important submarine tender Mosel while actually firing at (and missing) the smallish merchant ship Guadrun. It was the practice to go deep after firing and assume that any subsequent bangs signified a sinking—an assumption not unknown in other navies but much more common in the Red Fleet than elsewhere.

Two further Baltic sorties, in August and September 1942, resulted in claims of 14 merchant vessels for 100,000 tons sunk when five ships for 10,000 tons actually went down in exchange for two submarines lost and another severely damaged by mines.

Eighteen boats were sent out between 18 September and early November 1942 but by then the minefields had been reinforced and the defences alerted. Four Shch-class were mined on passage and Shch-305, 306 and S-7 were sunk by Finnish submarines. The Soviet group claimed 18 ships for 150,000 tons but post-war German findings fixed the total at six ships for 12,000 tons with a further four ships damaged. However, three more ships (12,000 tons) were destroyed by mines which were probably laid by L-2. Curiously enough the Soviet Official History for this period gave exaggerated credit to individual boats and cited some entirely imaginary happenings but, if anything, underestimated the total damage caused. Soviet statistics could not, it seems, be agreed internally, let alone be made credible externally.

Vice Admiral Friedrich Ruge (German Navy) mildly remarked that it was a slight exaggeration, therefore, for Admiral Isakov (Soviet Navy) to write that 'Soviet submarines put terror into the heart of the enemy'. However, the Soviet submarines were indeed potentially dangerous and had to be guarded against throughout the Baltic war at a cost which was unwelcome when German forces were badly needed elsewhere to counteract the operations of British and Allied submarines off Norway and in the North Sea. Traffic outside the Gulf of Finland was vital and, during 1942 when 400,000 soldiers had to be transported through the Baltic, it was no longer possible to ignore the underwater threat.

As soon as ice conditions permitted, the German Navy, assisted by the Finns, laid further minefields in the Gulf of Finland and in April completely shut off the Gulf with a double submarine net at the western end. This barrier proved impenetrable. Soviet boats were entirely prevented from operating
in the Baltic until Finland and the Soviet Union effected a truce on 4 September 1944 when the Finns were obliged to clear a way through the defences close to the Finnish coastline.

Navigating with the aid of Finnish naval officers, Shch-310, Shch-318 and Shch-407 made their way out into the Baltic a fortnight after the truce was arranged, soon followed by 12 more boats. Armed with mines and torpedoes they succeeded in destroying a score of ships including a minesweeper and U-479 which struck one of the mines laid by Lembit on 12 December. Fortunately for Germany, the 1944 Soviet submarine offensive was too late to interfere with the numerous transports evacuating Reval from 18 to 23 September; but in the following year the Germans were to be faced with near catastrophe as withdrawal and rescue operations intensified.

Twenty operational submarines remained to the Baltic Fleet at the beginning of 1945. They now had ice-free bases and were able to mount more patrols throughout the winter months; and they started to press home their attacks with more vigour. On 30 January 1945, S-13 (Captain Third Rank A E Marenko) torpedoed and sank the 25,000 ton liner Wilhelm Gustloff off the Bay of Danzig. Marenko was more expert than his colleagues and hit his target with three torpedoes. The liner was urgently ferrying 6,000 fugitives, including U-boat men, from Pillau and it had no escort because none was available, nor was the ship zig-zagging: speed was the essence. On 10 February Marenko torpedoed another large liner, the General Stuben of 14,700 tons which, in this case, was escorted. On 16 April L-3 sank yet another transport carrying 6,000 men. Between January and May 1945, Soviet submarines torpedoed 13 transports altogether totalling 63,000 tons and three more ships totalling 4,000 tons. Four warships were sunk by submarine-laid mines and Soviet submarines maintained a continual threat against supply ships going to Courland and troop-transports leaving Libau. There was sometimes direct
co-operation between submarines and reconnaissance aircraft; and quite effective tactical sub-air co-operation, of a type not attempted by Doenitz, was also employed in some areas. It is impossible to assess its value but the concept was good and it may have worked better than contemporary American sub-air procedures in the Pacific; in any event, Soviet secretiveness prevented the other Allies from knowing much about it.

The Soviet Black Sea Fleet was well supplied, from the beginning, with more than 47 submarines of all sizes, and they were mostly new. Throughout 1941 ten boats were at sea and they contributed, with other forces, to the loss of 29,000 tons of Romanian, Bulgarian and German shipping; but their share of sinkings in relation to the naval air arm is not known. As in the Baltic, commanding officers paid no attention to neutral flags and a number of small Turkish vessels were destroyed. Although gunnery was much favoured, torpedoes were fired at every opportunity, even against shallow-draught targets which, very occasionally, were hit, presumably by setting torpedoes to run on the surface. Torpedo depth-keeping and firing mechanisms do not seem to have been better than in any other navy; in all areas there were reports of torpedoes passing under ships (not only shallow draught) and detonating without hitting a target. The Soviet fish seemed particularly prone to explode in a wake and at the end of their run; but these phenomena were rather more easy to observe in the Black Sea than elsewhere and the proportion of malfunctions may not, in fact, have been unduly high. In general torpedo failures in the Soviet Fleet bore a marked resemblance to those in the German and United States Navies but, in contrast, defects were not corrected before the end of the war. During 1943 the Soviet Admiral in

Top Left
D-4 in the Black Sea, date not known but possibly before the war.

Centre Left
A Black Sea ‘baby’ sailing for patrol.

Bottom Left
Shch-205 (Captain Lieutenant P D Sukhomlinov) returning to its base at Poti in the Black Sea. A Soviet account simply states that Shch-205 gunned and destroyed a transport on 18 May 1942: the German version is that this was the Turkish MV Dumaș (250 tons), inside territorial waters, which had to be run aground after 70 rounds had been fired by the submarine’s gun. The same boat sank a 400-ton Turkish ship a few days later with the 45 mm gun.
the Black Sea said that the Soviet submarine arm had made considerable progress in its training and that 139 operations had been undertaken. Post-war analysis shows that 2.7 per cent of the total enemy tonnage escorted through the Black Sea in 1943 was lost due to submarine attacks.

The Soviet Official History admitted that by 1944 only 16 of the 29 submarines still available in the Black Sea were able to operate due to inadequate repair facilities. Some quite successful sorties were made along the Caucasus coast but they failed to interrupt the German convoys. Their activities gradually diminished and finally terminated when Romania and Bulgaria capitulated at the end of August and the beginning of September 1944 respectively. During the course of the Black Sea underwater war the Soviets lost about 20 boats, 40 per cent of the total operational number operating. Six small Type II German U-boats, which had been sent overland and via the Danube, operated at one time or another in the Black Sea and these were joined by six Italian Type CB midget submarines which arrived by rail in April 1942. Shch-207 and Shch-208 may have been destroyed by the midgets and Shch-214 was certainly sunk by CB-2 (Sdv A Russo). The Axis boats destroyed 33,630 tons of Soviet shipping but, to balance the picture in comparison with the Russians, it should be noted that German false claims amounted to about 41,600 tons more than the real total. These claims, not subject in the Black Sea to the usual rigorous examination by Doenitz, were even wider of the mark than Soviet boasts. However, the Romanian boat Delfinul (CC Costescu), with its sole attack on 6 November 1941, earned a high place in the long international roll of records for exaggeration throughout the war: Costescu reckoned his target, the Soviet merchant ship Uralles, to be 12,000 tons when in fact she displaced a mere 1,975 tons. He must have fired all his fish at point-blank range, presumably believing his target was some three times more distant than it really was.

Although the Baltic and Black Sea submarine operations were important during the German advance and subsequent retreat, it was the Northern Fleet that was most crucial to the defence of the Motherland. Despite the large number of submarines in readiness on paper in the northern bases, and an even larger number available in the Far East which could presumably have been transferred westwards when weather conditions allowed, only 16 Arctic boats were able to start operations on 22 June 1941. Three took up defensive positions around the Rybachy Peninsula, two off the Kola Inlet and four were sent to attack shipping between Petsamo and the North Cape. They contented themselves initially with observing shipping movements and it was not until the middle of July that any attacks were reported. The submarine command organisation ashore was not well organised and the Stalin purges of 1937 and 1938, aimed at individualists, had cut a wide swathe through the ranks of those experienced senior officers who should now have been operating the submarine fleet.

The Commander-in-Chief Northern Fleet, Admiral A G Golovko, took a personal interest in submarine activities but his memoirs show that he, like the staff officers and submarine captains under him, was very inexperienced. His memoirs, besides suggesting a pettishly parochial outlook, an extraordinary unawareness of global strategy and an inflexible belief that the Soviet Union’s allies were treacherous, displayed a remarkable ignorance of the way in which his submariners went about their business. Some of his accounts, in which he showed the utmost loyalty to his subordinates, were touchingly naive but he do give some idea of the difficulties under which commanding officers and crews were operating. The British Senior Officer (Captain, later Rear-Admiral, R H L Bevan), became quite friendly with the C-in-C who remarked that the 60-year-old British officer (he was actually 50) was an expert on agriculture who could discuss it ‘until the cows came home.’ Perhaps Bevan politely steered conversation in that direction knowing that the Russian Admiral had himself been educated at the Timiryazev Agricultural Academy; he wrote home that the C-in-C was a young man of ‘45 or even less’; Golovko was in fact 53 so honours were even.

The Soviet system of command and control was rigid in the extreme. Commissars had been reinstated during the Great Purge of 1937 and on 16 July 1941 a commissar was appointed to almost every naval unit including submarines. There they remained until 10 October 1942 when ‘individual freedom of action and personal responsibility were restored’ (for commanding officers) but, although the title disappeared, extremely influential party members remained and unmistakable commissars were plainly evident in boats being taken over from the British in 1944. Commissars wore uniforms and were officially under the orders of their commanding officers; but they retained the power to make reports directly through Party channels both officially and unofficially.

The constant presence of commissars and Party officials in submarines, with the widest possible powers to praise or condemn, must have made it impossible for commanding officers to act quickly or resolutely in fast changing situations when every action could be argued on the spot or criticised later. The only thing to do was to obey their dauntingly detailed operation orders strictly and literally; any deviation was dangerous and initiative was stifled. Submariners anywhere else would have found such close and frequently inexpert supervision intolerable. Furthermore, it was customary for Divisional Commanders (themselves inexperienced) to
accompany their submarines to sea and tell captains, step by step, how to do their job. This was well illustrated in Golovko's account of an approach by the small M-172 (Captain Lieutenant I Fisanovich) on the roadstead of Liinahamari Harbour through a narrow, heavily protected fjord. 'The steadiness and patience of Kalyshkin (the Flotilla Commander) who knew,' said Golovko, 'as nobody else, how to choose the right moment for attack, had a most beneficial influence on Fisanovich... First of all he suggested postponing the entry of M-172 into the enemy harbour for 24 hours... to study the position... on the second day Kalyshkin again advised delaying the entry. This was simply a test of patience for the captain to school him for independent operations later on.' Fisanovich duly heeded all this advice, successfully passing through the fjord, and fired a salvo at a merchant ship lying alongside a pier. M-172 then retired to sea and attacked the hospital ship Alexander van Humboldt. Both attacks were greeted with wild acclaim; but the truth was that the first salvo hit the pier, without damaging the target, and the second missed altogether. Perhaps genuinely unaware of these disappointing results, Golovko was moved to make the artless comment that 'such was the outcome of the first combat sortie of Captain Fisanovich, achieved under the supervision of the Flotilla Commander.'

There were other difficulties. Torpedoes froze in their tubes on the surface in winter; submarines had to dive at intervals throughout the night, while endeavouring to charge their batteries, in order to clear ice from the casing and the conning tower hatch; guns froze up; lubricating oil solidified; main vents stuck shut; periscope top windows cracked; lookouts could barely hold binoculars (which, anyway, froze over); periscopes were intolerably stiff to turn; and canvas mats (liable to jam the hatch) had to be laid on the bridge deck to prevent watchkeepers from slipping. Visibility clamped down suddenly and the sea alternated from glassy calm, sometimes with a heavy swell which made depth-keeping tricky and quickly ran the batteries down, to high waves during violent storms which blew up quickly and without warning. And in harbour external maintenance routines could not be carried out.

For one reason and another, the achievements of submarines in the Northern Fleet were understandably modest. It is possible that nothing at all had really been sunk in this area by the time that HMS Tigris and HMS Trident started operating from Murmansk in the second half of August 1941. Within a few days the two British ships despatched four German ships for 16,000 tons which made the Russians feel uncomfortable and led them to augment their own supposed successes still further. Even Bevan, on the spot, believed the claims they put forward; and it may be that the Soviet Staff succeeded in convincing themselves that their boats were wreaking havoc with the German communication lines.

The captains of the 'baby' M-class boats consistently showed dash and offensive spirit, according to Bevan, in contrast to the Staff who displayed 'lack of offensive, excessive caution, concentration on minor details and a lack of commonsense, practical sense and foresight...'. Unfortunately, spirit alone at sea did not make up for lack of training which resulted in single torpedoes or very loose salvos being fired, apparently more in hope than in anger. Bad recognition did not help either: M-172 fired two torpedoes at a tanker reckoned to be carrying 8,000 tons of fuel: one torpedo hit, but only because it was running so shallow; the victim was the Vesco of only 331 tons. The British Staff had high hopes for D-3 who was supposed to be using British salvo-firing methods and Bevan was delighted when D-3 claimed four successes between 26 September and 11 October (although he cautiously noted that the last was 'very doubtful'). D-3 actually hit nothing belonging to the enemy but there is reason for inferring, from missing correspondence and signals (which the British—presumably in the interests of good relations—destroyed in entirety) that D-3 mistook Allied ships for Germans. The difficulty in assessing Soviet sinkings can be gathered from the exploits of K-3 (Captain Lt V Utkin) who claimed a 6,000-ton east-bound vessel with one hit from a four-torpedo salvo and the subsequent sinking by gunfire of an armed trawler and an MTB. German records showed that he missed entirely with his torpedoes but had more luck with his guns. K-3 was armed with two 100 mm guns but the small A/S vessel UJ-1708 had only one 88 mm and two 20 mm guns while the other escorts in this engagement had nothing larger than 20 mm weapons. At 3,000 metres—long range for submarine gunnery—a fortuitous hit caused depth-charges on UJ-1708 to detonate and the boat sank. The other two boats, outgunned, retreated behind a smoke-screen. Although the odds were in her favour, K-3 certainly fought a spirited gun-action, something that Soviet submariners were quite good at, but the Commander-in-Chief found this of little interest and only recorded in his memoirs the fictitious 6,000-ton torpedo sinking.

Soviet boats made radio signals freely and the German monitoring service was easily able to establish what submarines were at sea. However, the Germans did not have sufficient A/S craft to counter the threat, which anyway proved small, and radio intelligence therefore had little significance.

By the beginning of 1942 the Soviets had about 30 operational submarines in the northern theatre including six large K-class and
12 small M-class boats. Their successes continued to be minimal but were sometimes rewarded by undeniable persistence: M-173 got into position for an attack no less than five times on one occasion and at last sank MV Blankenese (3,240 tons). The Soviet boats were not afraid of gun duels but these became increasingly hazardous: German reinforcements on the surface and in the air sank K-23, with the Divisional Commander, Captain Second Rank M.1. Gadziev on board, on 12 May, but the Russians continued to trust guns more than torpedoes, probably for the excellent reason that they had little or no idea of how to calculate a DA. This was particularly evident during an attack by K-21 (Captain Lt N. A. Lunin—a Hero of the Soviet Union) on the German battleship Tirpitz during the disastrous passage of convoy PQ 17 to Murmansk. Lunin claimed a disabling hit on Tirpitz and an accompanying destroyer but the Germans did not even notice that an attack had taken place. No amount of evidence has since convinced the Soviet Union that this attempt failed to secure what would have been a most significant strategic victory.

During the winter of 1942-3 five Russian submarines undertook the long trail from Vladivostok to Murmansk via the Pacific and Atlantic. Three of these boats, all S-class, arrived at Rosyth in early January 1943 and were given a minor refit which included the fitting of Asdcis. S-53 and S-56 were able to sail for the Kola Inlet on 1 March with new batteries: but S-54 had to be given a thorough overhaul in Portsmouth Dockyard where the crew were instructed in the use and maintenance of their new Asdic sets together with what knowledge could be imparted about radar in the time available. Dockyard relations were not happy with any of the boats but that was not due to the crews. The attendant, watchful commissars were to blame; the Soviet submariners could have learned so much more without them.

During 1943 the Soviets had as many as 20 submarines at sea in the Arctic area. The M-class ‘babies’ patrolled for between three and six days on station while the larger boats stayed out for somewhat longer but rarely for more than two weeks. Their achievements were unimportant because they aimed, primarily, for any small German naval vessel that happened to come within easy reach and sought no larger targets. German minefields were now protecting their shipping routes and were a significant deterrent to operations against transports and cargo vessels. Mines probably claimed five submarines in September and October 1943 and, while the number of submarine sorties steadily diminished, a handful of relatively invulnerable MTB’s took over most of the operations against convoys.

Shch-421 (Captain Third Rank F. A. Vadyaev) struck a mine while surfacing in the mine-strewn waters. All propulsion was put out of action; but Vadyaev, prompted by the ubiquitous Flotilla Commander, Captain Kolyshkin, raised both periscopes and hoisted diesel-engine covers between them as a sail in the hope that wind and tide would carry the heavily damaged boat out to sea and away from the enemy occupied Norwegian coastline. The improvised rig worked well for some three hours with a favourable wind and tide giving the submarine a speed of about four knots. The wind then changed leaving Shch-421 still in sight from the shore. Reluctantly, the boat was made ready for scuttling and, in accordance with Russian naval tradition, she was cleaned throughout and the brightwork was polished as if for an admiral’s inspection. When all was done, an open Party meeting was held. Those sailors

M-172 (Captain Lieutenant Fisanovich), one of the 205 256 ton M-class ‘baby’ submarines in Northern Waters. More than 200 boats of this class were commissioned between 1934 and the end of the war. They could quite easily be dismantled and shipped by rail and or barge to the Pacific and Black Sea. Twenty-three were probably lost due to enemy action, four were lost by accident (including one sunk off the Caucasuses Coast in March 1943 by Soviet surface craft) and a number were destroyed or dismantled to avoid capture by the Germans in the Baltic. There must have been very little room for the omni-present Division Commander and commissar.
who were not already Party members were accepted into the All-Union Communist Party of Bolsheviks. Soon after this prudent precaution had been taken the rescue boat K-22 (whose navigation had apparently been erratic) at last succeeded in finding Shch-421. After several fruitless attempts to take the stricken submarine in tow with enemy reconnaissance aircraft gathering ominously overhead, the crew were taken off and the boat went down. The Flotilla Commander and the captain left last and in that order. Vadayev went on to command Shch-422, replacing the former captain Malyshov who had been court-martialled for cowardice despite acknowledged displays of courage earlier. The only reference to the latter's court-martial throws a particularly sinister light on the role of commissars in submarines. Malyshov was said to have returned from patrol, on several occasions, with unexpended torpedoes. Senior Political Instructor Dubik reported that there had been ample opportunity to fire them and that the commanding officer 'bore the stamp of excessive, inexplicable caution'. When a new commissar, Senior Political Instructor Tabenkin, relieved Dubik and went on patrol he soon signalled the base asking for recall in view of the captain's palpable cowardice. It seems that the boat's gyro became unserviceable and that the captain, who had been the Division's Navigating Officer, personally tried to repair it. His efforts put the gyro completely out of action. At the subsequent court-martial Malyshov admitted to having caused the damage deliberately 'because he was afraid to carry on with his patrol.' It was said that Malyshov and other prisoners were killed when the building in which they were being held was hit during an enemy air raid. This small fragment of Soviet submarine history makes abundantly clear the reason for commanding officers firing torpedoes extravagantly at small (but reportedly large) targets.

Another example of a commissar's standing was evident after a battery explosion arising from incorrect battery-ventilation procedures in Shch-402 (Captain Lt N (Stolbov). The captain, commissar and most of the officers were killed. Naturally, the Secretary of the submarine's Party organisation, Warrant Officer Yegorov, took charge. The first thing to do, of course, was to appoint a new commissar and Yegorov lost no time in telling the crew that he was taking over himself. Having settled that, he got down to the less important question of who should be the captain. In his new capacity as Commissar it was obviously up to Warrant Officer Yegorov to make the choice and his suggestion that Engineer Captain Lt Bolshakov should move into the vacant post went unopposed. There was never any doubt about priorities; the all-powerful Party invariably came first.

Another Engineering Officer, Karatayev, also saved the day for M-172 whose captain, Lysenko, had been a sound peacetime commanding officer who handled his submarine 'without any glaring errors' but found the strain of war too much for him. One day, returning from patrol, Lysenko mistook a friendly aircraft for an enemy and hastily dived in shallow water close to the coast whereupon the boat hit a submerged rock and stuck there. According to his Division Commander, he immediately panicked and screamed, 'It's a magnet! The Germans have special magnets to attract our submarines. We're trapped!' However, the Engineer Officer, with 'skill and presence of mind', sorted the situation out and made sure the submarine surfaced and reached base safely. Not all engineers were so dependable. When Shch-402 sprang leaks in her external fuel tanks after an air attack, her captain, believing he had plenty of fuel left in the internal tanks, blew everything out of the externals to prevent the possibility of oil slicks giving away the boat's position. Unfortunately, he was wrong. The Engineer Officer had forgotten to fill the internals. A K-class boat had to put to sea and transfer 15 tons of fuel and lubricants. Neither boat was damaged during what was unquestionably a magnificent feat of seamanship; but the Division Commander coldly (and understandably) recorded that 'we have no right to create difficulties ourselves in order to overcome them heroically later.' There was a strong thread of improvisation and dogged perseverance running through Soviet submarine operations during the war and it seems that the engineering specialists, like those in other navies, were generally the most dependable and steadiest men behind these admirable attributes. The Soviet practice of keeping a man in one boat (or ship) for a large part of his naval career — sometimes for many years — probably helped to stiffen many a backbone when a newcomer captain was weak.

One of the submarines which had been given Asdics in Rosyth during her break in the 7,000 mile voyage from the Pacific to Kola put its new equipment to immediate use. S-56 (Captain Lt G I Shchedrin) carried out an Asdic (bearings-only) attack on 4 March 1944 without using the periscope. One hit, blind, was claimed on a 6,000-ton merchant ship although it was not explained how the target was identified. German records show no sinkings on that day but it appeared that Shchedrin handled his boat confidently and competently; and, ultimately, he had more real success than most of his comrades. He became a Hero of the Soviet Union and S-56 was made an Order of the Red Banner Guards submarine flying the coveted Guards Flag. As in all good Soviet boats accredited Party men were the aristocrats of the crew; but when Shchedrin passed the word, during a lengthy counter-attack by
German A S units, that non-Party men could take a rest 'while the Communists hold on', the reports from all compartments were said to have been: 'We have no non-Party men. We shall all stand on watch till the end.' The boats from the Pacific seem, incidentally, to have been more efficient than the rest. It may be that training facilities at Vladivostok, well away from Head Office, were less restricted than in the Northern Fleet and, besides, the winters were rather less severe and somewhat shorter.

Four veteran British submarines, Sunfish, Unbroken, Unison and Ursula, were handed over, after refitting, to the Soviet Navy on loan in July 1944. They sailed for Polyarnoe at the end of the month. A number of British ratings were appointed to help the Russians acquaint themselves with the British boats. Eleven Royal Navy submariners were lent to Sunfish who, it must be said, was not in mint condition after a 250 kg bomb had exploded close alongside (although her condition was certainly not the cause of her subsequent loss).

One British submariner, a Leading Stoker, left a record of his impressions which, shared by all the British sailors sent to Sunfish, resulted in no more than three remaining on board for her voyage north despite threats of severe disciplinary action from the politically minded Admiralty. The Leading Stoker and his companions were distinctly unhappy. There was an immense gulf between Soviet officers and ratings—greater than in any other submarine service including German U-boats with Prussian aristocrats, 'vons', in their wardrooms. The proclaimed Marxist equality for all did not seem to apply to submariners; officers were noticeably more equal than the ship's company! Yet the officers were not outstandingly competent. Professionalism was lacking and there was a distinct reluctance to ask questions and learn how to use foreign equipment efficiently and safely. When filling tanks, for instance, valves and vents were apt to be opened and shut by trial and error whatever advice was offered.

It may be that the Leading Stoker's outlook was unduly darkened by the Russians refusing to accept the rum ration provided for them by the Admiralty as for all British boats. Rum was not strong enough for some of the Soviet sailors who did their best to give it more body by topping up their tots with metal polish (thereby getting through several weeks' issue of cleaning gear in a few days) and vodka had to be hurriedly obtained instead, much to the disgust of the British submariners. However, it was a much more disturbing event which finally decided them that they had absolutely no wish to stay with the Soviet Navy.

It occurred while V-19 (ex-Sunfish) was still refitting at Rosyth. The British Leading Stoker and his Russian opposite number were hooking a chain purchase on to a cylinder head, preparatory to lifting it, when the commissar, in full uniform, stalked into the Engine Room. He pounced on the pair, making it clear by extravagant gestures that in the Soviet Navy cylinder heads were always lifted by hand. For some reason, perhaps because he thought the message was not getting across, he became furious and knocked the British man to the deck. The Russian Stoker put up his arm to ward off a similar blow and, in so doing, knocked off the commissar's cap which fell into the oily bilges. He was promptly arrested and the boat was quickly made ready for sea. When outside territorial waters, the unfortunate man was brought up onto the casing, shot and disposed of over the side.

Submarine V-18 sailed for the North in good mechanical order. She was allocated a safety lane and stayed within it, albeit over to one side. But she was taken for a U-boat and sunk with all hands by an RAF aircraft on 27 July 1944. The Board of Enquiry had no doubt that RAF navigation was at fault. The tragedy did nothing to help Anglo-Soviet relations.

From the end of 1944 until the war finally finished, it seems that the submarines of the Northern Fleet were scarcely employed at all; but in November V-2 (ex-Unbroken with a distinguished career behind her) claimed notable successes in the Barents Sea under Captain Third Rank Y Iosselini. However, the 'unescorted tanker of 3-4,000 tons' which went down to V-2's torpedoes was actually the small Norwegian coaster Stortind of 168 tons; the rather large disparity in size explains why Iosselini had to fire three salvos before obtaining a hit! His other claims, which included a 10,000-ton transport, were not substantiated by post-war analysis. Admiral Kolyshkin, some 20 years after the war, noted, the 'scrupulousness' of Soviet submarine captains in assessing the results of their attacks but went on to acknowledge that the subjective element would inevitably creep in'. This was seen to be true not only in the Soviet submarine service: it happened everywhere to a greater or lesser extent; but Soviet exaggerations were quite unequalled in other navies and almost certainly arose from a mixture of politics and fear—the fear of what failure would cost an individual submariner when he returned to base.

The other Allies were forced to conclude with regret that Soviet submarines in all areas contributed very little to winning the Great Patriotic War. The crews were smart, keen and did their best with old-fashioned equipment, uniformed tactics, inadequate maintenance, poor training facilities and a super-abundance of political control; but the sum of their achievements was not impressive.
The Monstrous Midgets

Secrecy was not the only reason that so little was heard about human torpedoes and midget submarines. Only a handful of men in any navy understood them and they were not conversation pieces. The mini-monsters embodied in one diminutive hull everything about submarines that was most disliked and feared by surface sailors. Most midgets were intended for destroying targets in harbour, alongside a jetty or at anchor: it may have been thought this unsporting habit plumbed the depths of submarine depravity. In British terms, midget operations were definitely 'not cricket'! Nonetheless, the British Navy scored heavily with these craft and the Admiralty was unstinting in recommending decorations for the crews who manned them.

Midget submariners, K-Men, charioters and the like tended to treat naval customs, rank and courtesies with cheerful disregard. The message flashed from HMS X-24 to the battleship Duke of York—'what a big bastard you are'—did little to foster big and little ship relationships. Nor were the extra-curricular activities of German K-men any more endearing to authority: training at Venice in 1943, they played endless pranks which were not calculated to improve Public Relations with the inhabitants of that watery city. Publicity, though, was the last thing that midget submariners sought anywhere. They were perfectly happy to grow up as a race apart.

When Italy entered the war on the side of Nazi Germany, the Royal Navy still dominated the Mediterranean just as it had done for the better part of two centuries. It was now left to Italian Maffe—pigs—to put the situation right for Mussolini.

Two Italian engineer officers, Lieutenants Tesei and Toschi, invented a type of human torpedo in the middle of 1935 and put their plans to the commander of the naval base at La Spezia on 22 October of that year. At a subsequent demonstration Admiral Falangola was much impressed by the tiny submersible which could make three knots for about five hours and, hopefully, dive to 30 or even 40 metres. The operators wore water-tight rubber suits and oxygen masks for breathing underwater, not knowing that oxygen would soon have proved fatal at the craft's maximum depth. During early trials, Tesei had to abandon one of the vehicles and it sank. His first words to the men who fished him out were 'that pig got away again'! The name stuck.

The first attempts in 1940 by the MAS (Motoscafi Sommersgibile) against Alexandria were frustrated. It was probably due to the excellent British intelligence service that the parent submarines Ire de and Gondar were sunk before the pigs, lashed to their decks, could be launched. Early attacks against Malta and Gibraltar also failed, but valuable lessons were learned which led to future victories.

At 0200 on 20 September 1941 six frogmen, wearing improved Pirelli breathing apparatus, climbed out on to the deck of the submarine Scire lying off Algeciras, straddled the three pigs which she carried and set off for Gibraltar harbour. The three craft pressed forward slowly with the operators' heads and shoulders above the water. British patrol craft, dropping random charges into the Bay, were easily evaded. Lieutenant Visintini's approach was typical. When just short of the anchorage, he carefully calculated his position and pushed the control lever forward, taking his mount down to 10 metres. The expected anti-submarine net loomed up ahead but its meshes were so large that the small craft was able to slip through. When safely on the other side, another look above the surface revealed a fat merchant ship silhouetted against the night sky less than 200 metres distant. Edging closer Visintini planed the pig gently downwards until its nose scraped the ship's plates. Feeling his way, he clamped one end of the securing wire to one bilge-keel and then drove the pig right under the hull and up again to attach the other end. With the 300 kg explosive charge held by the wire, he had only to turn a knob and the delayed action fuse was set.

All three crews attached charges to different targets in the same way and then scuttled their craft in deep water before swimming ashore to a Spanish house, the Villa Carmela, that had recently been pre-
pared for them. From start to finish it was a model operation.

The pig-men themselves had no way of knowing immediately what they had achieved. But the Italian propaganda machine could not resist telling the world as soon as intelligence sources revealed the extent of the damage:

"Attack craft of the [Italian] Royal Navy have succeeded in penetrating the Roads and the Grand Harbour of Gibraltar where they sank a 10,000-ton tanker and a 6,000-ton merchant ship loaded with munitions. A 12,000-ton merchant ship loaded with war material was hurled against the rocky coast by the force of the explosions and can be regarded as lost."

The British correctly interpreted the implications: security measures of all kinds were immediately strengthened. Meanwhile, German and Japanese naval experts were much interested and soon started a series of visits to La Spezia, the MAS headquarters, where the secret weapon — no longer quite so secret — was on show.

It was now decided to mount a second expedition against Alexandria. Every effort was made to preserve security and mislead Allied intelligence. On 5 December 1941, the same parent submarine Sciré left La Spezia for the island of Leros where rumours were circulated to the effect that she was damaged and in need of repair. On 14 December, three pig-crews arrived secretly by flying-boat and on the following evening Sciré slipped out of harbour and set course for Alexandria where German reconnaissance had reported that the British 30,000-ton battleships Valiant and Queen Elizabeth were moored. On 17 December CC de la Penne, the leader of the mission, received the order to attack.

Sciré risked a known submarine minefield and surfaced at 2047 on 20 December to launch the pigs no more than one kilometre from the fairway which was heavily patrolled by anti-submarine vessels. There would be ten hours of darkness to complete the operation. Passing fully submerged through the patrolled approaches the three craft were delighted, on breaking surface, to see two warships steaming into harbour. The anti-submarine net must therefore have been lowered: there would be no need to use compressed air cutters. De la Penne was able to lead his team, deep, through the harbour entrance in the wake of these ships without hindrance: he selected Valiant as his own target.

At 2215, as previously agreed, the three crews made contact with each other on the surface well inside the harbour and then set off for their respective targets whose torpedo nets proved no obstacle. Bianci, de la Penne's Number Two, was having trouble with his breathing apparatus and, during the final stage of the attack, was swept off his seat. He swam to a buoy and managed to remain unseen while de la Penne carried on by himself. The 300 kg charge could not be attached to the hull by one man alone so de la Penne dropped it on the sea-bed a few feet beneath the giant keel. He then sank the pig and, unwilling to leave his companion, joined him on the buoy, allowing the British to take them both prisoner.

They were interrogated on board without giving anything away and were sent ashore under arrest. However, at about 0900, when Admiral Cunningham in HMS Queen Elizabeth heard of their capture he ordered them to be returned to HMS Valiant and placed below the water line. The boats of all ships were called away to drop scare-charges and the ship's companies were turned out to rig

Keeping up appearances! Admiral Cunningham C-in-C Mediterranean, directed that the ceremony of Colours, with Guard and Band and himself attending, would be carried out as usual on board his flagship, HMS Queen Elizabeth following the devastating attack by Italian human torpedoes. The hope was that the world would think the battleship was undamaged and the Royal Navy was still supreme.
chain bottom-lines for dragging along the bottoms of all warships in harbour. The bottom-lines revealed nothing (understandably in the case of Valiant) and it is surprising that the British ships did not attempt to shift position in the light of a probability of ground mines: this action would certainly have saved Valiant. Admiral Cunningham noted sardonically that, as time went on, 'the prisoners became very restive'. Eventually de la Penne sent a polite message to Captain Morgan (commanding Valiant) to the effect that his ship was due to blow up in five minutes. The subsequent explosion was punctual and devastating. Four minutes later the Admiral, on the quarterdeck of the other major target Queen Elizabeth, felt rather than heard a dull thud and was tossed about five feet into the air by the savage whip of the great ship as the charge secured to the bilge detonated. There had already been a heavy explosion under the tanker Saguna which also severely shook the destroyer Jervis.

Investigation revealed a hole 40 feet square under the foremost boiler room of Queen Elizabeth. All steam was lost for 24 hours and submarines had to be secured on each side of the stricken battleship to provide power. Valiant's damage extended over 80 feet, including the keel.

Six brave men had put two battleships, one destroyer and a valuable tanker out of action and radically changed the balance of power in the Mediterranean within the space of a few minutes. None of the operators was lost although they spent the remainder of the war in prisoner-of-war camps. Once crew swam ashore and nearly avoided capture altogether despite some difficulty in changing an English £5 note in Egypt; but they were finally arrested on 23 December by a policeman in Rosetta.

When the war, for Italy, was finally over in March 1945, the Italian Crown Prince awarded de la Penne his country's highest decoration, the Medaglio d'Oro: it was pinned to his breast by none other than Vice Admiral Sir Charles Morgan, the man whose ship he had disabled more then three years earlier.

Winston Churchill, Britain's Prime Minister, took careful note of the spectacular Italian success. In a memorandum to the Chiefs of Staff dated 18 January 1942 he wrote:

'Please report what is being done to emulate the exploits of the Italians in Alexandria Harbour and similar methods of this kind . . . At the beginning of the war Colonel Jefferis had a number of bright ideas on the subject which received very little encouragement . . . One would have thought we should have been in the lead . . .'

The Navy was, in fact, already engaged in producing self-contained midget submarines (X-craft). The production of human torpedoes, based on an Italian machine salvaged at Gibraltar, was now started in parallel. The British Chariot was, like the Italian Maiate, basically a slowed-down torpedo driven by batteries, with a detachable warhead. Number One of the two-man crew who straddled the machine steered and controlled it submerged; Number Two assisted him in negotiating anti-submarine nets and in fixing a time-fused charge to a target.

The task of providing a breathing system for the riders was given to the newly formed Admiralty Experimental Diving Unit where many of the divers, says a report, 'were taken to the point of unconsciousness and convulsions . . . Diving with a closed-circuit, oxygen apparatus and with a built-in carbon dioxide absorbent unit to avoid tell-tale bubbles, was not an enjoyable occupation. Pure oxygen was dangerous below 30 feet (although that was not fully appreciated then) and if sea-water reached the absorbent it effervesced, forcing a corrosive ‘cocktail’ down into the diver's lungs. Cold water, too, made life unpleasant for the Charioteers. Although British crews scored successes in Norway their major triumphs were in the warmer waters of the Mediterranean and Pacific where the climate was a good deal kinder to the poorly protected operators in their frogman suits.

By way of return for the damage that the pigs had done earlier, British chariots sank three Italian cruisers and damaged other vessels at Palermo and La Spezia in 1943 and 1944. The last attack, on the Bolzant (which the Germans had taken over when Italy abandoned the Axis and joined the Allies), was a joint British-Italian effort.

Charioteers in the Royal Navy were not accredited to the Submarine branch. Indeed, the submarine arm was by no means anxious to promote chariot carrying and recovery duties gravely interrupted normal
British 'chariot' (Mark I) being floated from a submarine.

'Chariot' attack by Lt Greenland RNVR and Leading Signalman Ferrier on the Italian cruiser Ulpio Traiano in Palermo harbour on 3 January 1943 (from the painting by D A Rapkins).

HMS Trooper alongside HMS Titania in Loch Cairnbawn with chariots out of their containers for inspection. Three T-class submarines were fitted with containers and chariots with the intention of attacking the Italian battleships at Taranto. The three, Trooper, Thunderbolt and P-311 sailed in November 1942 direct for Malta, passing Gibraltar at night to avoid watching Axis spies who were very active in the area. The Italian battleships changed their base to Naples and alternative targets were chosen at Maddalena, Cagliari and Palermo but the loss of P-311 in the area, probably from mines, resulted in Palermo only being attacked. Five chariots were launched from Trooper and Thunderbolt on 2 January 1943 but only two penetrated the harbour; the other three broke down. The liner Viminale (8,500 tons) was badly damaged and the new cruiser Ulpio Traiano sunk but three limpet mines were removed from the hulls of three destroyers before they could explode. Thunderbolt carried out a later operation against Tripoli harbour with partial success but chariot operations not only caused the loss of P-311 but diverted submarines from their more valuable task of operating against the Axis supply line to North Africa.
This collection of Koryu midgets assembled at Kure gives some idea of the importance which the Japanese Imperial Navy attached to midget submarines. The two torpedo tubes were muzzle-loaded by large supply submarines or other vessels. These craft had immense potential although it was never developed. Great thought was given to the design, which was far in advance of other navies', with particular emphasis on control surfaces to counteract the rotating effect of the single propeller's torque at the exceptionally high speed of 14 knots submerged which could be maintained for one hour. A crew of five were well supplied with equipment which included a hydraulic system and a raisable radio mast. The welded construction was only fair but it is extraordinary that the Western Powers discounted this excellent design because, with a range of 1,380 miles on the surface, it could have been—and could still be, if brought up to date—a very powerful weapon. It is more than likely that the Soviet Navy gained full details of this important but inexpensive weapon.

patrol activities at a time when there were many valuable targets at sea on the Axis supply routes to North Africa. Submariners also felt that, directly or indirectly, two T-class submarines had been lost on chariot operations due to their being obliged to surface and launch them dangerously close to the enemy coastline.

Japan, meanwhile, had very little luck in waging dwarfish underwater warfare. The Japanese midgets and human torpedoes—Kairyu, Koryu and Kaitens—were manufactured in great quantities and made numerous gallant attempts to prove their worth; but they were not effective. The reason was tragically plain: they were suicide weapons which Italian and British craft emphatically were not. It was not technically difficult to fly an explosive aircraft into a ship during a straightforward Kamikaze attack requiring minimal flying skill and no thought beyond the honour of dying for the Emperor; but it was quite another matter to control a human torpedo or midget submarine over a long period in the unpredictable, rapidly changing tactical situations common to any type of underwater operation. It must, above all, have been extremely difficult to concentrate on accurate navigation when certain death lay not far ahead.

The Japanese expected the US Navy to attack their harbours with midgets or human torpedoes and ingenious underwater defence ports were built into old ships scuttled for the purpose: Tokyo itself had three of them. But, despite having originated the idea some 170 years earlier, American submarine authorities did not pursue it: they had no need to and it would not have been in character. This was, perhaps, best evidenced by the US Navy's insistence that boats were manned by submariners and not submersers—the latter pronunciation (as used in the Royal Navy) suggested, it was felt, that they were sub-standard mariners.

British X-craft, the first of which was laid down in September 1941, were built originally with one clear purpose—to destroy the German battleship Tirpitz ('The Beast' as Churchill called her) lying holed up in a Norwegian Fjord where no other kind of vessel could reach her.

X-craft were quite different to Chariots. They were perfect submarines in miniature, about 60 feet long with an average hull diameter of six feet. Although towed by full-sized submarines to the target area, they were thereafter entirely independent and capable of operating for several days on their own. Endurance was only limited by crew fatigue.

X-craft proved to be exceptionally powerful weapons of war but so little was known about them that they deserve some explanation.

A midget was divided into four compartments. The battery was right forward. Then came the diving lock known as the Wet and Dry Compartment which also contained the WC, a cramped, hand-pumped, hazardous and very public inconvenience; it could not, by any stretch of imagination, be called a comfort station. The Control Room amidships was the largest section of the craft; and a diesel engine filled the tapering stern.

From main-vent hand-levers to the electric switchboard everything was ingeniously scaled down. Taking command of a midget for the first time was rather like being given a new toy train for Christmas. A battery of small cells fed the motor which gave a maximum speed submerged of nearly six knots. The designers placed a bunk right forward on top of the battery whose cells fizzed merrily on charge. Even if the bunk's occupant managed to avoid trailing a sleepy hand across the terminals below him, he was sure to wake up with lungs full of battery gas and a splitting headache. Anyone off watch usually preferred to sleep on a foreshortened couch in the control room or coiled around the periscope. There were two crews—one of three men for the exhausting period under tow and the other of four for the actual operation.

The passage crew had an unenviable job. Their craft was submerged for most of the tow during which they had to make sure that
everything was on top line for the operational team who would have, naturally, most of the excitement and rewards.

The Operational Crew were, of course, exposed to most of the dangers but the passage crew were not without a few of these themselves. If the heavy tow-ropes parted, for example, its weight could take the craft straight to the bottom. On tow the craft oscillated gently up or down through a hundred feet or more; it was unwise to try towing submerged in shallow water! At two hourly intervals the towing submarine called the passage crew by telephone—if the telephone worked. Its cable was wrapped inside the tow rope; a few contortions of the latter when leaving harbour were enough to ensure that communications would be non-existent for the remainder of the tow. Life thereafter became a series of surprises. Every six hours, the midget was brought up to ‘guff through’, changing the stale air by raising its induction mast and running the engine for ten minutes—or longer if the battery and air bottles had to be re-charged. In rough water this was a miserable, unwelcome interlude despite the fresh air.

For much of the time the passage crew worked hard. In northern waters this at least helped to keep away the cold—a damp, grey almost tangible variety that no kind of clothing could keep out. There was, needless to say, no galley. A carpenter’s glue-pot in the control room served as a double boiler and for a day or so some attempt was made to cook meals. The first four tins which came to hand were emptied into the glue-pot, heated and stirred into an unidentifiable potmess. It was not an attractive meal but its memory remained until the next ‘guff through’; the odour of potmess pervaded the craft and condensation trickled drearily down the inside of the pressure hull. It was difficult to be truly thankful for food in these circum-

Top Right
A Japanese two or three-man Kaira’ midget. This version carried two 21-inch torpedoes externally and a suicidal warhead in the bow if required. The torpedoes were angled astern at 35 degrees by bevelled wedges on the torpedoes themselves which fitted into tapered slots built onto the hull. Displacing 20 tons, this Kaira’ had a maximum diving depth of 330 feet (100 metres). The second periscope in the three-man version was raised by band and it seems likely that the original purpose of the type seen here was for training with a ‘teacher’ embarked.

Bottom Right
A Biber (Beaver) on the surface with the conning tower open.
stances but one Engine Room Artificer, whose gratitude could only be admired, knelt to say an aggressive grace before and after each meal. Appetites dwindled rapidly after the first day. Cooked food, biscuits, oranges, apples, coffee, tea and fruit-juice were rejected one by one—usually in that order.

There was a more popular way of going from one port to another in the UK. The complete craft was small enough to be loaded onto a railway truck. Rail was the quickest means of transport from one shore base to another and far more tolerable than a tow although it gave rise to some unlikely situations. The crew travelled with their craft and soon found that railwaymen were a congenial crowd, quite willing to accede to midget submariners' eccentric whims and wishes. Trains were known to stop for the crew to shoot pheasant or refresh themselves at favourite hostleries en route. It was not always easy to persuade the railway police, when returning from one of these sorties to a marshalling yard in the middle of England, that a few innocent sailors were simply rejoining their submarine on a railway siding.

Unfortunately there were no friendly railway lines to Norway or Singapore where the most important operations took place.

In hostile waters, when the passage crew had paddled back in a rubber dinghy to the towing submarine, the operational crew slipped the tow and settled themselves into the positions they would occupy for the next two days or more. Under cover of darkness the captains stayed on the casing while making best speed on the 42 hp Gardener engine which properly belonged to a London bus. By first light it was hoped to be within about ten miles of the objective so that the craft could submerge for the remainder of the approach. At this point the induction mast was lowered; all gash ditched; the position fixed as accurately as possible; and the gyro compass checked against the sun. The captain then lowered himself through the hatch and pressed the diving klaxon.

Diving depth was nearly as good as that of a larger submarine despite the craft having glass viewing ports above and at either side of the command position. External shutters could be drawn across these scuttles, from inside the craft, in the event of depth-charging. The controls were hydraulic and practically everything could be worked from the First Lieutenant's position at the after end of the control room. Course and depth had to be held precisely (within a degree and a few inches respectively) and the captain, when manoeuvring under a target, often required the craft to go astern or to stop suddenly and rise or descend vertically for a few feet. The trim was tender; a plate of potmess and cup of coffee passed from aft to forward could cause a bow-down angle.

Navigation looked crude; but it had to be extremely accurate. There was no space for an adequate chart-table and the chart had to be folded. It was soon sodden with condensation and the compass-rose was invariably on the wrong fold.

When approaching an anti-submarine net the diver had to struggle into his suit. It was a tiring performance in the cramped space forward of the periscope and he was helped by the captain and the helmsman. He then retired to squat, in solitary state, on the heads in the Wet and Dry compartment. When the time came, he pumped water into the lock from an internal tank to avoid upsetting the delicate trim. The water flood-
ed slowly up and over his person until it reached the top of the compartment when, water being incompressible, the pump savagely exerted its energy on each and every compressible portion of the diver's body and flattened his breathing bag. This phenomenon, experienced in solitude and utter darkness, was known, without affection, as The Squeeze. He then had to equalise pressure inside and out, open the upper hatch and haul himself up onto the casing. A S nets were made of thick wire-mesh interlacing steel rings suspended from tell-tale buoys which gave away their position to midgets trying to get through. The time of entering a net was planned, ideally, so that the craft would oppose the tide. This enabled the captain to manoeuvre into and through the net at about 25 feet with the least possible disturbance while still maintaining full control of the craft. If the tide changed the craft was liable to be swept broadside, and perhaps inextricably, into the barrier. For cutting wires the diver used an hydraulic gun which fired a toughened steel blade against an anvil in a hook which made the tool look something like an outsize tree-pruner. It was all too easy, especially in numbingly cold water, to amputate a finger without even noticing its loss. He started by climbing down the net as far as the X-craft's keel and, from that level, cut a slit upwards in each successive strand so that the craft gradually pushed its way through while he flattened himself on the casing before crawling back into the lock.

It was best to go deep—below the keel depth of the target—when about 600 yards away. As soon as the Captain, craning his neck to see out of the upper glass scuttle, glimpsed the target shadow like a huge black cloud overhead, he ordered the motor to be put astern so as to stop directly underneath. With no movement ahead or astern the craft was then pumped very slowly up until it rested, like a fly on the ceiling, with the three special antennae which were raised for that purpose against the enemy's hull. Alternatively it hovered or rested on the bottom while releasing its weapons.

There were two types of weapon. Two large side-cargoes strapped on either side contained either a quantity of limpet mines (sometimes stowed in the casing) for attaching individually to the target or two tons each of high explosive with a variable time fuze; these huge delayed action mines were laid directly beneath the enemy without needing the services of a diver and without necessarily coming up against the hull.

After an attack the captain did not linger. The risk of detection increased with time and it was uncomfortable to be around when limpets or side-cargoes detonated. Then there was the long journey out to the rendezvous point; an exchange of recognition signals; and finally the welcome reappearance of the passage crew.

German heavy ships based on Norway seldom ventured out into the Atlantic; but the possibility of their doing so and the carnage they could then cause amongst Russian convoys forced valuable battleships of the British fleet to remain on guard in Scapa Flow. By 1943 they were much needed elsewhere, particularly in the Far East. The greatest threat which tied them down—Tirpitz—had to be eliminated. September 1943 found her securely berthed in Kaa Fjord.

Six midgets set out from Scotland for the lair. They were towed by standard sub-
marines and stayed submerged for most of the long passage. One craft simply disappeared; on surfacing one night the towing submarine found the tow-rope hanging loose with nothing on the end. Another was forced to jettison its explosive charges, one of which exploded correctly after the maximum time delay but still severely damaged the retreating midget. A third reached the outer fjord but was suffering mechanical problems. Its Australian captain, Lieutenant Ken Hudpeth, reluctantly turned back so as not to put the entire operation at risk: it was morally a gallant and selfless decision. X-5 (Lieutenant H Henty-Creer) apparently reached the inner fjord but was probably sunk by gunfire before reaching her objective.

X-6 (Lieutenant Donald Cameron) and X-7 (Lieutenant Godfrey Place) were the only two craft to reach the target. By the early morning of 22 September both were approaching the inner defences—an anti-submarine net at the entrance to the fjord and a triple line of anti-torpedo nets closely surrounding the battleship.

At about 0400 X-7 passed through the gate in the A/S boom but was forced deep where, blind, she tangled for an hour with an unoccupied anti-torpedo net, putting her trim pump and gyro out of action. At 0600 she was on her way again, precariously trimmed at periscope depth. Meanwhile Cameron in X-6 was having trouble with his periscope which had flooded and was virtually useless. Determined to gain his objective at any cost he surfaced to pass through the A/S boom gate, conning through the short net-cutting (or 'night') periscope, diving again when safely past. Both craft fouled the A/T nets but after 'wriggling and blowing' and 'some extraordinarily lucky chance' they groped their way into the lair:
the compasses in both had by now gone off the board due to sundry collisions, groundings and steep angles.

X-7 hit Tirpitz at full speed at 20 feet below B turret. Place let the craft slide gently down below the keel where he went astern for an estimated 150 to 200 feet and let go the port charge approximately under X turret. Cameron in X-6 was snared in one more obstruction which forced the craft up to the surface again close on the battleship's port bow where he was greeted with a brisk fire from hand grenades and small arms—he was much too close for the big guns to bear. Realising that escape was impossible, he destroyed the most secret equipment, went astern until X-6 was scraping the giant hull abreast B turret, released his charges and scuttled the craft. As he started to sink, a power boat from the battleship came alongside to take off the crew but were too late to stop the craft following her charges to the bottom.

Tirpitz had a Ship's Company of 2,500, displaced 42,000-ton, mounted eight 15-inch guns along with 96 smaller weapons and was sheathed in armour 15-inches thick. At breakfast-time on 22 September 1943 HMS X-6 and HMS X-7, each with four men inside their fragile, half-inch pressure hulls, slipped four two-ton delayed action mines beneath the pride of the German Navy at her moorings. 'The Beast' never put to sea again.

But X-craft did. Not content with sinking ordinary ships they quickly added a floating dock to the mounting score and then turned their attention to affairs in the Far East. On 26 July 1945 XE-1 and XE-3 set out under tow for Operation STRUGGLE to attack Japanese cruisers berthed off Singapore with priority being given to the 10,000-ton Takao.

Before setting off the crews were addressed by Admiral Fife USN whose flag HMS Bonaventure, their depot ship, happened to be flying. 'Jim' Fife, the senior American submariner in the Pacific, was a great supporter of the British 14th Submarine Flotilla (XE-1—XE-6) commanded by Captain W R Fell RN. British reserve was somewhat shaken when he barked, at the end of his address: 'You’re the little guys with a lotta guts. Good luck!'

Neither XE-3’s diver, Leading Seaman ‘Mick’ Magennis, nor his captain, Lieutenant ‘Titch’ Fraser, realised just how much luck they would need when they paddled across from the towing submarine Stygian with the other two operational crew-members to take over from the passage crew some 40 miles short of Singapore in the early morning of 30 July. They slipped the tow and went on alone at 2300 that night. Fraser found the Singapore harbour net boom open and passed through in dangerously clear, shallow water without being seen despite the proximity of a Japanese Boom Defence Vessel. At one stage XE-3 inadvertently bottomed on a mine but luck held and it failed to explode.

Their real difficulties started when Fraser tried to position his craft beneath the cruiser. There was too little space beneath the target—even for such a small submarine as XE-3—and the tide was falling. There was no room to open the hatch fully for the diver, let alone to raise upright the folding antennae which were supposed to ensure a clear three feet beneath the top of a craft and the bottom of a target.

No X-craft diver’s job was easy; but Magennis in XE-3 had the toughest task of any. He found the awkwardly sloped hull covered in weed and heavily encrusted with barnacles. These had to be scraped off with a knife and although the six limpet mines which he extracted from the port side-cargo container were slightly buoyant it was hard work attaching their magnetic pads. It took him half-an-hour to do so; and by the time he wriggled his way back into the craft he was near to collapse. A slow leak from his oxygen set did not help and he was barely able to shut the hatch behind him.

Fraser turned the release wheel inside the craft and the starboard side-cargo fell away onto the sea-bed under the cruiser. He then turned the other handwheel and assumed that the port container had also freed itself. XE-3 now found herself tightly wedged between the hard sea-bottom and the menacing hull above. Sub-Lieutenant Smith, the New Zealander First Lieutenant, worked the motor full ahead and astern, flooding and blowing tanks for 50 minutes. Eventually his increasingly desperate struggles extricated the craft from its precarious position alongside a huge quantity of time-fused high explosive. Fortunately, the Japanese did not hear the commotion or notice XE-3 break surface momentarily when it finally pulled free; but Fraser’s problems were by no means over. For some reason the empty port limpet carrier had failed to jettison and it was making the craft impossible to control. Magennis, despite his exhausted condition, immediately volunteered to go out and clear it. After seven minutes work with a large spanner he persuaded the side-cargo to drop clear and XE-3 was able to head back over the obstacle-course of harbour defences for the pre-arranged rendezvous with Stygian. Fraser’s crew had been in action continuously for 52 hours. Operation STRUGGLE was well named!

Takao was damaged beyond repair and the threat of her eight-inch guns to Allied troops planning to advance along the Singapore causeway was annulled. Magennis and Fraser, like Cameron and Place, were awarded the Victoria Cross.

X-craft were extraordinarily versatile. Amongst other diverse sorties they severed the underwater telephone cables linking Japanese-occupied Hong Kong, Singapore and Saigon. This obliged the enemy to revert to radio communications which could be intercepted and deciphered by Ultra units. It was an exceedingly valuable operation.

In the West, X-craft were given an even more unlikely task. Two were selected to act as beach markers for guiding amphibious DD tanks to British-Canadian landing areas at dawn on D-Day.

Invasion planners knew that if the X-craft failed a vital part of the invasion forces might never land on the narrow strips of beach that shelved gently enough for the cumbersome amphibians to crawl ashore: and if they were discovered the whole invasion might be jeopardised. The boats chosen were X-20 (Lieutenant Ken Hudspeth who had been forced to turn back from the Tirpitz attack) and X-23 (Lieutenant George Honour who had exceptionally long command experience).

On the night of Friday, 2 June 1944, the pair put out from HMS Dolphin, the submarine base at Gosport. They were escorted by a tug and trawler past the Isle of Wight where, parting company, they dived. Their subsequent experiences were similar: X-23’s are followed here. Except for a one-hour battery-refresher during hours of darkness, Honour and his crew motored southerly, submerged, at an average speed of three knots to a point off what was to be SWORD Beach close to the mouth of the River Orne at Ouistreham. They arrived at dawn on Sunday, 4 June.

The crew, besides Honour, consisted of the normal First Lieutenant and ERA but two COPP (Combined Operations Pilotage Party) specialists in beach-landings were also embarked: one of these was a qualified navigating officer. When the position had been precisely fixed by bearings, Honour let go a small anchor and bottomed.

X-23 came stealthily to the surface at 2300 to listen for a pre-arranged radio signal from Niton on the Isle of Wight and to 'gull through', changing the air. The beach by night looked dangerously close. Honour reflected on the code name for their part in these activities—Operation Gambit. He had checked gambit in the dictionary: as he darkly suspected it referred to a move in a
game of chess where 'a pawn is sacrificed for position'. Whoever named X-craft operations had a sardonic sense of humour.

The expected radio message duly arrived while the craft lurched and plunged to its an anchor in an increasingly heavy sea that swept over the casing. The coded signal told Honour that Operation OVERLORD would be delayed. It did not say for how long; but the weather made the reason obvious. There was nothing for it but to dive back down to the bottom, play a few rounds of singularly vicious liar-dice and go to sleep. This pause in the proceedings came as a relief to one of the COPP party who had suffered agonies of sea-sickness on the surface.

On Monday night X-23 came up again to learn that the landing was now due on the following day. At 0530 on Tuesday, 6 June Honour surfaced finally. The sea had moderated and he was able to prepare his craft for the job in hand. A mast, 18 feet high with a green light shaded to landward, was hoisted to signify that X-23 was in her correct position; a radio homing device was also triggered and an underwater sonic beacon switched on. A red and white international flag H ('I have a pilot on board!') proudly announced HMS X-23's qualifications; and Honour prudently added, in case anybody should mistake the craft for a German U-boat, a huge White Ensign of a size normally issued only to battleships.

The incoming fleet appeared from the north exactly on time. It was an impressive sight. Invasion craft clustered trustingly around X-23 and poured their canvas-clad DD tanks into the water. Honour watched with awe and sincerely hoped that the enthusiastic amateur sailors in khaki understood the Rule of the Road at sea. The tanks, as if on a parade ground, sluggishly formed up in line abreast and chugged their way towards the beach. Two of them sank on the way but their crews (rather pessimistically) had been provided with submarine DSEA (submerged escape) sets and no lives were lost. Honour and Hudspeth watched for a while from their respective vantage points at either end of the beach before being taken in tow by the trawlers assigned to them and changing over with the passage crews. When they eventually got back to the base at Gosport they were indignant to find nobody willing to believe that two midget submarines had spearheaded the invasion and been first off the beaches.

Meanwhile, there was frenetic midget submarine activity on the German side.

By the Autumn of 1943 the German Navy was in a poor state. The Atlantic tide had turned against the U-boats in the spring and was now running strongly in favour of the Allies. An invasion of Europe was clearly imminent; but neither the regular U-boat arm nor the German surface fleet was in any shape to meet the threat. In desperation, Dönitz turned to human torpedoes and midget submarines as one means of defence during the forthcoming crisis. The German Naval Command had, up until now, rejected this kind of underwater warfare; but the damage inflicted by the Italian 'pigs' and British X-craft, especially the outstandingly successful Tirpitz operation, heavily influenced the decision to create a new naval commando unit, to be called the Kleinkampf-mittel-Verband (small battle-weapon force or 'K-force'). It was composed of explosive motor-boats, frogmen, human torpedos and small submersibles inspired by British fragments dredged up from Kaa Fjord. All were produced amidst an air of urgency that amounted almost to panic.

The K-force was hastily conceived, inadequately equipped and poorly trained; and its assorted craft were flung into the fray long before they were ready for combat. But if the K-men achieved little of real significance it was not for want of trying. They had, essentially, the same independent, super-ificially irresponsible character as Italian and British charioters and midget submariners. Indeed, in seeking to become a select Nelson 'band of brothers', a stated aim of their commander Vice Admiral Heye, they went further towards non-conformity than their opposite numbers by discarding all badges of rank.

Human torpedoes were cheap, easy to produce and, by adapting existing Type G7e torpedoes, the Neisers or Niggers, as they came to be called, needed no precious raw materials. On 10 March 1944 Dönitz, in Berlin, sent for Lieutenant Hanno Krieg, a promising young U-boat commander whose boat had been put out of action in Pola harbour by enemy bombing. As usual, Dönitz came straight to the point. A single prototype one-man torpedo awaited trials at Eckendorf; all trials must immediately be completed and ten complete weapons made ready within four days. They were then to be transported to Italy, fully prepared for action, within a fortnight. Further Allied landings at Anzio behind the German lines in Northern Italy were expected hourly and it was here that the Niggers, launched from the German occupied coastline to the south, were to be baptised. The Admiral had one more thing to say as Krieg turned towards the door: 'I can spare no U-boat men...'.

Looking back on that remarkable interview it is difficult to believe that Dönitz, with his unequalled experience of underwater warfare, really believed that the K-force could be anything more than a diversion. But desperate measures were called for. None of the General Staff any longer believed that the Allies could be altogether stopped; but any conceivable means of hindering their advance was worth putting to the test.

A Nigger was basically two modified type G7e electric torpedoes. One, a range-reduced weapon to save weight, was slung below the other converted to a carrier. The pilot sat, sheltered by a perspex dome, in a small cockpit which replaced the warhead in the carrier fish. He had a start-stop lever, a column for horizontal and vertical rudders (although none of the models was able, in practise, to submerge completely) breathing apparatus, a compass and a handle for firing the weapon-torpedo which started automatically when released from the two-clamp cradle which connected it to the carrier. Drinking water and concentrated food tablets were also stowed in the cockpit. The aiming device consisted of a graduated scale marked on the canopy and a spike striking up from the body to serve as a foresight. The weapon was, in every sense, cheap and nasty. The carrier's endurance (there and back) was 12 hours at four knots (six knots after the torpedo had been fired).

In theory, especially to shore-based tacticians, the Niggers seemed attractive. They were quick to produce (the all important factor), capable of inflicting appreciable damage and there was a real chance of the pilots coming back. The first snag arose when it was discovered that they were very difficult to launch from the shore: 500 (admittedly reluctant) troops only managed to push 17 out of 30 Niggers into the sea for initial and wholly unsuccessful operation in Italy. When one eventually settled in the water a pilot was made too low down to see properly and any oil on the surface smeared the canopy and made him blind. Potential targets were thus almost impossible to evaluate; and aimed off was more a matter of luck than good judgement. For the same reason it was difficult to take avoiding action and, being unable to dive fully, a pilot had no defence if sighted. As one pilot gloomily remarked, an enemy motor boat had only to 'come alongside, remove the canopy with boat hooks and strike the pilot. The torpedo would then fill with water and sink!'

In vain endeavours to distract the omnipresent opposition milling around the invasion landing areas a number of canopies were painted to simulate the head and shoulders of a pilot; these dummies were floated off on the tide but did not decoy the
Commander Richard Compton-Hall MBE, RN (ret'd) is Director of the Submarine Museum at HMS Dolphin, the Royal Navy's submarine base at Gosport. He commanded three submarines, including an X-Craft, and had extensive experience in RN and USN nuclear submarines, also serving for two years with the US Navy's Submarine Development Group at New London. He is the author of over 1000 articles and TV and radio programmes, amongst them the 'Leading Stoker Bootle' comedy series set in a submarine. He is a regular consultant to international publishing houses and broadcasting authorities, a member of the Translator's Society and speaks fluent French.

**Back of jacket:** Lt R G P Bulkeley, First Lieutenant of HMS Tribune, looks forwards through the for'ard periscope. As captain of HMS Statesman, he was awarded the DSC for his aggressive patrols against the Japanese. (Credit: Imperial War Museum.)

**Front of jacket:** View from the bridge of HMS Tribune running on the surface in Scottish waters. One of the famous T-class submarines, HMS Tribune saw service in the Atlantic, Norway, the Arctic, Biscay and the Mediterranean, her career including the PQ17 convoy operation, landing agents in Corica and surviving a deadly depth charge attack off the Isle of Capri. (Credit: Imperial War Museum.)

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*Top*
A German Neger being winched out for trials.

*Centre*
A German Molch awash in harbour showing how easily such craft could operate in tight spaces.

*Bottom*
A German Biber being taken alongside a launch.

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