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Smart Mining without Smart Mines - Second World War British Operations in the Baltic

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Introduction

In the latter years of the Second World War the British secured a very considerable victory over the last important German naval effort. This is hardly known about now in even quite enlightened historical circles. The reasons for this can be speculated about later. What is clear, however, is that the potential of an important series of technological breakthroughs by the Germans in submarine warfare was not achieved and this was largely, if not entirely, as the result of well informed and intelligent application of force to the problem. In particular the defeat of a new and revolutionary type of submarine was achieved in large part not by technological wizardry of the same order but by the humble and often overlooked mine.

A Debate

But this was not necessarily understood by all even then. Two important voices can be brought to bear against the hypothesis in the opening paragraph: Grossadmiral Dönitz and Frederick Barley. The first will be a familiar name but most will not recognise the second¹. His worth lies in being one of the authors of the seminal Admiralty Naval Staff History on the Battle of the Atlantic². It would thus appear that these are both candidates to be listened to: principal victim and most authoritative chronicler.

What Dönitz writes is that;

... success was achieved in keeping the mining carried out by the enemy in the Baltic to a small degree of significance for the maintenance of U-boat training, as there were enough available deep water areas

in the eastern Baltic. Only when the military situation in early 1945 compelled the surrender of the eastern Baltic and evacuation of the U-boat bases there did the mine danger increase considerably. For with growing number of new boats in training at home, the sea area in the eastern Baltic became without doubt not only in quantity but also, on account of the lack of depth, in quality a hampering factor in the training and preparation for operations. In the last two months of the war therefore ...³

This statement would appear uncompromising as a rebuttal of the British Baltic mining campaign having any significant effect. However, Dönitz's claim should be carefully scrutinised.

Support for Dönitz appears to come from Barley:

Fleet and U-boat training, which had taken place in the Baltic since the beginning of the war, proceeded virtually unhindered until 1941. From 1943 enemy [British] minelaying precluded exercises in the deep water to the east of Bornholm. From 1944 the ever-increasing danger from enemy [British] mining and air activity progressively interfered with fleet and U-boat training. Owing to the shortage of surface escort forces and other small forces and because of dwindling fuel supplies, newly commissioned [surface] warships had to be employed operationally without having been fully trained.

U-boat training was practically unaffected until 1943. After that there were some interruptions and losses of U-boats and U-boat personnel through enemy mines in deep as well as shallow water. Yet until the situation in the East deteriorated we were able to maintain the requisite amount of U-boat training⁴.

Barley continues in what appears to be more nearly his own views:

To sum up, from blockade or 'bottling up' mining, few kills can be expected in the course of a war, and it cannot be relied upon as a method of appreciably reducing the U-boat menace. At no time in the 1939-1945 war was the passage of U-boats seriously affected by this form of mining. Mining never closed the U/B bases or the Baltic. Its chief effect was a reduction in the time spent on operations due to extra precautions and this effect was becoming progressively smaller as the endurance of U-boats was increased.

This experience of 'bottling up' mining is confirmed by British experience of enemy mining on the East Coast of England in both World Wars. Few ports or shipping routes were closed for more than 48 hours even at the height of the enemy's minelaying campaign in 1939 to 1941⁵.

But there is an opposing view. Patrick Beesly notes with the advent of "three Paymaster Lieutenants of above average intelligence" that it became possible for the Operational Intelligence Centre (OIC) of the Admiralty to become expert in German swept (that is minefree) channels and any movements along them. This was not only an Admiralty effort but also one by the Naval Section at Bletchley Park, the British codebreaking establishment⁶. What Beesly stop short of saying, however, is what effect there was if any on the German war effort, especially the submarine campaigns, other than noting that the Germans had to pay an ever-increasing bill for mine clearance.

So where does the balance of truth lie on this subject - were mines important in limiting the waning but still considerable power of the German Navy, most especially in the Baltic? In order to evaluate the matter it is necessary to start not in the eastern part of Europe in 1945 but rather in the mid-Atlantic in the middle of 1943.

The German quest for a better submarine

In May of 1943, Dönitz and his groups of submarines - commonly known as wolfpacks - were effectively defeated by the Allies in the open ocean. Contrary to some opinions this was not attributable to a single cause but rather to the cumulative effect of a number of factors such as escort numbers and proficiency, the use of aircraft, equipment development and intelligence⁷. What cannot be doubted is that the German *U-bootwaffe*, equipped with competent but limited submarines such as the Types VII and IX were no longer able to operate effectively where they had before. This is hardly surprising as these were not markedly better than the submarines which the First World War had been fought. Indeed, they were not really submarines at all and had to make extensive use of the surface to move, find targets then attack them. These U-boats were probably better considered as submersible torpedo boats.

In the short to middle-term a series of expedients were adopted. These included in approximately sequential order:

- Attempting to attack convoys on different routes such as the direct USA-Mediterranean one. This failed largely because of poor German intelligence and strong escort forces together with an aggressive US posture of attack groups making good use of small aircraft carriers.
- A number of equipment measures including better anti-aircraft armament, radar detectors and the Schnorkel. The first two were largely negated by Allied tactics and the latter improved survivability but severely limited tactical mobility for the submarine. None of these, separately or together, resulted in any worthwhile progress towards regaining supremacy.

- A change in mid-1944 to an inshore campaign using single submarines and virtually no two-way communication. Although this improved submarine survivability somewhat and resulted in some Allied loss of shipping it did not produce results on the scale desired and needed by the Germans.

The Germans were far from complacent about the situation and this was combined with both a degree of priority and the technological competence that this nation has often demonstrated. This was manifested in the various submarines designed by Professor Walter. These took a radical approach to propulsion utilising a hydrogen peroxide propulsion plant capable of delivering high underwater power. There were, however, important disadvantages. Firstly it was very complex and it proved unreliable to the point where a practical operational submarine could not be produced. Secondly the fuel was inherently dangerous⁸. The Walter submarine in itself does not directly concern this account but it does have a part to play in what transpired⁹.

What happened was that the Walter boat proved too radical to promise the prospect of being a practical, far less a war-winning, weapon, at least in any realistic timescale. However, the Walter designs comprised far more than just a high-performance power plant. The submarines included powerful electric motors, high-capacity batteries and a hull designed for optimum performance underwater rather than on the surface.

So it was decided to go ahead with the construction of new submarines which took many of the features of the Walter boats but not the hydrogen peroxide plant. These promised nevertheless a huge advance in underwater performance with the potential to be able to close a convoy, attack and withdraw, all underwater. Further an underwater speed either equal to or faster than most escorts appeared to be practicable. The designs of these submarines proved to be the basis of submarine developments in most of the more advanced nations in the postwar years¹⁰.

Radical Changes to Submarine Production

Changes to submarine design were indeed radical but there were also similar efforts made in the production of submarines. This was to some extent because of the effect of bringing Albert Speer, the Armaments Minister into the system¹¹. Not only were many existing working practices considered inefficient but so too was the whole system of submarine production which was traditionally based. In this, sub-contractors produced small components, most of which then went directly to the shipyard for installation. In some cases, such as main engines, these would go to the large component manufacturer, who in turn

would send their product on to the shipyard. It was there that final assembly would take place (see Figure 1).

Under the new system, there was still a considerable body of sub-contractors but instead of large component assembly there was a system of assembling sections of the submarine. There were eight of these split vertically along the length of the submarine and much of the sectional assembly was carried out inland. The completed sections were then moved to shipyards for final assembly¹² (Figure 2). There are several observations worth making at this point. Firstly, the change in system was not brought about by any response to any Allied action of which the most obvious one would have been bombing, especially of industrial targets. Rather it was because of an attempt to streamline and accelerate the building of submarines. Nevertheless it might be argued that the overall system was probably at least as vulnerable - if only potentially - as the old one had been. Secondly although promising efficiency and faster delivery of the new boats there were sometimes significant difficulties not present in the old system. One particular one was that there were very fine tolerances in the dimensions of different sections so that they could be readily joined to their neighbours. Lastly there is the matter of the British observation of empty slipways in early 1944. At the time some authorities wanted to attribute this to bombing against the building facilities but it is probable that the transition to the new building methods is a more likely explanation¹³.

German Submarine Construction - Old

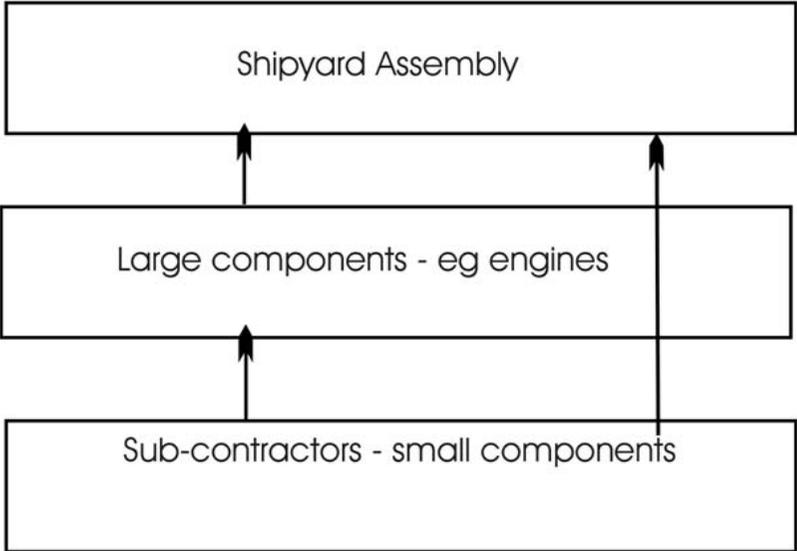


Figure 1

German Submarine Construction - New

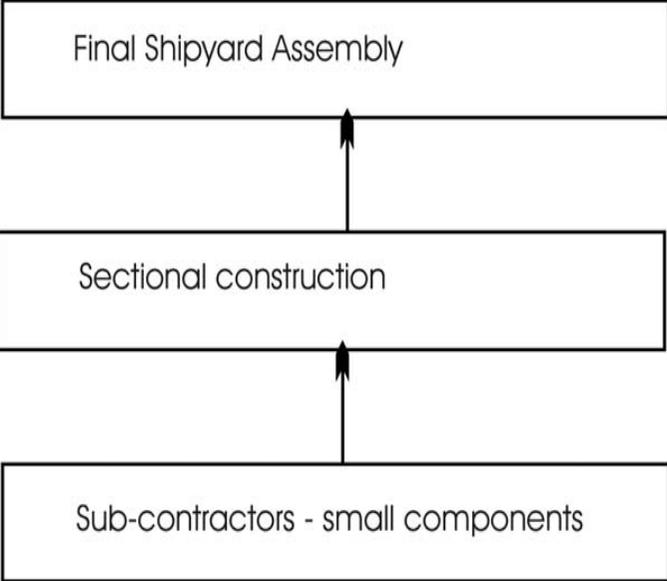


Figure 2

The advent of the Type XXI

Whatever the difficulties for the Germans there is little doubt that they managed to produce a large number of capable submarines in a relatively short period of time. It is probable that about 120 Type XXI submarines had been completed and commissioned by the end of the war in Europe (Figure 3)¹⁴. Approximately half that number of the similar but smaller and less capable Type XXIII had also been commissioned by that time but this paper will confine itself to the Type XXI.

Type XXI Commissioned

Cumulative Total

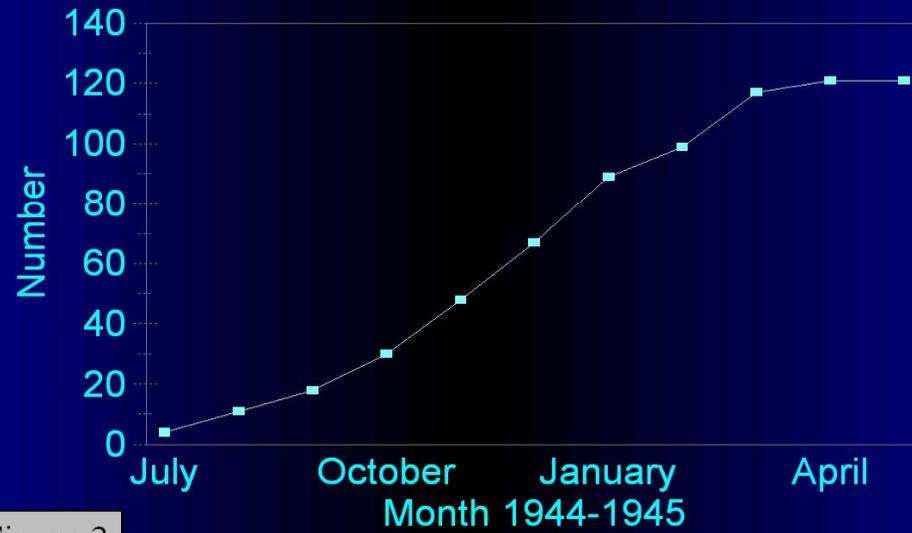


Figure 3

But between commissioning and operational service lie a number of barriers. Any ship or submarine which is a new class, even one less revolutionary than the Type XXI, needs a series of trials to evaluate its capabilities and limitations, and to iron out any faults either endemic to the class or applying to individual hulls. As well as trials it is necessary to train the crew so that they can operate the submarine safely and successfully and, finally, as the potent weapon of war that the submarine should be. It is very clear that the German Navy understood these processes well and there is every indication that these were steps which they never stinted on, even under the pressures of war, and even when they were clearly losing the war in which they were engaged. It is difficult to establish the time which the combined trials and training period ought to take but they were assessed by the Admiralty in late 1943. There they gave a figure of “up to six months” for trials and training¹⁵. If this was a maximum then about four months would seem to be right for an average submarine. But this is a figure based on observation of the older Types VII and IX submarines and on relatively little interference in the activities by the British. In 1944-1945, the following factors might be considered to lengthen the process somewhat:

- Unfamiliarity with the new types of submarine (the Learning Factor)
- Problems associated with the deteriorating German situation in the war (Internal Interference)
- Specific action by the British to disrupt trials and training (External Interference)

It is obviously difficult to try and disentangle these factors but some attempts can be made.

The Learning Factor

Some 120 Type XXI submarines were commissioned: only one sailed on an operation before the end of the war¹⁶. This was a poor return for the great investment of resources involved. When it is considered that the first submarine was commissioned as far back as June 1944, nearly a year previously, the transformation to operational service seems inordinately long. The only submarine to be operationally effective, U-2511, commissioned in late September 1944, suggested a period of about 7 months in trials and training. At this point a total of about 18 other Type XXIs were in commission.

What this suggests is that the minimum number that should have been on operations at this point was that number. A number of other figures based on varying training times might be considered to suggest the number that should have been available without taking account of the other two factors.

Type XXI Submarines - Predicted Operational May 1945			
Training Time			
8 Months	7 months (U-2511)	6 months	4 months
11	18	48	89

Table I

This suggests two things. Firstly that the 6-8 month curve is relatively steep and that the Germans may therefore have been on the verge of actually being able to deploy quite significant numbers of Type XXI boats. Had the war lasted perhaps as little as two months longer then the Type XXI could have been a real rather than an illusory threat. But this, of course, is counterfactual as is the larger scale conjecture that a longer European war would have led to the first deployment of the atomic weapon against Germany rather than Japan¹⁷.

The other surmise would be to attempt to estimate more nearly the number of boats that would have been deployed without Interference (Internal and External) as defined above. It is fully understood that an element of Internal Interference (the deteriorating German situation in the war) was as a result of Allied action and it is a very difficult to tease out the contribution made by, say, bombing of oil-related targets. What can be said, however, is that if the measure adopted is that of commissioned submarines then the oil target problem will probably already have had its main effect in slowing production, transport and assembly. There remains the possibility that shortage of oil actually inhibited Type XXI operations but there is little to suggest that conjecture. Submarines, in any case, consume relatively little fuel and there is little on the German naval side to suggest that fuel shortage was a direct problem for submarine operations¹⁸.

It can be suggested that the order of Interference effect would probably have denied the Germans between 10 (the 8 month figure) and 30 (a conservative interpolation between the 7 and 6 month figures) submarines. If further the Internal/External share is considered to be equal then the credit due to specific British action is probably in the order of 10 operational submarines. Intuitively this is probably kinder to the Internal Interference cause than it probably deserved. In any case losing the service of at least 10 of these very capable submarines is a very worthwhile outcome.

The Baltic Mining Campaign

So what form did specific action take? Essentially there was only one measure adopted: mining in the Baltic. Some characteristics of this have to be mentioned at the outset: firstly the strategic situation caused by the presence of both nations at the Baltic approaches under German occupation. This rendered mine laying by surface ships or submarines impossible and there was only one possibility left - air minelaying.

The second problem concerned the efficacy of any mining campaign. There can be few types of warfare in which there are more problems of determining probability. This is a constant of warfare. If, for example, claims made by fighter pilots, anti-aircraft gunners and submarine captains should always be treated with scepticism and some form of independent verification. But these problems are much worse for both mine warfare and mine countermeasures. From the miner's perspective, there are questions, perhaps most marked when laid by air, of placement and mine reliability. But the even greater difficulty lies in determining success. How does a miner know, especially when deploying mines in remote areas what success has been achieved? A prudent miner will also assume that the enemy is not sitting still and will attempt to sweep recently laid mines. Again on the other side of the coin, in any realistic context what guarantee has a body in mine clearance have that all mines have been swept? But probably the greatest difficulty lies in the matter of knowing what success has been scored by individual mines. Unlike "instant" weapons such as bombs, bullets and torpedoes (which have their own imponderables) a mine may not be actuated for days, weeks or months, if at all.

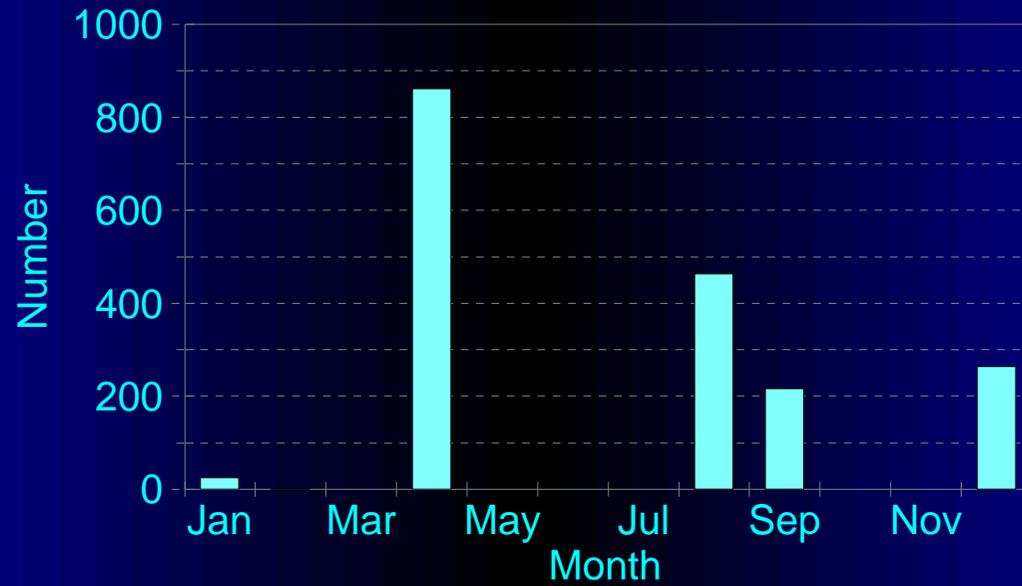
Even then this makes it very difficult for a miner to know what fields have been successful, which have been successfully countered by the enemy and which ought to be resown. Even in home waters this can be difficult and the element of the enemy being able to remove the mines has been removed from this equation. A good example of this were the antisubmarine mines laid by the British in the Northwestern Approaches to the United Kingdom in 1944-45 and elsewhere, the success of which was not fully known for several decades¹⁹.

Considered annually there were never more than 500 mines laid in the Baltic until after 1943²⁰. There were perhaps several limitations which precluded greater numbers being laid in this period. These might include: the paucity of suitable aircraft to carry a sufficient load to the area of the eastern Baltic, typically to the German exercise areas off the Bay of Danzig; the other demands made on such aircraft, normally 4-engined bombers, and a limited understanding of the effectiveness of such a campaign. A further factor would probably have been the lesser imperative of stopping the German offensive close to its source - something that was brought on by the concern about the possibility of the Type XXI coming into operational service²¹.

What becomes clear, however, is that the earlier part of 1944 saw a considerable increase in the effort applied to mining the Baltic. The first two months saw very little effort indeed with 25 and 2 mines laid respectively although this slight effort may have been affected by the weather conditions with ice being at least as much as a problem for the Germans as it was for the British. March saw no mines laid at all but April was a different matter indeed with no less than 861 laid. There was a further surge in August, September and December (see Figure 4).

1944 Minelay - Baltic

Monthly Profile



The decision to intensify the campaign

It would be tempting to think that the April peak in minelaying was a direct response to the advent of the Type XXI, but the first did not commission until the summer of that year. However, knowledge of this submarine did predate the commissioning and it is possible that any attempt to step up the mining campaign may have been informed, if not totally, stimulated by such intelligence.

One indication comes from a correspondence beginning on 12 February 1944 and involving the following:

- Deputy Director Operations Division Mining (DDOD(M)), Captain J S Cowie
- Assistant Chief of the Naval Staff (UT) (Anti U-boat warfare and Trade Protection), Rear Admiral J H Edelsten
- Assistant Chief of the Naval Staff (Home), Rear Admiral E J P Brind
- Assistant Chief of the Air Staff (Operations) (ACAS(Ops)), Air Vice Marshal W A Coryton

DDOD(M) then minuted ACNS(UT) copying it to ACNS(H) noting that there were some 200 U-Boats in the Baltic and that immediate steps should be taken to disrupt them. He further noted the development of radar and Pathfinder techniques which would allow mining carried out from altitude and through cloud. He concluded that an intensive British mining campaign would be effective in countering submarines. Cowie also used the politically clever point that any such effect would also bear on the activities of submarines in the period prior to the invasion of northwest Europe, planned for that summer²².

The gist of this was used in a letter from ACNS(H) to ACAS(Ops) on 17 February adding the further advocacy of the First Sea Lord to the case²³. ACAS (Ops) responded on 29 February noting several competing claims on Bomber Command including reduction of the German Air Force and support of the Special Operations Executive (SOE) but nevertheless providing a degree of assurance about Baltic bombing. He also noted the degree of demotivation in mining aircrew caused by the non-publication of mining results²⁴. It might reasonably be assumed that there were two reasons for this:

- The difficulties alluded to earlier of determining mining results.

- The likelihood that the information on minefield success probably came from Ultra intelligence and although the correspondence in this file was all “Most Secret”, Ultra was never directly referred to despite the fact that all officeholders concerned were almost certainly cleared for access to such material²⁵.

This last point is almost certainly alluded to in the last item of correspondence when ACNS(H) assures ACAS(Ops) of the value of Baltic mining whilst acknowledging that the sensitivity of intelligence information precluded fuller details being given²⁶. Whether such a piece of appreciation was the most significant factor in implementing the massive April minelay seems unlikely ever to be known, but happen it did.

Minelaying Operations

In April 1944 the Baltic minelaying campaign took a huge leap forward with no less than 861 mines being laid in the Western Baltic²⁷. On 9/10 April, for instance 47 Lancaster aircraft of Bomber Command laid 187 mines off Gdynia and a further 56 laid 120 mines off Danzig and 164 off Pillau (Baltiysk). Almost all of these were laid from high-level using H2S centimetric radar for navigational guidance, a technique that had been developed recently. By doing so accuracy was increased, the enemy was less alert and aircraft casualties reduced²⁸. Although this was before the first of the Type XXIs was commissioned, it is interesting to note the impact of the minelay:

Air Ministry Intelligence claimed that no less than 40 per cent of German naval personnel were now employed on minesweeping and escort duties but that after a heavy [mine]lay the minesweeping forces were unable to cope expeditiously with the sweeping of the necessary channels. They claimed that after this operation Danzig Bay was closed to traffic for 15 days and the ports of Königsberg and Pillau for 13 days.

Captured German Naval records show that this mining operation undoubtedly caused considerable disruption in the Gulf of Danzig but this appears to have had a more acute effect on U-boat training, torpedo firing and so on, than on the actual movements of shipping²⁹.

A similar, if reduced, scale of minelaying was seen in August, September and December with 463, 216 and 264 mines respectively³⁰. Again results were significant. At the end of August, for example, when 171 mines were laid in Danzig Bay, although a patrol craft and one submarine, U1000, were sunk, there were other, more important consequences:

When therefore the presence of hostile aircraft was noted over the Danzig Bay area on the nights of 26/27 and 29/30 August all U-boat training areas and the shipping routes from Kiel were closed.

Sweeping located only a few mines and it was assumed that a new variety of firing assembly had been incorporated. This necessitated meticulous sweeping with strict convoying and meant unavoidable delay in re-opening any of the U-boat training areas. To anticipate the narrative, on 6 September Admiral von Friedeburg, who was responsible for all U-boat trials and training, reported that the mine situation in the gulf of Danzig was preventing him from carrying out trial schedules, particularly those concerned with the new Types XXI and XXIII. He urgently requested the clearance of at least the U-boat Acceptance area which lay close off Hela as well as provision for adequate mine escort for U-boats proceeding via the compulsory routes to this area. The only outcome was that on 8 September a part of the deep water technical training area was re-opened but with the restriction that U-boats must keep at least 50 metres (162 feet) of water under the keel.

More hostile aircraft were detected over the Gulf on the night of 15/16 September [75 mines laid] and no other parts of the training area were re-opened until:

20 September	-	The Acceptance area off Hela
24 September -		Part of the general torpedo firing area but restricted to keeping more than 50 metres under the keel
1 October -		Part of the C.O's torpedo firing area but restricted to a diving depth of 35 metres (114 ft.) ³¹

What this demonstrates is the effect that mining had on the process of bringing submarines up to frontline service, an effect that was worthwhile, economical and - considered cumulatively - reasonably long-lasting.

The Application of Intelligence

What has been clearly established now is that mining of the Baltic submarine trials and training areas was both economical and effective. A further point was the large amount of force tied up by the Germans in countering this relatively small-scale effort³². Beyond that there were some losses to German shipping: surface warships (including mine countermeasures vessels), merchant ships and even the occasional submarine. But the main importance remained the large-scale disruption to the German advanced submarine operational programme. What has not been quite so evident is the role of intelligence.

There have been several hints dropped outside of the main documentary evidence of the relationship between intelligence and Baltic minelaying, most especially by Patrick Beesly³³. However, the main evidence must be found in the papers of the Naval Intelligence Division itself.

This largely falls into two categories: evidence of knowledge of the German view of the Baltic and mining, and a late monograph on the subject. The former, it is clear, is not just

confined to one period of time but rather indicates a thorough knowledge of German trials and training areas, and German perceptions of minefree routes³⁴. It includes, for example:

- Index of Reference Points and Swept Ways
- Baltic Swept Ways
- Exercise Areas in the Gulf of Danzig
- Changes in U-boat exercising areas in the Baltic
- U-Boats in the Bornholm Area
- Fleet Anchorages

There are some uncertainties expressed, generally positional as “possibles and “probables” but the general impression is of very comprehensive knowledge and no suggestion that the Germans suspected that the British knew as much as they did.

The monograph does not make its provenance totally clear. However it is written on Operational Intelligence Centre form paper indicating two important things:

- That it is unlikely to have been written later than the end of 1945 as the OIC was abolished at the end of the war
- It was probably written by someone who was a practitioner of the art of operational intelligence described in it

It is a large document notwithstanding the use of double-spaced typing - 21 pages of large format paper and a few points made in it are described below³⁵.

It mentions, for example, the deliberate tactic of simultaneously mining two well-separated points in order to place the maximum possible strain on the minesweeping forces³⁶. It was noted that these and other minelays had a marked demoralising effect on the Germans³⁷. But the implications of these operations were not just irritating and bad for the German psyche. They had material effects other than the ones noted earlier in this paper. An illustrative instance of this occurred in March 1945 when British action resulted in lack of minefield

escorts for “main units [submarines, large transports and other warships]” operating in Danzig Bay³⁸.

The production of intelligence is dealt with to some extent, too. It is made clear, that this very useful product was the result of many sources of intelligence, a skill which the Operational Intelligence Centre had to a large extent perfected during the course of the war. Captured documents were of use, as was photo-reconnaissance and observations from adjoining countries. The British Naval Attache in neutral Sweden, for example, was able to interview masters of neutral merchant ships involved in supplying U-boats and although the latter went to some lengths not to display their identities by submarine number, they had used them when signing for repairs and bunkering. The amount of fuel taken on in the latter operation often indicated the difference between a boat continuing in training or about to start an operation³⁹. But what the monograph also indicates is the importance of “Special” or what has become known as Ultra.

A clear list is given of items which Ultra gives the only reliable indication. These include:

- Casualty details
- Effects on routes and harbours - resultant disorganisation
- Sweeping difficulties
- Accurate convoy routes and deviations therefrom⁴⁰

The Sounds of Silence - Historiographical Obscurity

One of the oddities about this campaign is the way in which it has been little known, if not totally obscure. There are some good reasons for this. The first is that the mine has often been and possibly still remains an undervalued weapon. Its design, laying and sweeping are not glamorous activities. Indeed the nearest approach to excitement and allure is probably the business of mine disposal and the dangerous activity of trying to find out how an enemy's new mine design works. There is good reason to mark and acclaim the activity of those who have undertaken this tedious, uncomfortable and dangerous activity over the decades but the real significance of minewarfare lies elsewhere. Secondly there are good reasons why this

campaign had little or no publicity either at the time or in the years immediately after the Second World War. This lies, of course, in the sensitivities of Ultra.

There was slight mention of the Baltic in some of the standard official and other histories prior to 1974 and the publication of Winterbotham's The Ultra Secret⁴¹. Another authoritative but Ultra-innocent account is given by Alfred Price in 1973⁴². After 1974 there was some revelation of the importance both of the Baltic mining campaign and Ultra's role in it given in the intelligence official history⁴³.

It is probable, however, that mining - in a similar fashion to another lesser-regarded but important subject, operational research had slid back into the mists of obscurity by the time that the Ultra revelations were being made⁴⁴.

But perhaps the greatest historiographical irony concerns Captain J S Cowie who wrote a book shortly after the war on minewarfare⁴⁵. This comprehensive survey of the subject is distinguished by barely mentioning the Baltic during the Second World War. This is understandable in its time but considering the important role played by Cowie in the events that unfolded during the war, it seems somewhat unfortunate that it has taken over 60 years for its and his significance to be understood.

Conclusion

What emerges from this study is that there was a very real risk to the Allies from the German new generation submarines, and that the undoubted potential they had was almost completely neutralised. This was achieved not in the open Atlantic, not in the littoral waters around the United Kingdom and Ireland where German submarines had been operating with limited success from the middle of 1945 but rather in the Baltic. Nor was it achieved by overwhelming military might - Brute Force - to use the title of John Ellis' book⁴⁶. Instead it stands as a model example of an effective campaign - effective at the strategic level - carried out with a minimum of force. It was an intelligent and intelligence-led outcome which deserves to be much better known than it has been in the past.



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1. United Kingdom, The National Archive (subsequently TNA) ADM 223/708. Freddy Barley was one of the authors of the seminal British naval staff history “The Defeat of the Enemy Attack on Shipping”. Barley, Freddie and Waters, David; The Defeat of the Enemy Attack on Shipping: a Study of Policy and Operations; (London, Historical Section, Admiralty; 1957) 2 Vols; also (London, Navy Records Society, 1998) - See also TNA ADM 234/578.
2. See latter reference in Note 1.
3. TNA ADM 223/688 NID 1/GP/10 of 21 September 1945 “Essay by Grossadmiral Doenitz on the War at Sea”, Appendix 1, para 4 (extract).
4. TNA ADM 223/708 Undated “British offensive minelaying vis-a-vis the German minesweeping organisation and the effect of German minesweeping requirements on U-boat production” Annexe, page 2. There is a little doubt as to how much of this is attributable to Barley and how much to Kapitan sur See (sic) Kupfer.
5. TNA ADM 223/708 Undated “The effect of British minelaying on German U-boats during World Wars I and II” page 6.
6. Patrick Beesly; Very Special Intelligence: the Story of the Admiralty’s Operational Intelligence 1939-1945; (London, Green hill Books and Mechanicsburg PA, Stackpole Books; 2000) page 97.
7. For a full treatment of this complex area see W J R Gardner: Decoding History: the Battle of the Atlantic and Ultra; (Basingstoke, Hampshire; Macmillan and Annapolis MD; Naval Institute Press, 1999.
8. It is probable that the loss of the Russian submarine KURSK in 2000 was caused by an accident in a hydrogen peroxide-fuelled torpedo.
9. A fuller account of the Walter boat can be found in Eberhard Rössler; The U-Boat: the Evolution and Technical History of German Submarines; (London, Arms and Armour, 1981); Chapter 6.

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10. For example, MccGwire, Michael and McDonnell (eds); Soviet Naval Influence: Domestic and Foreign Dimensions; (New York, Greenwood Publishing Group, 1977); page 152.
 11. Rössler 214.
 12. TNA ADM 223/41 Pre-Fabricated U-Boat type XXI – Method of Production and Rössler Chapter 8.
 13. TNA ADM 223/320 Harris (CinC Bomber Command) to Rushbrooke (Director of Naval Intelligence) 7 March 1944.
 14. Axel Niestlé; German U-Boat Losses During World War II; (London, Greenhill Books, 1998 pages 159-171. There is some uncertainty about exact numbers.
 15. TNA ADM 223/320 NID 08710/43 of 29 November 1943 page 19.
 16. TNA ADM 234/68 Diagram 28.
 17. Harry Hinsley; “The Enigma of Ultra” in History Today (September 1993), page 20.
 18. TNA ADM 223/691 Essay by Rear-Admiral Hans Meyer on the War at Sea, para 56 notes the oil shortage but makes no specific mention of submarine operations.
 19. Some may still be unknown.
 20. Unless noted otherwise all statistics are drawn from TNA ADM 234/560 and/561 British mining operations 1939-1945: Vol 1 and 2.
 21. As late as the spring of 1944 the realisation of the Type XXI was perhaps not fully apparent to the British. There was then an ambiguity in the interpretation of the “empty building slips”. See Note 13.
 22. TNA ADM1/15708 ACNS(UT) UT41/44. DDOD(M) to ACNS(UT) of 12 February 1944 paras 1-3.
 23. TNA ADM1/15708 ACNS(H) to ACAS(Ops) 17 February 1944.
 24. TNA ADM1/15708 ACAS(Ops) to ACNS(H) 29 February 1944 para 5.
 25. One of the intriguing sidelines in the extant records is a fleeting mention of an “In the Know” book kept by NID10 in which people signed to indicate knowledge of Ultra. It also states that A V Alexander, the First Lord of the Admiralty (the political head of the Navy and equivalent of the US Secretary of the Navy), refused to sign on the grounds that his oath as a Privy Councillor was more

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- binding. Other research indicates that Alexander did see some Ultra material. TNA ADM223/469 "In the Know Book" (Pages not numbered).
26. TNA ADM1/15708 ACNS(H) to ACAS(Ops) 7 March 1944.
 27. This does not include another 496 being laid in the area of the Kattegat, Kiel, the Sound and Belts. TNA ADM 234/560 page 481.
 28. TNA AIR41/48 page 445.
 29. TNA AIR41/48 page 445.
 30. TNA ADM 234/560 page 481.
 31. TNA AIR41/74 page 135.
 32. There is more than a little irony here that this adverse balance for the Germans was coincident with their own simultaneous espousal of a "tying down" philosophy for the continuing use of the U-boat arm despite significant losses. This was first stated on 31 May 1943 and given a numerate rationale nearly a year later. TNA ADM 116/6080 Fuhrer Conferences on Naval Affairs 1939-1945, translated from captured German naval archives: minutes of staff meetings between Hitler and various commanders - 31 May 1943 and ADM 234/68 p62 citing BdU Diary of 15 June 1944. For a commentary on this rationale, see W J R Gardner (cited as John R Gardner) "ASW Victory - Resources or Intelligence" in *Service historique de la Marine; Les marines de guerre du dreadnought au nucléaire* (Service historique de la Marine, Paris, 1988); pages 341-2.
 33. See above and Endnote 6.
 34. For example see TNA ADM 223/2 and 3 (1941 and 1942), and ADM 223/6 (1944 and 1945).
 35. TNA ADM 223/209 Photocopies of papers cited in History of Intelligence 1939-1945 Vol 3 Pt 1; The Role of Special Intelligence in Bomber Command's Minelaying Campaign in the Baltic.
 36. Ibid page 13.
 37. Ibid page 16.
 38. Ibid page 17.
 39. TNA ADM 223/489 page 70.
 40. TNA ADM 223/209 page 19.

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41. Winterbotham, F W; The Ultra Secret; (London, Weidenfeld and Nicolson, 1974) and Roskill, S W; The War at Sea; Vol 3 Part II; (London, HMSO, 1961); page 141 which contains an intriguing footnote,

The author considers that the effects of our minelaying were previously underestimated. Though actual sinkings of U-boats by mines were few, the cumulative effects of the minelaying campaign were greater than was first believed.

The significance of this observation is strengthened by two things: the footnote being attached to maintext which reads,

...the delays caused to training the crews of new U-boats , and to trials of new types, were particularly favourable to our cause.

and the undisclosed fact that Roskill knew about Ultra when he was writing the book.

42. Price, Alfred; Aircraft versus Submarine: the evolution of the anti-submarine aircraft, 1912 to 1972; (London, William Kimber, 1973); page 218.
43. Hinsley, F H; Thomas, E E et al; British Intelligence in the Second World War: Its Influence on Strategy and Operations; Vol 3 part II; (London, HMSO, 1988), pages 483-484.
44. For an account of the effect of historiographical chronology on operational research see Jock (W. J R.) Gardner; "Blackett and the Black Arts" in Peter Hore (editor); Patrick Blackett; Sailor, Scientist, Socialist; (London, 2003, Frank Cass); pages 126-7.
45. J S Cowie, Mines, Minelayers and Minelaying, (Oxford, Oxford University Press, 1949).
46. John Ellis, Brute Force, (London, Andre Deutsch, 1990).