BRITISH ANTI SUBMARINE TACTICS 1926-1940

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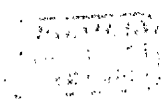

ABSTRACT

Most of the published literature on the 1939-1945 Battle of the Atlantic follows the line established by the official historian, S W Roskill, that overconfidence in the Asdic submarine detection system led the inter-war navy to assume that the submarine menace had been mastered. The argument continues that this led to a neglect of anti submarine tactics, especially in defence of merchant ships, between 1919 and 1939, and on the outbreak of war in 1939 the Royal Navy was forced to improvise and develop tactics. It is also argued that the German use of surfaced night attack, against which there was no effective countermeasure, was unexpected.

This thesis examines the development of tactics from 1926 to 1939, drawing on official and private contemporary sources. It aims to determine whether the Royal Navy made proper and effective efforts to study the tactics and strategy of potential enemies, and whether appropriate exercises and trials were devised to counter the anticipated threats. It also aims to establish whether the information so gleaned was properly disseminated within the navy and to associated government departments. Finally, wartime experience is studied to establish the accuracy of the predictions and the actual effectiveness of the measures which were devised.

It is established that much work was done on anti submarine tactics and that, by 1939, trained and experienced specialists were in place to provide operational commanders with tactical guidance. The view of those who understood anti submarine matters was that the Asdic sensor did not allow ships to sweep even small areas of water clean of submarines, but that it would allow a ship within about ten miles of an accurately reported submarine to hunt that submarine with a fair chance of success. In the specific matter of surfaced attack the dissertation argues that the RN was aware of the threat but the state of technology prevented an effective countermeasure until the introduction of radar.

A study of the first nine months of the U-boat war shows that where a U-boat revealed itself by attacking or allowing itself to be seen on the surface in the vicinity of Asdic fitted ships, there was a good chance of it either being destroyed or damaged.

It is concluded that an organisational weakness in the structure of the Naval Staff meant that the strategic planners and operational staffs were under the impression that Asdic would allow offensive searches of wide areas of ocean, and as a result of this misconception ships which might have been more effectively used for convoy escort

were directed to largely unprofitable patrolling operations. This was in spite of the fact that the anti submarine experts at sea and in the tactical development organisations, having worked hard to optimise Asdic tactics in the inter-war years, were aware of the limitations of the equipment.

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"History has shown time after time the fatal results of basing Naval or Military strategy on an insecure line of communications. Disaster is certain to follow, and our present policy is heading straight for disaster, and it is useless and dangerous in the highest degree to ignore the fact. If we do not recognise this fact, and shape our policy accordingly, it is my firm conviction that we shall lose the war"[1]

"Despite the Experience of the First World War that had made clear the lethal potential of German undersea warfare, and the buildup of Nazi military might in the 1930s, the British and American anti submarine defences were inadequate and their weapons virtually useless. Seen in this light the final victory over German aggression and technical skill was a major triumph"[2]

"Not one exercise in the protection of a slow mercantile convoy against submarine or air attack took place between 1919 and 1939"[3]

INTRODUCTION

During the First World War the German submarine campaign against British trade in the Atlantic came very close to bringing Britain to its knees. It became evident to the Royal Navy, and to the country as a whole, that the methods being employed against submarines were unsatisfactory, and after an extended debate the system of convoy was introduced. This was substantially successful, and reduced massively the rates of losses to submarines. Parallel to the development of convoy, and other anti submarine tactics, came investigations into weapon systems, sensors, suitability of platforms for anti submarine work, and a debate about the efficacy of conducting forward defence by bombing the U-boat bases. Many works have been written about the period 1914-1919, and in matters of anti submarine warfare over the period little controversy remains.

[1] Jellicoe, as First Sea Lord, to the War Cabinet, ADM 1/8480/36 "The Submarine Menace", 21/2/17.
[2] Edwin P Hoyt, *The U-boat Wars*, Robert Hale, 1985.

When the Second World War started in 1939 Britain very quickly found its trade routes once again under attack from a rebuilt German submarine service. The Battle of the Atlantic lasted from the first to the last months of that war and saw much inventiveness in tactics, strategy and materiel development.

There is a widely held belief that the inter-war years were wasted by those sections of the Royal Navy which were charged with responsibility for anti submarine warfare. This school holds that there were no properly formed plans to introduce convoy in 1939 and the navy as a whole believed that the introduction of Asdic, initially developed but never operational during the first war, had robbed the submarine of its advantage of invisibility. The submarine menace, they argue, was thus considered to have been mastered, and detailed analysis of anti submarine tactics could be dispensed with; as a result of over confidence in Asdic, therefore, little or no work was done to prepare to defend against submarine attack.

The first fully authoritative works to be published covering the inter-war period were S W Roskill's two volumes on "Naval Policy Between the Wars". Roskill had achieved great success in his official history of the war at sea, during the writing of which he was allowed unattributable access to unreleased official papers, and through this had achieved an oracular status among those interested in the naval history of the period. That status remains, deservedly, largely in place today. When Roskill wrote, then, that "not one exercise in the protection of a slow mercantile convoy against submarine or air attack took place between 1919 and 1939"[4] this seemingly extraordinary assertion was taken, without question, as fact. Subsequent writers have been content to quote this as the final word on the period. One thus emerges with a picture of an inter-war navy which, having developed Asdic, was content to ignore anti submarine matters and get on with the rather more entertaining business of cocktail parties and battle fleet exercises. When war comes, and the Germans make a submarine attack on Atlantic trade, the navy is to be found blowing dust off 1919 documents, learning how to do it all again, and doing extraordinarily well under the circumstances. Clearly there have been some more reasoned analyses than this, but the broad gist remains consistent. Peter Padfield, for instance, talks of the Royal Navy's "neglect of the necessary protection for merchant shipping against submarine – and indeed air – attack". He finds that "Undoubtedly, faith in Asdic played its

[3] S W Roskill, *Naval Policy Between the Wars*, HMSO, London, 1968, vol 1, p536.
[4] Ibid.

part."[5] As evidence of this neglect, he goes on to cite Roskill's contention that no exercises in the protection of slow convoys took place between the wars.[6]

John Terraine[7] makes the same quote from Roskill, and goes on to allege that the Admiralty was "hypnotised" by the success of Asdic, calling on Roskill for further substantiating evidence. Willem Hackmann[8] also cites Roskill's "Not one exercise..." statement but concedes that "There is some evidence, however, that the Admiralty did consider this problem and conducted at least one slow convoy exercise." In common with Vice Admiral Sir Arthur Hezlet[9] he notes that a 1932 review found that the RN's capacity for anti submarine defence of mercantile trade was unsatisfactory, and that escorts could not reliably detect submarines before the first merchant ship was attacked. Once the submariner had revealed himself, however, the escorts had a good chance of counter attacking to sink or at least drive off the submarine. Correlli Barnett[10], refreshingly, does not quote Roskill, but does note that faith in Asdic's performance led the Admiralty to believe that the submarine menace had been largely mastered. Clay Blair, in a very detailed 1997 history of the U-boat war, writes that the RN "had not pursued Asdic vigorously"[11] between the wars, and further tells us that "Not until December 1938, when the Germans advised Great Britain that they would build to submarine parity, did the Admiralty begin serious planning for the possibility of a U-boat war"[12]

According to Arnold Hague[13] the Admiralty "Publicly claimed that (Asdic) had defeated the submarine even though it was untested in other than theoretical investigations", but adds that private doubts about its effectiveness spurred inter-war preparations for convoy.

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[5] Padfield, *War Beneath the Sea, Submarine Conflict 1939-1945*, Peter Padfield, John Murray, London, 1995, p23.
[6] ibid, p24.
[7] John Terraine *Business in Great Waters; The U-boat wars 1916-1945*, Leo Cooper, London, 1989, see esp pp177-178.
[8] Willem Hackmann *Seek and Strike; Sonar, Anti submarine Warfare and the Royal Navy 1914-1954*, p131.
[9] Vice Admiral Sir Arthur Hezlet, *The Electron and Sea Power*, Peter Davies, London, 1975, p178.
[10] Correlli Barnett, *Engage the Enemy More Closely; the Royal Navy in the Second World War*, Hodder and Stoughton, 1991, p45.
[11] Clay Blair, *Hitler's U-boat War; The Hunters, 1939-1942*, Weidenfeld and Nicolson, 1997, p26.
[12] ibid, p71.
[13] Arnold Hague, *The Allied Convoy System 1939-1945, Its organisation, Defence and Operation*, Chatham, London, 2000.

Dan Van Der Vat, writing in 1988[14], found that Asdic "led to a dangerous complacency about submarines, including almost total neglect of anti submarine tactics". He goes on to make the by now familiar quote from Roskill, also alleging that although "from 1933 all destroyers had Asdic, less happily, very little practice was acquired with it". As a result of this failure to practice with the equipment, it was not until after the beginning of the war, he claims, that it was discovered that Asdic was prone to giving false contacts, performed poorly against surfaced targets, degraded when the ship was at speed, could not determine submarine depth, and had a minimum range of some hundreds of yards. In all he concludes that, following inter-war lack of attention to the subject, "Asdic's blind spots and the fact that until well into the war anti-submarine ships had to drop their depth charges over the stern made killing submarines harder than had been thought before the war".[15] This opinion has spread beyond the literature into general acceptance. Admiral Sir Roderick MacDonald KBE, giving a speech on the Battle of the Atlantic at the Naval Club in 1991 told his audience that "There is no record of any exercise in the protection of a slow convoy against submarine or air attack between 1919 and 1939"[16] and went on to talk of the Royal Navy's "unjustifiable reliance on a primitive underwater sound detection system even though U-boats had attacked on the surface in World War I".

The intention in this dissertation is to study the development of anti submarine tactics during the inter-war period to attempt to discover whether the matter was ignored, or whether development continued in earnest. The limitations of such a dissertation do not allow a thorough study of manning, procurement and strategic issues, but where they impinge directly on tactical development they will be analysed. Specifically, advances in Asdic itself, as well as other anti submarine sensors, are thoroughly covered in Willem Hackmann's authoritative and near definitive book[17], to which very little can be usefully added. Little work was done over the period in the development of weapons, but some study is made of the failure to produce effective air launched weapons.

The specific areas of tactical work which will be studied cover the use of anti submarine aircraft, merchant convoy escort, battle fleet escort, the use of independent

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[14] Dan Van Der Vat, *The Atlantic Campaign; The Great Struggle at Sea 1939-1945*, Hodder and Stoughton, London, 1988, pp55-67.
[15] Van Der Vat, op cit, p116.
[16] IWM 92/4/1, Speech given at the Naval Club, Hill St Mayfair, 17 May 1991, in the papers of Papers of Admiral Sir Roderick MacDonald KBE.

striking forces and the alleged failure to anticipate that the Germans would repeat the successful first war tactic of surfaced night attack. Specific harbour defence tactics will not be studied, instead the dissertation will concentrate on tactics used at sea. Similarly, the use of submarines in the anti submarine role has not been examined. In order to put the process of tactical development into perspective a section on the organisational structure has been added. This will explain who was responsible for the design and testing of tactics, how they were integrated into fleet procedures, who provided the core of expertise, and by what channels comments from the fleets were fed back into the development cycle. On a strategic level, this section will also study the organisational structure of the Naval Staff in order to determine the extent to which the authors of higher policy were kept informed of the capabilities and limitations of anti submarine forces.

A commencement date of 1926 has been chosen as the years immediately after the armistice saw a general reduction in defence spending which led to a period of considerable flux. It was only when, in 1926, anti submarine efforts were brought under a unified command at *HMS Osprey*, the depot at Portland, that a coherent and identifiable structure was built up. It seems that little can be gained by a study of inter-war work without making some reference to at least the early months of the war to determine if the methods adopted were in fact successful. The dissertation will therefore cover the period from 1926 to June 1940. The wartime period has been terminated in June 1940 for two main reasons, the first being that all inter-war strategic planning for a war against Germany made the assumption, at the highest level, that France would not fall. The Navy, therefore, planned for a war with an ally across the channel, a war during which German submarines would have to make a long and dangerous transit before operating in the deep and open waters of the Atlantic. From July 1940 the Germans operated from the ideally placed Biscay ports, so could take the battle to the mid Atlantic with an ease not envisaged by strategic or tactical planners in the inter-war period. It seems hardly reasonable, therefore, to judge inter-war anti submarine development against the test of a war which the Admiralty were told not to expect.[18] The second reason is that, not surprisingly,

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[17] Hackmann, op cit.

[18] While it might seem naïve of the Admiralty to have based all planning on France resisting German attack, one must remember that departmental estimates will only be approved by the Treasury if they are based on the assumptions given to the respective department. An Admiralty request, therefore, for

methods did evolve as war experience grew, and the techniques employed by both sides after the summer of 1940 resembled less and less those used in the early months of war. The wartime study will take the form of a close examination of interactions between German submarines and RN anti submarine vessels to establish the success of the anti submarine methods employed. Explanatory appendices have been included, one giving a basic explanation of Asdic theory and problems presented by oceanographic phenomena, the second giving a glossary of acronyms and initials, and the third gives details of standard anti submarine exercises.

The process of development of military tactics in time of peace follows a predictable pattern. First a strategic analysis is made of the conflict for which one is preparing, then tactics are designed and exercised, in an iterative and continuous process. Once satisfactory tactics have been developed for the weapons, sensors and platforms currently available, it is usual to enter into a discussion process with other specialisations to ensure that there is no compromise with the requirements of other branches. A plan to stay close to the support of one's own shore batteries, for instance, may have to be compromised to meet the requirement to stay in deep water to avoid enemy mines. Once the service has accepted the theory of a tactic it is then published and integrated into the operating procedures of the relevant arms of the service. Throughout this process the strategic planners should be kept informed of the current state of development and the anticipated capabilities and limitations in the relevant field, in order that war plans may be properly devised. Faithful to this process, there will be an attempt throughout the dissertation to answer five core questions:

i) Did the anti submarine organisation of the Royal Navy make thorough studies of the likely tactics and strategy of the anticipated enemy, and were the results of these studies realistic?

ii) Did the exercises and trials carried out test the conditions anticipated, and did they prepare personnel for the anticipated war?

iii) Were the wider navy, the relevant sections of the air force, and policy makers outside the services kept aware of progress in, and limitations of, anti submarine capability?

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funds to finance construction of extra ships against the contingency of France falling would have been turned down on the grounds that they were planning outside the strategic assumptions.

iv) Were the procedures developed by the anti submarine specialists understood by, and integrated into the operating procedures of, the wider navy?

v) Finally, the key question, which can only be answered by close examination of individual wartime actions, asks whether the conditions anticipated actually materialised.

There are very few published works which deal in any detail with the Royal Navy in the inter-war period, and as discussed above the majority of those which are available follow, almost slavishly, Roskill's line. Initial research among primary sources indicated that the provenance of Roskill's evidence may be limited, and so reduced the reliability of the majority of the secondary sources. The dissertation is therefore almost exclusively based on primary source material. The most lucrative source was the Public record Office, most notably the ADM 116 series of Admiralty papers, the 186 series, which includes reports of progress from the anti submarine establishment at Portland and a selection of post exercise reports. Useful material was also found at the Admiralty Library in the Naval Historical Branch, London, whose partly unindexed collection contains material which nicely fills gaps in the PRO material. Personal papers were drawn from the Naval Museum Library in Portsmouth, the archives centre of Churchill College, Cambridge, the Maritime Museum, the Imperial War Museum, and the Submarine Museum in Gosport. Serving officers of the time have also been consulted, including Admiral Sir Ian McGeoch, who was a pre war submariner, Admiral Sir Antony Morton, who served in wartime destroyers, Captain Barrie Kent RN, expert on the history of naval communications, and Lt Cdr David Waters RN, a pre war Swordfish pilot and instructor who co-authored the Staff History of the Second World War U-boat campaign. A list of abbreviations used in footnotes to specify sources is provided at appendix B.

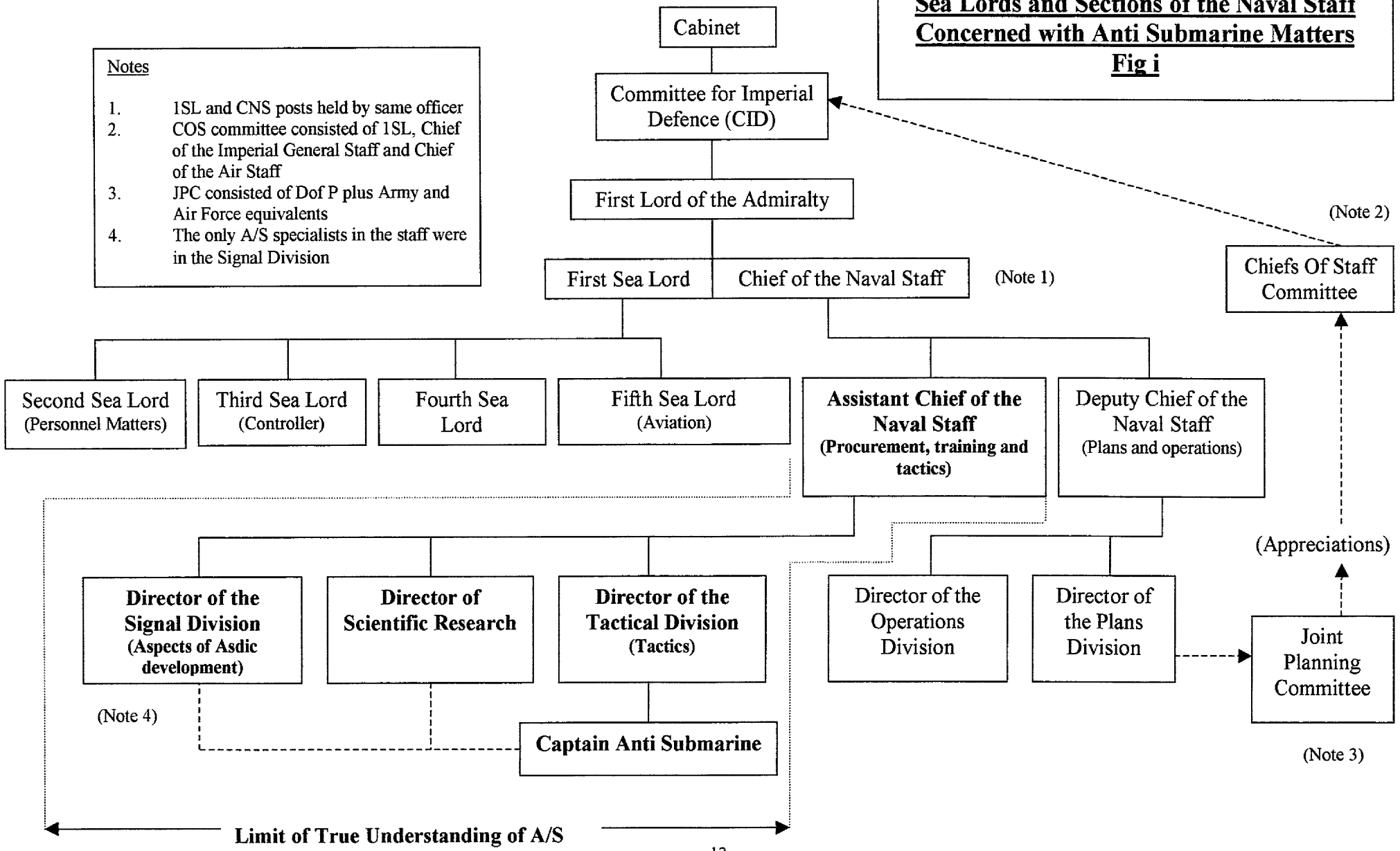
The final explanatory note covers the subject of ships' names. In order to avoid maintain a clear differentiation between merchant ships and warships, while avoiding tedious repetition of "HMS", "SS", "MV" etc, the convention has been adopted of placing warship names in italics while leaving merchant ship names in conventional script.

It is worth noting here that much of the common misunderstanding of this subject may have arisen from the fact that the vast majority of trial and exercise reports from

1919 to 1937, which were kept at the Staff College at Greenwich, were destroyed by bombing during the second war[19], and were thus not available to any post war historian.

[19] A Wells, unpublished PhD thesis "Studies in British Naval Intelligence, 1880-1945", University of London, 1977, available in Kings College library.

Sea Lords and Sections of the Naval Staff Concerned with Anti Submarine Matters Fig i



Chapter 1

ORGANISATION

NAVAL STAFF

In order to have any understanding of the process which led to major decisions about tactical development it is necessary to have a sound understanding of the structure of the Naval Staff. No such discussion could be complete without a "wiring diagram", and fig i gives a diagrammatic representation of the hierarchy of responsibilities within the staff.[20]

Leading the organisation was the Chief of the Naval Staff (CNS), also known as the First Sea Lord (1SL or simply "First"), the professional head of the Navy. He was responsible, through the First Lord of the Admiralty, a politician, to the Committee for Imperial Defence (CID) and the Cabinet for the running of the Royal Navy. Working for the CNS were the Assistant Chief of the Naval Staff (ACNS) and the Deputy Chief of the Naval Staff (DCNS), officers of broadly equal seniority with very different areas of responsibility. The Deputy Chief of the Naval Staff was responsible for plans and operations, and has been described as the "user". The Assistant Chief of the Naval Staff, covering procurement, tactical development and some aspects of training, could be styled the "provider". The Assistant Chief of the Naval Staff's responsibilities for training were shared with the Second Sea Lord (2SL or "Second"), who can correctly be thought of as the personnel manager.

While final decisions lay with these senior officers, the majority of the functions of the Staff, including analysis of proposals and submission of recommendations to the decision makers, fell to the various directors who worked for them. Generally officers of Captain's rank, these were selected for their expertise in the business of their departments, so many posts "belonged" to certain branches or specialisations. Of the directors who reported to Assistant Chief of the Naval Staff, for instance, the Director of the Signal Division (DSD) was a specialist communicator, and the

[20] PRO ADM 1/8766/66 "Naval Staff organisation", 1933, ADM 1/8778/183 "Instructions for Naval Staff", 1934.

Director of Scientific Research (DSR) was a civilian scientist. Less obviously, the Director of the Tactical Division (D of TD) tended to be a torpedo specialist; the significance of this will be discussed later. Of the directors who reported to Deputy Chief of the Naval Staff, the only ones who are of direct concern to us are the Director of the Operations Division (DOD) and the Director of Plans (D of P). Among other roles, the Director of Plans, who tended to be a gunnery specialist, sat with his Army and RAF opposite numbers on the Joint Planning Committee (JPC), which prepared reports and appreciations for the CID and the cabinet. The Director of Plans, however, had no direct responsibility for anti submarine development, which fell within the bailiwicks of the Director of the Tactical Division, the Director of Scientific Research and the Director of the Signal Division. Captain A/S, whose role will be discussed in the next section, reported to Director of the Tactical Division.

Prior to the 1921 reorganisation of the staff, an Anti submarine Division existed in its own right. It was proposed in 1921 that the Anti Submarine Division, together with Mercantile Movements and Minesweeping, should become part of an expanded Trade Division,[21] in order to unify all aspects of trade defence. In the event, the Anti Submarine Division became part of the Tactical Division, and was cut to a staff of only one commander. To put this into perspective, this Commander was one of eighty five uniformed officers in the staff, and at no time in the inter-war period was the post occupied by an anti submarine specialist.[22] His administrative support came from the ten civilian clerical and secretarial staff who were shared between the Tactical, Plans and Trade divisions.

The only anti submarine specialists who were appointed to the Naval Staff during the inter-war period worked for the Director of the Signal Division, who was concerned with design and procurement of equipment rather than the development of tactics.

The practice of repeatedly appointing Torpedo Officers to the posts of Director of the Tactical Division and Capt A/S meant that no gunnery officers, and thus no subsequent Directors of Plans, had any staff experience in anti submarine. This compartmentalisation of anti submarine expertise within the staff was exacerbated by

[21] PRO ADM 166/2105 "Naval Staff Reorganisation", 1921.
[22] A/S specialist indicates an officer who has completed a long A/S course, for further explanation see the section on the A/S branch.

the tendency, superficially beneficial, to appoint ex Capts A/S to the post of Director of the Tactical Division.

From this it can be seen that there was a narrow vertical stratum of anti submarine expertise, or at least understanding, within the Staff, which should have allowed efficient development of material, tactics and manning throughout the period under study. It will be argued later in the dissertation that, given the prevailing constraints of finance and technology, advances in anti submarine were as satisfactory as could reasonably be expected. What was not satisfactory was the integration of tactical capabilities and limitations into strategic planning and wider policy issues. The reasons for this failure can be show to have lain within the structure of the Staff.

Broadly, strategic policy, especially in peace, is concerned with what will be done in the future, its main building blocks being identification of a potential enemy, assessment of his capabilities and intentions, and a proper recognition of your own capabilities and limitations. Given these factors it is possible to come up with a series of contingency plans. All this was done, on a tri service level, by the Joint Planning Committee (JPC), and in the Admiralty by the Director of Plans, himself a member of the JPC. As has already been discussed, the Director of Plans tended to be a gunnery specialist with a background in capital ships and little or no detailed understanding of anti submarine warfare. Similarly, there was within his staff no expertise in anti submarine, so their understanding of the RN's own capabilities and limitations must have been, at best, limited. The CB 3002 and CB 1769[23] publications, widely referred to in this dissertation, would have been their only reference source, and there is no evidence of the Directors of Plans making a habit of going to the Director of the Tactical Division, or indeed Captain A/S, for advice or guidance. The appreciations drawn up by the JPC for the Committee for Imperial Defence do survive, as do some of the drafts which were circulated within the Naval Staff prior to publication, and it seems that in the majority of cases they were not circulated to any of those sections of the staff which possessed expertise in anti submarine .[24] The Chiefs of Staff, the CID and, ultimately, the cabinet, then, were presented with visions of how a future trade defence campaign would be pursued, which had been prepared without input from the experts in the newly emerged and rapidly evolving discipline of anti submarine

[23] CB (Confidential Book) 3002 was an annual report on progress in, among other areas, Asdic. CB 1769 was an annual digest of reports of major exercises which often contained comments on tactics.

warfare. It can hardly be surprising, then, that while the officers of the fleets were well aware of the limitations of Asdic, Admiral Chatfield (First Sea Lord) was writing to Churchill in 1936 that "Our anti submarine methods are so efficient, not of course 100% efficiency, but I do not think that 80% is too high an efficiency to safely put it at...."[25] and Samuel Hoare was telling the CID in 1937 that "the position is very satisfactory".[26]

The result of this failure was that much of Government and Admiralty policy was based on flawed assumptions some of which, as will be shown later, can be laid at the door of the Portland organisation, but many of which were due to the ignorance of the planners.[27]

ANTI SUBMARINE SCHOOL (PORTLAND)

During the First World War Portland became the Royal Navy's centre of anti submarine activities, although experiments, trials and development work were also undertaken at outstations throughout the country. The general reduction in defence spending following the armistice left the majority of the outstations either closed down or allocated to other work. By 1924 the situation was that fundamental research into underwater sound was carried out at the Admiralty Research Laboratory (ARL) at Teddington, under the direction of the Director of Scientific Research. The Signal School at Portsmouth, which belonged to the Director of the Signal Department, was responsible for design and experimental work on oscillators and Asdic gear, and the Minewarfare and Torpedo establishment at HMS *Vernon*, in the bailiwick of the Director of Torpedoes and Mining, dealt with hydrophones. This left the anti submarine school at Portland, under Captain A/S, being responsible for sea trials, tactical development and personnel training.

The Asdic fitted "R" Type destroyers and "P" type patrol boats of the first anti submarine squadron (1 A/S), all of which were of wartime construction, were based at

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[24] See, for instance, PRO CAB 53/29, COS paper 513 "Appreciation of situation in the event of war against Germany in 1939", prepared by the JPC for the Chiefs of Staff.
[25] CHURCH CHAR 2/272, Letter from Chatfield to Churchill 5 May 1936.
[26] PRO CAB 2/6, Minutes of 292nd meeting of the CID, 15 April 1937.
[27] For a full discussion of the influence of the Staff structure on the development of A/S see G D Franklin "A Breakdown in Communication; Britain's Overestimation of Asdic's Capabilities in the 1930s", Mariners Mirror, vol 84, No 2, May 1998.

Portland.[28] Although these did not come under the direct command of Captain A/S, they spent much of their time working in support of the anti submarine School.

The turnaround in the fortunes of the anti submarine school can be traced to a paper written by Captain S D Tillard, Captain A/S, in November 1924. This paper argued that *Vernon's* and the Signal School's activities should move to a greatly expanded establishment at Portland, where Captain A/S would preside over a unified and much more efficient anti submarine organisation. While much of the paper made good sense, and was generally compelling in its arguments, Tillard does occasionally seem to have got carried away into an almost spiritualist rapture:

> The Scientific staff will consist of comparatively young and rising scientists in close association and co-operation with their contemporary specialist Naval colleagues, and consequently mutually benefiting one another, acting complementarily and co-ordinatedly[29]

He went on to gloss over Portland's vulnerability to air attack, but set great store by the "bracing air and exhilarating climate which would be conducive to intensive brain work". The Rear Admiral commanding Submarines (RA(S)), meanwhile, was staking his own claim, arguing that it would make far more sense to unify the anti submarine effort under his command at Fort Blockhouse in Portsmouth.

In reaction to these two papers, the Naval Staff appointed Rear Admiral Napier to produce a report on the future of anti submarine development in the Royal Navy. Napier was to head a committee which included representatives, at Commander level, of Vernon, the Signal School, Captain A/S, the Director of Scientific Research, the Director of Dockyards and the Secretary to the Admiralty.[30] The committee was to report on three proposals; full integration at Portland, unification in the Portsmouth area, and a compromise involving administrative unification under Captain A/S with a limited actual movement of facilities to Portland.

The first scheme, with a projected capital cost of £45 000 to £50 000, was judged to be prohibitively expensive and the Blockhouse scheme was judged impracticable

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[28] It is important to note that there were two separate organisations at Portland, HMS Osprey, which was the A/S school, and the dockyard, which acted as a basing facility for, among other ships, 1 A/S.
[29] PRO ADM 116/2410 "Anti submarine Depot at Portland".
[30] It is interesting to note that Capt A J Murray, who was DSD's representative on the Napier committee, became Capt A/S in December 1928, so inheriting the fruits of his labour.

because of the distances it would be necessary to steam to get from Portsmouth to deep water exercise areas. Almost inevitably, the compromise scheme was selected. The directors of Torpedoes and Mining, Tactics, Signals and Scientific Research met to discuss the findings of the Napier committee, which were approved and duly endorsed by the Assistant Chief of the Naval Staff (ACNS), who held responsibility for training and tactical development. The transformation was gradual, but 5 April 1927 was picked as the date when unification at Portland was deemed to be nominally complete, at a capital cost of £27 000. Captain A/S now had unified administrative responsibility for all anti submarine related matters, but much of the actual activity still took place away from Portland.

Within six months it was discovered that the original buildings at Portland were uneconomical to maintain, and a further £40 000 was requested for reconstruction. After once again considering the possibility of moving the school away from Portland, the Admiralty decided in March 1928 that it was to stay in the existing accommodation, no money being allocated for refurbishment. In what was becoming a familiar refrain throughout a cash strapped navy, Captain A/S was told that "the inconvenience entailed must be accepted". A year later, however, £50 000 was voted for office and accommodation improvements, and Captain A/S could relax in the knowledge that the inertia of capital expenditure had secured the future of his establishment.

The anti submarine school, HMS Osprey, comprised three distinct sections. The largest was that devoted to instructional duties, which included a staff of four anti submarine specialist officers of either Lieutenant or Lieutenant Commander's rank. Two further specialists were dedicated to experimental duties, and another two formed the part that is of most interest to this dissertation; the tactical section.

The duties of the tactical section were specifically laid down as follows:

i) Conduct analysis of and write reports and records on all tactical exercises carried out at the direction of the school.

ii) Initiate tactical developments and investigate tactical problems.

iii) Assist in the recording of special exercises.

iv) Scrutinise reports from 1 A/S and fleet flotillas.

v) Prepare tactical manuals, quarterly reports and the CB 3002 series.[31]

[31] PRO ADM 116/2410 "Anti submarine Depot at Portland".

It can thus be seen that the majority of the tactical development studied in this dissertation was at least initiated by a pair of Lieutenants working in an austere and dilapidated office perched on the side of the Portland peninsula.

The most useful surviving documents to come out of Portland were the CB (Confidential Book) 3002 series, entitled "Reports of Progress in Torpedo, Mining, Anti Submarine and in Allied Subjects"[32], which were published every year from 1924 to 1939. These reported on, among other things, the progress made at Portland in tactical developments. In order to give results which could be analysed and compared, a series of standard exercises were devised, and criteria established to assess the success of those exercises. These criteria formed the basis of much of the development that will be examined in this dissertation, and are listed at Appendix C.

Ships, both of 1A/S and the Fleets, used to go to Portland to conduct "work up", during which the whole ship's team was taken through a series of exercises designed to develop their anti submarine capabilities. There were 29 such standard exercises which varied in complexity from the anti submarine operators keeping in contact with a passing submarine while the ship was at anchor to full blown convoy defence and area patrol exercises. Exercises of particular interest to this study were undertaken after the ships had proved themselves in a number of "set piece" hunting and screening exercises and are listed below:

> 20) Screening and Counter Attack. Ships formed a screen around a notional main body[33] and were attacked by a submarine. The ship which detected the submarine counter attacked and was then joined by one other ship from the screen to hunt the submarine and press home deliberate attacks. The submarine was allowed complete freedom of movement.
>
> 25) Search for a Submarine Sighted by A/S Vessels. The submarine positioned itself on the surface as if conducting a transit. When the surface vessels sighted it they flashed lights to simulate gunfire, the submarine dived and a hunt was initiated.

[32] PRO ADM 186 series.

[33] For the purposes of this dissertation the term "main body" will be used to describe the submariner's target. This main body could be the battle fleet, a troopship, a merchant convoy or a single stricken vessel.

28) Convoy Exercise. Exercise in Air and Sea co-operation to protect a convoy and prosecute submarines detected while attempting to attack.

29) Shipping Patrol Exercise. Air/Sea striking force defending shipping in the vicinity of a notional base.[34]

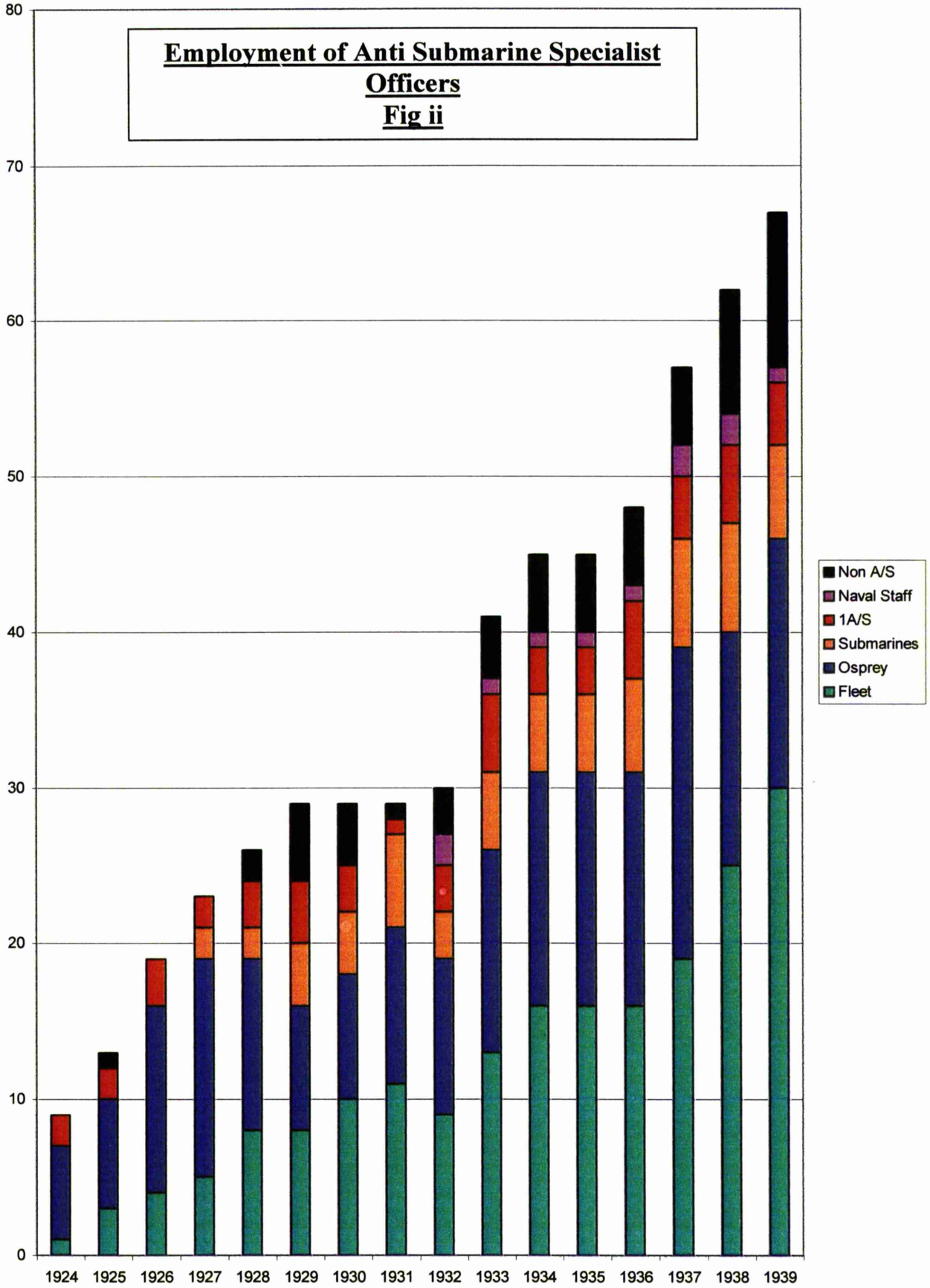
ANTI SUBMARINE BRANCH

As an understanding of the structure of the Naval staff is required to appreciate high level decision processes, so some explanation of the sources of seagoing expertise is required before one can one can make a proper study of how tactics were developed in the fleets and at Portland. For this reason, although the introduction did state that the emphasis of the dissertation would be on tactics, a short description of the training and employment of the fleets' anti submarine experts follows.

Clearly there were in the inter-war years a good many officers who had been involved in operations against German submarines during World War I, and who would feel themselves qualified to comment on anti submarine matters. The introduction of Asdic into fleet units after the armistice, however, resulted in such a quantum shift in the way anti submarine was conducted that much of the valuable expertise developed during the war became obsolete, and there was a requirement to train Officers in the new methods, so developing an entirely new branch of anti submarine experts.

One of the most important jobs of the anti submarine school at Portland was to run the anti submarine qualifying course for officers, and it is the graduates of this course who can be considered to have been the experts in the field. The course was a year long and included instruction in technical aspects of the Asdic apparatus, operation of the apparatus to locate submarines, handling of ships to optimise for detection and subsequent prosecution, and methods of attack.[35] There was also instruction in oceanography, properties of underwater sound and other related subjects. One can see from this that they would possess a wide variety of expertise not available to other officers. For the purposes of this dissertation, therefore,

[34] PRO ADM 186/140, CB 1868/1931 "Anti submarine Practice Memoranda"
[35] PRO ADM 116/2242 "Specialist Officers – Gunnery and Torpedo", 1924 and ADM 1/8728/161, "Submarine Detector Branch", 1936.


Employment of Anti Submarine Specialist Officers
Fig ii
80
70
60
50
40
30
20
10
0
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
Non A/S
Naval Staff
1A/S
Submarines
Osprey
Fleet

graduation from this course has been taken to be the qualification for membership of the new branch, and it does seem to have been the case that specialist anti submarine posts were only available to those who had completed the course.

It is instructive to study the development of the branch between the rationalisation at Portland and the outbreak of hostilities. The appointing histories of all individual officers within the branch have been traced, and fig ii shows their employment by categories. Those appointments shown as "Fleet" jobs include all postings to surface ships other than ships of 1A/S, which has been placed in a category of its own as it was an experimental and training unit rather than a true fighting formation. The fleet appointments were made up of anti submarine specialists embarked in each of the major fleet flagships as "Fleet A/S Officers", those embarked in the leaders of all Asdic fitted destroyer flotillas, those embarked in Asdic fitted cruisers, and those in ships of the Asdic fitted destroyer flotillas. The last category were a great rarity in the early years, but in the late 1930s it became more common to find anti submarine specialists in ships other than those of squadron commanders. We have the testimony of Capt, then Lt, Mosse, who as the second anti submarine officer to Captain D2 in 1937 was responsible for training and maintenance and moved between the ships of the flotilla. Lt Cdr Farquhar, as the first anti submarine officer, was executive officer of the squadron commander's ship and acted as his tactical adviser.[36] The great majority of destroyers which did not carry qualified anti submarine specialists instead had an officer, usually the junior Sub Lieutenant, appointed as the Asdic control officer; by all accounts a thankless and unpopular task. These officers generally completed a short course at Portland, as did the Commanding Officers of Asdic fitted surface ships.[37] Attendance on this short course was evidently not universal for Asdic officers; Sub Lieutenant (later Captain) P J Cardale wrote in his memoirs that he joined *Escort* in August 1939 as anti submarine officer but "I knew very little indeed about Asdics and anti submarine work, as I had not done a course in this".[38] During the ship's subsequent Portland work up, though, he did spend ten days in the shore based attack teacher. Finally, in the late 1930s, the Rear Admiral Destroyers in each of the two main fleets had an anti submarine specialist added to their staffs. The green

[36] IWM 90/23/1, Memoirs of Captain John Mosse.
[37] Author conversation with Capt R De L Brooke.
[38] IWM 90/23/1, Memoirs of Captain P J Cardale.

section of the figure can, thus, be said to represent the fighting anti submarine expertise of the service.

The introduction of the submarine anti submarine specialist in 1927, a man who unlike most submariners would spend his career switching between the submarine service and general service, must have been a most useful development. When serving in submarine appointments he could advise the submariners on surface ship tactics, as well as the use of Asdic for submarine versus submarine engagements, and when he returned to Portland or the fleets he was ideally suited to counter the latest submarine tactics. The submarine appointments were on the staff of Rear Admiral Submarines at Dolphin and in each of the flotilla depot ships. Those in the flotillas are noted in the Navy List as being carried "for service in submarines", so presumably spent at least some of their time witnessing the "other end" of anti submarine exercises.

There is evidence of a flow of information and ideas between Osprey and the submarine service, notably in a 1924 paper which mentions the good relationship between the anti submarine school and the sixth submarine squadron[39]. Vice Admiral Sir Ian McGeoch, however, a pre war submariner who served in the first submarine squadron in the Mediterranean, has no memory of their having been any anti submarine specialists attached to the squadron, despite the Navy List showing the post as having been filled throughout the period. The names of the officers shown in the Navy List were familiar to Admiral McGeoch, but he describes their influence as having been minimal. He does remember the main line of communication between submariners and surface ship officers as having been through submarine COs and squadron commander to the destroyer squadron commander.[40]

The first obviously discernible trend in the graph shows the branch expanding from its embryonic base in 1924 to the full established peacetime strength in 1928-9. Removal of the ten year rule in 1933[41] then increased the demand for specialists as more Asdic fitted destroyers were planned and built. The Portland establishment expanded during the years 1932 to 1934 in order to cope with the increased training

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[39] PRO ADM 116/2410 "Anti submarine Depot, Portland", 1924 and IWM 90/23/1, Memoirs of Captain John Mosse.
[40] Author conversation and correspondence with Admiral McGeoch.
[41] See Roskill "Naval Policy" vol 2, pp145-146 for a discussion of the timing of the removal of the Ten Year Rule.

load, and then stayed reasonably static, with the greatest increase being in fleet bearings, as one would expect.

The Director of Scientific Research commented in 1924 that, as Asdic was developing fast and the ten year rule was still in place, it was likely that the equipment fitted to ships in 1925 would become obsolete before the outbreak of war. It was therefore, he argued, pointless to train large numbers of men to use equipment which would never be used in action.[42] It is unknown if this opinion held wide currency, but it does have a certain logic, and may have contributed to the dramatic expansion in the branch following the removal of the ten year rule.

It was pointed out in 1928 that only 50% of anti submarine specialists were serving in seagoing appointments, as against 70% for gunnery and torpedo specialists.[43] This apparent inefficiency was successfully defended on the grounds that the ratio was likely to change as more Asdic sets were fitted at sea.

There is no doubt that the anti submarine branch was an unfashionable section of the Navy, as is backed up by the verbal evidence of a number of officers of the period, contemporary literature, and the difficulties encountered in recruiting officers into the branch. The reasons for this reluctance to specialise in anti submarine were many and various, and among the most obvious were the tendency for frequent postings to the relatively cut off and austere establishment at Portland (notwithstanding Capt Tillard's "bracing and exhilarating climate"), the limited scope of seagoing appointments, the widely held perception that anti submarine was a subject for rather odd technical specialists, and the sometimes pedestrian nature of the ships used for anti submarine work. In the latter regard it should be remembered that repeated appointments to one of the hotchpotch of ancient ships that made up 1 A/S were inevitable for an anti submarine specialist. The Admiralty's attitude to the requirements of anti submarine ships is nicely illuminated in a 1928 paper on destroyer policy.[44] The conclusion of this paper was that one should build destroyers with the intention that they be used in their conventional roles with the fleets for the first half of their lives. When they became too old and slow for such fleetwork they would be handed over to "subsidiary services", which included anti submarine protection of merchant traffic. Hardly a great incentive for a budding young officer to specialise in anti submarine.

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[42] PRO ADM 116/2410 "Anti submarine Depot, Portland", 1924.
[43] PRO ADM 116/2410 "Anti submarine Depot, Portland", 1924, minutes of A/S committee meeting 29/2/28.

Having said all of which, there were of course some fine and very dedicated men serving as anti submarine specialists, not least among whom was Capt Walker, whose wartime success was based as much on experience gained between the wars as on his leadership or inventiveness.

[44] PRO ADM 116/2685 "Destroyer Policy", 1928.

Chapter 2

TACTICAL DEVELOPMENT

When conducting an anti-submarine engagement there are two very definite aspects. The first aspect, before actual contact is made with the submarine, involves disposition of ships to protect potential targets or to locate undetected submarines. These dispositions can be either defensive or offensive. The second aspect is the actual attack on the submarine, during which a series of pre planned and exercised moves will be undertaken aimed at its destruction or neutralisation. The first aspect, the disposition of A/S ships, depends very much on their mission, and in particular whether it is tactically defensive or offensive. In contrast, the second aspect, the actual attack, will not vary substantially. For this reason it has been decided to break the main substance of this chapter into three sections, the first two covering the dispositions of A/S ships under defensive and offensive scenarios, and the third the direct attack to run down the submarine once detected. In each of these sections the general principles involved will be discussed, followed by a chronological account of the developments.

As a preliminary, however, it is worthwhile to look briefly at the status quo in A/S thinking that existed in 1919, when wide experience had been gained of anti submarine operations but Asdic was not yet in service. The most effective ship launched weapon for use against a dived submarine was the depth charge. Some ships did tow explosive sweeps, or paravanes, in the hope that they would make contact with a submarine and detonate, but this method was abandoned soon after the armistice. Gunnery and ramming were employed against surfaced submarines. Aircraft would drop contact fuzed bombs against surfaced or shallow dived submarines, but it has to be said that this method had enjoyed the absolute minimum of success during the war.

The eyeball was the only sensor available to aircrew, and while surface ships relied heavily on visual sightings, some employed passive hydrophones which could be lowered into the water to listen for the transmitted sound of a submarine.

Aircraft had been found to be extremely useful when employed to search areas of ocean, and although lacking an effective means of attack, they could force submarines

to dive, so making them expend valuable battery power and limiting the submariner's range of visibility.

Surface ships conducting offensive sweeps or area patrolling had been found to be substantially ineffectual, and the submarine was defeated largely through the use of convoy. Even in convoy escort surface ships could do little against dived submarines, which were invisible to them, but a submarine which revealed its position by surfacing, showing its periscope, or accidentally broaching, could expect a large number of admittedly unaimed depth charges to be dropped in its immediate area.

Theoretical tactics had also been developed which allowed ships undertaking escort duties to station themselves in those positions with reference to their charge which would afford best protection against submarine attack. The concepts of danger areas and limiting lines of approach, which allowed the escort commander to predict the direction of attack, are discussed later in this chapter.

DEFENSIVE DISPOSITIONS

Just as dispositions of A/S ships can be defensive or offensive, so the discussion of defensive dispositions can be usefully sub- divided. On the one hand these dispositions depend on the specific types of ships being defended against enemy attacks. The three categories used here, differentiated by their speed and perceived value, are warships, troopships, and mercantile convoys. The first two types had common features, and are dealt with together in the fourth section of this chapter, while slower mercantile convoys are considered in the final section. But before looking at these different types of targets three features common to all types of target will be considered: the general principles involved in defensive A/S work, the use of aircraft in this role, and the particular danger - highlighted by the actual experience of the Second World War - of surface night attack.

General Principles

The misguided vacillation which preceded the eventual decision to adopt convoy as a means of trade defence in 1917 does not fall within the scope of this dissertation, but the fallout from that decision underpins all that can be said in this section.

While the lesson of convoy seems to have been learnt at a strategic level, there is some evidence that the tactical emphasis remained the destruction of submarines rather than the safe delivery of the main body. The anti submarine policy statement that formed the preamble to the 1932 CB3002, and was repeatedly confirmed throughout the decade, was unequivocal:

> "The object of all anti submarine operations is the destruction of enemy submarines. While under certain circumstances successful defence must be the primary consideration in general the most certain means of obtaining security from enemy submarines is by carrying out a vigorous offensive against them"[45]

One runs here into an admittedly esoteric problem of definition; if one defines anti submarine warfare as the business of sinking submarines then the above statement is clearly beyond question, but if one extends that definition to cover defence against submarine attack, doubt must be cast on its validity. The contemporary perspective taken over the period of this study seems to have been to regard anti submarine warfare as the business of prosecuting submarines, while the discipline of trade defence tied in debates about convoy versus independent sailing, the utility of evasive routing, the employment of deception etc. The student of 1914-1918 naval history, then, who reads that "the object of all anti submarine operations is the destruction of enemy submarines" must remember that the first battle of the Atlantic was a trade defence, rather than anti submarine, campaign.

The appointment of Admiral G.H.W. Eldon Manisty in 1935 to the Naval Staff, with instructions to lay plans for the Trade division and the Naval Control of Shipping (NCS) organisation represented the start of the steady development of a convoy system.[46] Aside from building a staff at home, Manisty toured the world appointing reservists to act as NCS officers in the event of war, so populating all the world's major harbours with men who understood, and were ready to institute, convoy. Certainly when the decision was made to adopt convoy in September 1939 the guides, publications, officials and structures were in place to allow the rapid and relatively painless institution of a complex and widely spread system. Credit must therefore go

[45] PRO ADM 186/500, CB 3002/32.
[46] Hague, op cit, p20.

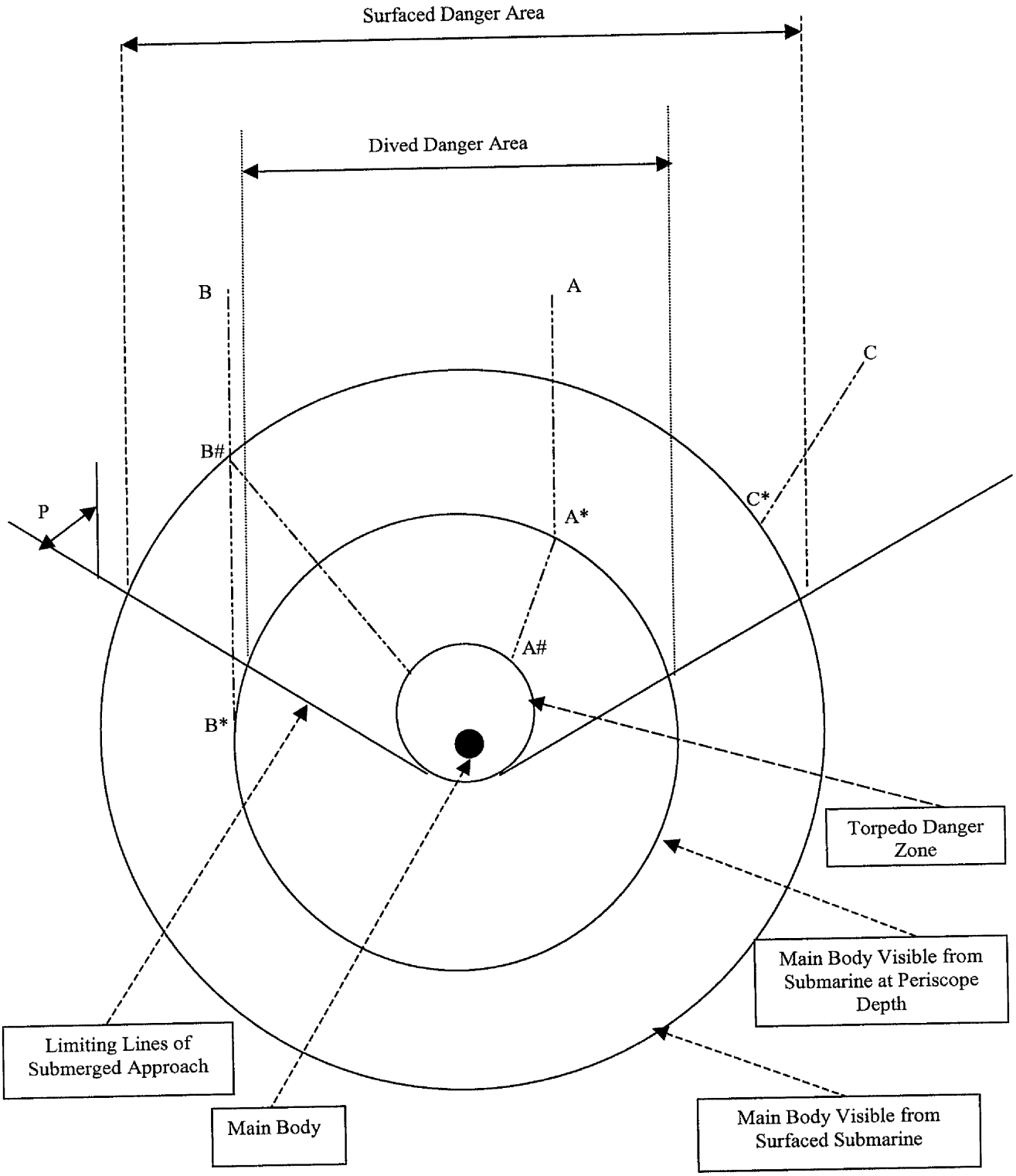
to the officers, mostly passed over for promotion, who staffed this Admiralty backwater.

The inter-war Admiralty, when considering trade defence, did not employ its sometimes considerable capacity for forgetfulness, and generally accepted that in the event of a future unrestricted submarine attack on maritime trade, convoy would be adopted. It will be shown in this dissertation that the strategic and tactical planners anticipated the employment of the convoy system in the early stages of any war, and that tactics in the protection of convoys from air, surface and sub surface attack were frequently trialled and practised. This still left scope for debate about the employment of assets allocated to the defence of a convoy, or Battle Fleet. In the first war, as has been discussed, the escorts were largely blind once the submarine had dived, and they had to rely on close screening to stand any chance of deterring submarine attack, while hydrophone equipped vessels could patrol areas of known submarine activity. The advent of Asdic extended the debate about the relative merits of screens and offensive hunting groups. In the early heady days of great faith in Asdic, when the talk was of the "undetectable being detectable" and a "transparent ocean", there was a compelling logic behind sending groups of Asdic fitted ships to sweep the seas clean of submarines. When, however, with the passage of time it became evident that Asdic was not all that had been hoped, the argument swung back in favour of the defensive Asdic screen. The doctrine being issued by Portland in 1925 stated, quite categorically, that "the submarine should be left alone in the open sea, as the seas are too large to search for her".[47] By 1924, therefore, serious thought was being given to the issue of screen design. Before going into the details of this discipline it is worth outlining some of the basic principles of escort work.

The basic principles of screen design, adhered to throughout the inter-war years and in many respects still current today, can be found laid out in a 1919 document.[48] Fig iii shows a diagrammatic representation of the problem faced by the escort commander.

In order to achieve an attacking solution the submariner did not need to get inside the convoy, only within a reasonable firing range, usually reckoned to be around 4 000 yards. A perimeter of 4 000 yards was thus drawn around the convoy, offset to allow

[47] POR ADM 186/447, CB 982 "Progress in Torpedo, Mining, Anti submarine and allied subjects 1925". This was the precursor to the CB 3002 series.
[48] PRO ADM 186/40, CB 648(2), "Mercantile Convoy instructions, 1919".



The Submarine Approach Problem
Fig iii

for the distance steamed during torpedo running time. This area, known as the torpedo danger zone (TDZ), had to be penetrated by a submarine intending to attack. The figure of 4 000 yards could be adjusted depending on visibility, sea state, changing estimates of torpedo range etc.[49]

The essential assumption in considering the submarine's approach was that the speed of the target was greater than that of the submarine, so the submarine needed to start its approach from ahead of the target if the attack was to have any hope of success. In fig iii the lines marked as the limiting lines of approach are the lines ahead of which the submarine had to keep in order to be able to work into an attacking position. The faster the target, in relation to the assumed maximum speed of the submarine, the smaller the angle P, so the harder for the submarine to get into an attacking position. The water astern of the limiting lines was of no interest to the escort as a submarine here would not be able to catch the convoy up in order to attack. A submarine conducting a dived patrol in position A, making periodic periscope observations, would see the target approximately at A*, from where it would be able to work in to an attack position at A#, as shown. A dived submarine in position B, however, would not see the target until B*, by which time it would be astern of the limiting lines, and so would not be able to attack. A surfaced submarine at B, however, would, with its increased visibility, be able to see the target at B#, and would then be able to manoeuvre for an attack. It is assumed, reasonably for daylight conditions, that the surfaced submarine would dive on sighting the target, and would thus make its approach at periscope depth and dived speed. A submarine which starts at C would, clearly, never be in a position to attack unless it happens to be steering, by chance, across the line of advance of the target and found itself at C*, which was within the surfaced danger area (SDA). It can be seen from these three conditions that a submerged submarine needed to be within the dived danger area (DDA) to have a chance of attack, and a surfaced one within the surfaced danger area. These would thus be the areas which would need to be covered by the escort force if it were to be efficiently placed to detect or interfere with a threatening submarine. The shape of this diagram, and thus the front to be covered by the escort, clearly, varied with target speed, submarine dived speed and visibility.

[49] AL, CB 4097(1), "Conduct of Anti U-boat Operations" and AL, CB 1870(A)(39), A/S Manual, 1939.

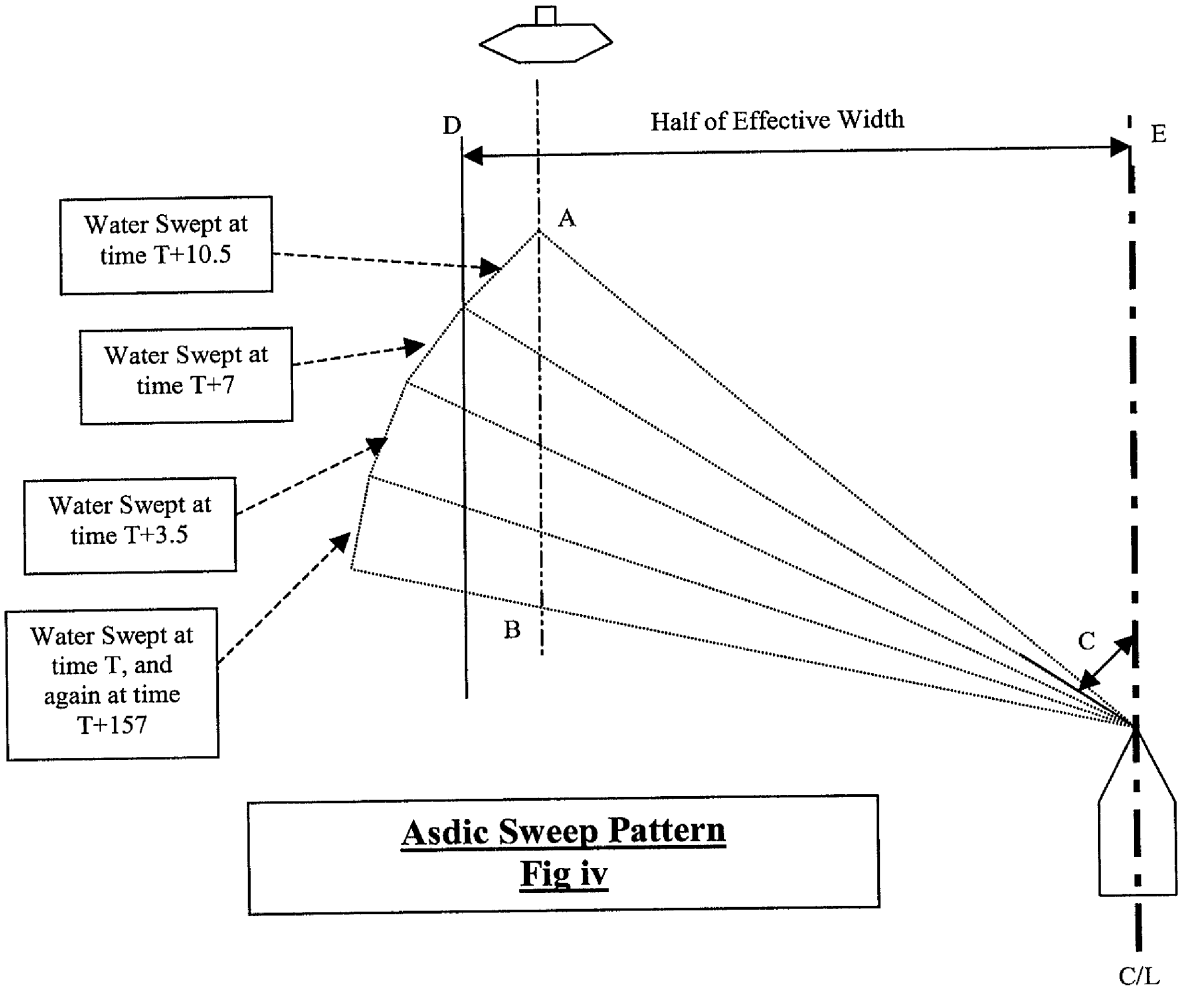
If a submarine was detected ahead of a force and within the limiting lines, the heading of the force could easily and rapidly be altered to put the submarine outside the limiting lines, so making attack impossible. The escort commander could then make a decision about whether to detach escorts to prosecute the submarine, or to keep them in their stations to protect against further attackers.[50]

The idea of a zig zag as an anti submarine tactic, all be it nakedly defensive, was well established during the First World War. The idea was to disguise the main line of advance of a force of ships by constantly zig zagging together around that line. An attacking submariner, it was hoped, would see the force on one heading and would manoeuvre himself so as to be ahead of it for a torpedo attack. Some minutes later, when he again raised his periscope to check on the ships' position, he would find that they had altered course and he was not ahead of them, as he had hoped to be. In an extreme case he might find himself outside the limiting lines of approach, so unable to attack, and in any event his approach would be made very much harder. The whole force would alter course together using pre planned zig zags executed either by signal or at a given time. Thus the ships' logs of escorts often show entries such as "Commenced zig zag No 23 at 1042". A 1916 summary indicates clearly that the tactic was well established and gave some directions as to its employment:

> Alterations of course should not be so frequent that a submarine can estimate the possible course and speed and calculate when the alteration will take place; nor should they be so seldom that it is possible for the ship to have remained on the same course throughout the time she has been visible to the submarine[51]

Although widely used during the first war, the tactic of the zig zag was hardly employed at all in exercises up to 1932 for a combination of reasons, including submarine safety, fuel economy and a need to simplify the exercises in order to develop tactics. Asdic destroyers screening the Mediterranean fleet during exercise RE in September 1932 did, however, employ zig zags. In his report Captain D2 noted that during extreme zig zags the destroyers on the wings of the fleet, which were stationed on a line of bearing, found their Asdic performance being degraded by the

[50] AL, CB 1870A "Anti submarine Manual, 1939", Part III.



Asdic Sweep Pattern
Fig iv

wake of the ship in front. The solution to this was to limit the maximum angle of the zig zag to the angle of the line of bearing.[52]

Another question concerned the spacing of units within the screen. The ideal would be (and still is) to place ships at such a spacing that there is no gap in Asdic coverage between units.[53] Inter-war Asdic sets could not search all around a ship in one transmission, but could only transmit along a cone of around five degrees. Thus, to search over an arc it was necessary to make one transmission, wait for the echoes to return (if there were any), move the transducer through five degrees, make another transmission etc. The length of time it was necessary to stay on each bearing depended on how long the furthest echoes were going to take to get back to the transducer, and that in turn was governed by the Asdic officer's estimate of the maximum effective range for the day. If oceanic conditions determined that a submarine was unlikely to be detected at a greater range than 3 000 yards, there was little point in waiting for echoes to return from 6 000 yards; the equipment would be more effectively used by moving it onto the next bearing as soon as the 3 000 yard echoes had returned.

It took around half a second for the transducer to be moved through five degrees between transmissions, so for an Asdic working range of 2 500 yards, which meant waiting 3 seconds for the echoes to return, the time between transmissions was 3.5 seconds. It was found that the best way to sweep was from 80 degrees abaft one beam through 5 degree steps to the ahead position, then from 80 degrees abaft the opposite beam again to the ahead position. This total involved 34 transmissions, as the ahead position was swept twice, and gave a basic sweep time of 119 seconds. Add to this a 25% safety margin and the 8 seconds required to train from ahead to 80 degrees abaft the beam, and the total sweep time was 157 seconds.

Fig iv shows a submarine approaching a ship conducting just such a sweep, the sweep starting at time T. Clearly, if the submarine is so fortunate as to be able to transit from A to B between T+(10.5) and T+(157) seconds, it will be able to avoid detection, passing the Asdic ship with impunity. It is possible to derive an equation for the angle C, or effective angle, such that any submarine approaching within the corridor D-E, or effective width, could not avoid at least being swept by Asdic. The

[51] PRO ADM 1/8478/2 CB 0259 "Remarks on Submarine Warfare", 1916.
[52] PRO ADM 186/152, CB 1769/32(2).

angle C varied according to Asdic range being used, ship speed and estimation of submarine speed. It was of course far from guaranteed that a submarine within the cone of the Asdic transducer would be detected, but the chances of detection could be optimised by ensuring that the effective widths of adjacent ships abutted, or overlapped. For an Asdic screen, therefore, the spacing of the screening ships would be the same as the effective sweep width in the prevailing conditions.

Use of Aircraft

A discussion of the whole naval air controversy, which dogged the development of British maritime air throughout the inter-war years, falls outside the scope of this dissertation, but it is worth noting some of the salient points of the debate as they relate to this subject. Aircraft tactics were equally applicable to the defensive screening of mercantile convoys and other faster, more valuable units, the speed of the aircraft being in either case so much greater than that of the ships that the tactics were interchangeable. For this reason this subject, rather than being subsumed into either the convoy or warship/troopship sections, is afforded a separate section of its own.

Broadly, procurement and control of ship borne aircraft throughout the period was an Admiralty responsibility, as was the training of aircraft observers, while the Air Ministry was responsible for shore based aircraft, all air weapons, and training of all aircrew with the exception of naval observers.[54]

The Air Force was largely dominated by bombing enthusiasts who felt that the best place to hit any enemy capability was at source. The RAF anti submarine offensive would thus be directed against U-boats in their bases rather than at sea, and the best weapon to achieve this end was a large contact fused bomb which did not have to be dropped against a moving target, or with any particular accuracy. Further, any mission flown against an enemy naval base was likely to come up against considerable anti aircraft fire; the bombers would therefore be well advised to fly at medium or high altitude. Clearly, a high level aircraft dropping contact fused bombs with at best moderate accuracy against a static target, having no sighting capability

[53] The following is taken from AL, CB 1870(A)(39), Anti submarine Manual, 1939, but these principles are thought to have been current throughout the period under study.
[54] This is a great simplification of a complex subject. The most reasoned explanations are to be found in S W Roskill "Naval Policy Between the Wars" and J Buckley "The RAF and Trade Defence 1919-1945".

against a moving one, stood very little chance of hitting a submarine on the surface, and none at all of hitting one dived. It must be conceded here that the Admiralty was not free from similar belief in "forward defence". It was written in the Naval War Manual of 1925 that "If the enemy attacks trade, an attack upon some interest which he will feel bound to defend may result in the withdrawal of his forces from trade attack" and more specifically that "Attacks upon the bases of forces attacking trade is (sic) an important method of reducing the activities of these forces"[55]

Notwithstanding this, there was an acknowledged requirement for a maritime strike aircraft, and these were flown by Coastal Area, or Coastal Command as it later became known. In the early inter-war years these tended to be large flying boats aimed at an Imperial policing role and lacking any useful weapons. In the later years, largely in response to Admiralty concerns, greater emphasis was placed on aircraft which could attack shipping, though even these had to have a secondary capability as strategic bombers, and ended up not being terribly good at either role. The broad situation, therefore, with respect to RAF anti submarine aircraft was that they were grudgingly allocated in no great numbers, and suffered from very definite restrictions in capability.

RN carrier borne aircraft, necessarily smaller and of lesser endurance than Coastal Command's land based aircraft, were generally envisaged as being reconnaissance tools. If the main threat was from surface ships they would be used to seek out the enemy and, once he had been found, to spot for the big gun warships. Some were assigned the role of fighters, to shoot down or chase off enemy reconnaissance or spotting aircraft, but their maritime attack capability was largely disregarded. In a similar way, their main role against a submarine threat was to screen ahead of the ships to be protected, forcing the submarine to dive and alerting friendly ships to its presence. The attack would then be delivered by anti submarine ships guided to the scene by the aircraft.

The 1926 CB 3002 mentioned that Fleet exercises had demonstrated the importance of "combined anti submarine tactics by ASDIC destroyers and aircraft", and noted that "this will receive more attention in the future", but there is no direct indication that aircraft were getting involved in Portland exercises. They were, however, used extensively in the fleet exercises, where the first problems encountered

[55] ADM 186/66, CB 973 "Naval war Manual 1925", p35 paras 233,234.

revolved around communications. In the early days aircraft communicated with ships using flashing light, and the 1928 edition of the Battle Instructions specified that the outer air patrol should "pay attention to the outer limit (of their patrol area) as this is where submarines will first be located. They should close the extended screen at intervals though, to verify position and receive (visual signalling) signals".[56] The same instructions specified that aircraft should indicate the position of the submarine by conducting a series of dives, or actually attacking, while surface vessels were to use flashing light, or flags, or point their forward guns in the direction of a detected submarine.

The increased use of aircraft radios, which promised to solve many problems, actually introduced a number of new difficulties. The aircraft radio sets available in the 1920s were rudimentary and notoriously unreliable, with the result that the aircraft often had great difficulty in alerting ships to the presence of a submarine, or guiding them onto it.[57]

The limited radio fit in fleet destroyers also presented obstacles to the development of co-ordinated tactics. Ships in a screen were unable simultaneously to monitor traffic on aircraft and surface ship nets, and as it was necessary for the screen as a whole to be informed of traffic on both nets it became the practice for some ships to watch one net and some to watch the other. The method settled on in exercise AU[58] was for the flotilla leader to watch the aircraft circuit, in order to obtain early warning of submarines. He would then use flashing light to communicate this information, and his instructions, to the rest of the screen. If he was within visual signalling range of the main body he could simultaneously send a contact report, which would provoke the commander of the main body to issue instructions for evasive action. If the screen commander was out of visual signalling range of the main body, as was often the case, it would fall to one of the screen destroyers to make the contact report to the main body. The time taken for an aircraft to contact the screen commander, the screen commander to make a visual signal to the screen, one of the screen to make a morse contact report to the main body, and the main body commander to issue his intentions, was clearly too long for this arrangement to be satisfactory in a tactical environment. There was also a requirement for the main body commander to pass instructions to the

[56] PRO ADM 186/106, CB 01821.
[57] See, for example, exercise NO in ADM 186/143, CB 1769/27(2).
[58] PRO ADM 186/148, CB 1769/30(2).

aircraft, and for this purpose the 1934 amendment to the Battle Instructions specified that "vessels of the extended screen are responsible for passing to aircraft of the outer patrol all signals that affect them"[59]

Awareness of the shortcomings of air/sea radio communications forced the introduction of other tactics. During exercise NX in 1928 it was found that aircraft could, by firing Very flares and diving over the position of a submarine, attract the attention of the escorts.[60]

A year later further methods had been developed, and the report on one 1929 exercise noted that aircraft had indicated detection of a submarine variously by circling the detected boat, firing very lights, indicating "SSSS" on flashing light, dropping smoke bombs or making radio contact. In one textbook action an aircraft detected the presence of a submarine and was joined by *Rowena* and *Salmon*, who both gained Asdic contact and were later considered to have prosecuted the boat to destruction.[61]

It seems the communications fits of destroyers improved with time, a 1928 paper on destroyer policy stating that all newly built ships were being constructed with one short wave and one long wave set, flotilla leaders being fitted with three sets.[62] Further improvements followed, as shown in a report that noted that aircraft radios, which had until 1931 required constant tuning, were greatly improved, with the result that it was no longer necessary to carry three in an aircraft to keep one frequency open.[63]

The utility of aircraft when working with surface ships in a striking force was explored at some length, with the conclusion that if the aircraft was able to maintain contact with the submarine once dived it could then indicate this position to surface ships, which had a reasonable chance of engaging the submarine. If, as was usually the case in Atlantic waters, the submarine was lost once dived, there was little benefit to be had from guiding destroyers to the submarine's last known position unless the destroyers were already reasonably close by. A full discussion of the subject of area patrols and striking forces, which addresses the issue of having ships stand by ready to be guided by aircraft, is undertaken later in the dissertation.

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[59] PRO ADM 186/106, CB 01821.
[60] PRO ADM 186/144, CB 1769/28(2)
[61] Ibid.
[62] PRO ADM 116/2685 "Destroyer Policy", 1928.
[63] PRO ADM 116/2792 "Shipborne Aircraft", 1931.

The 1930 CB 3002 contained a note that aircraft had been used to counter shadowing submarines to some effect. This may have reflected the results of exercise OD in June 1929, in which an eight knot convoy with a heavy escort and land based air support was attacked by surface units and the first submarine flotilla. The defending aircraft met with considerable success, detecting and harassing surfaced submarines. One aircraft is reported to have found a submarine (L23) and "took three photographs of her on the surface at heights between 600 and 250ft. The aircraft approached down sun with engine throttled down. L23 does not appear to have observed the attack, and took no action."[64] How frustrating, then, for the aircrew to know that they possessed no effective anti submarine weapons.[65]

The Battle Instructions of 1928, which were amended in 1934 to an edition which remained in force until 1938, acknowledged the high workload imposed on anti submarine aircraft crews by navigation and communication requirements. The instructions specified that the outer patrol, which worked out of visual range of the destroyer screen, was to be made up of multi seat W/T fitted aircraft, while any aircraft could be employed on the inner screen.[66]

Atlantic fleet exercise AR, in November 1929, saw the Battle Fleet, its normal complement of destroyers augmented by 1A/S, being attacked by no less than 15 submarines. In addition to the aircraft of *Furious* and *Argus*, the flying boats of 201 flight RAF were supporting the Fleet. The destroyers were stationed 10nm ahead of the Fleet, and the aircraft worked further ahead, there being no inner air patrol. Even though the Fleet was not permitted to zig zag or undertake any evasive steering, only one of the 15 attacking submarines managed to make an undetected approach. Rear Admiral (Destroyers) commented in his report that "Though only two submarines were sighted (from the air), the air patrols had the effect of often putting down the submarines when still well ahead of the anti submarine vessels". As well as the implications for battery conservation, this would have meant that the submariners were much less aware of the positions of the escorts and the main body. Rear Admiral (Submarines) confirmed this feeling when he wrote, in the same report, that the success of the anti submarine force "encourages belief in the value of such vessels as a striking force well ahead of the Fleet, especially when air co-operation is available".

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[64] PRO ADM 186/145, CB 1769/29(1).

[65] A full discussion of the issue of procurement of air weapons can be found in the final section of this chapter.

For policy development purposes, however, the final word lay in the Admiralty's concluding comments that the submarines were badly handled and that "there is hardly enough evidence to show that this is the best way to use Asdic vessels in home waters, where submarines are not easily detected by aircraft".[67]

As has already been mentioned, the inability in home waters to see a dived submarine from the air was not vastly significant from a tactical point of view, as the aircraft would have achieved its objective merely by forcing the submarine to dive, so denying it the opportunity to attack. The only decision which remained was whether or not to send Asdic vessels to hunt the submarine once it had dived. Clearly the sea state, escort speed, and range of the submarine from the nearest escorts would inform this decision, but the most significant factor would be the ability of the aircraft to track the dived submarine.

In mid 1930 the Atlantic Fleet exercised the defence of a 10 knot convoy, simulated by battlecruisers and battleships, against an attack by 16 submarines. The convoy was protected by two destroyer flotillas, aircraft from *Argus*, and flying boats of the RAF. The destroyers in this case were split between a close screen and a distant screen 6nm ahead of the main body. The tactics proposed for the submarines were practically identical to those later used by Donitz for the wolf packs. Any submariner finding the force would shadow, making positional reports to his Commander in Chief, who would direct other submarines to intercept. Although one submarine did manage to shadow successfully, all attempted daytime attacks were detected and countered by the aircraft and destroyers, forcing RA(S)'s somewhat fatalistic comment that "against enemy anti submarine air patrol it is desirable when possible to maintain a dived patrol".[68] The same exercise conducted at night, it was conceded, would have presented much greater problems for the defending force.

An investigation into the utility of flying boats was carried out by the Mediterranean Fleet in 1932. This seems to have taken the form of all Commanding Officers submitting their thoughts to the Commander in Chief, who drew conclusions and circulated the resulting paper to the fleet and the Admiralty. Some Commanding Officers gave their own opinions and some commissioned wardrooms to conduct the study themselves. Detailed reports do not survive, but various notes made on

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[66] PRO ADM 186/106, CB 01821, "Battle Instructions", June 1928.
[67] PRO ADM 186/146, CB 1769/29(2).
[68] PRO ADM 186/147, CB 1769/30(1).

circulation are available.[69] The Commander in Chief showed a sound understanding of the subject, acknowledging the usefulness of flying boat patrols in keeping submarines down and stating that "There is general agreement that, if aircraft accompany convoys, the danger from submarine attack will be reduced" while qualifying his enthusiasm by conceding that "It is more than doubtful if flying boats, unaided, will ever be able to destroy or neutralise hostile forces (whatever their nature) employed in the attack on trade"

The Director of Plans, a certain John Cunningham, lived up to the model of an influential officer with no real understanding of anti submarine in minuting under the Commander in Chief's comments that "It is not considered, however, that the use of flying boats for the protection of trade would materially reduce the numbers of auxiliary vessels required in war" and, extraordinarily, going on to argue that "It seems doubtful whether the great number of aircraft required to search an area has been generally realised." It is clear from these comments that Cunningham was still thinking in terms of clearing large ocean areas of submarines, rather than just sweeping ahead of a force. The Vice Admiral Commanding the First Battle Squadron broadly agreed with Cunningham, but the Captain of the *Resolution* was openly optimistic, believing that "With a depth charge load equivalent to that of a 'P' boat and a speed four times that of any surface craft, the flying boat would prove a definite menace to submarine operations."[70]

While it is unclear if this study had any influence on policy, it allows an interesting insight into the spread of opinion about the subject. In particular, the failure of the Director of Plans to understand the subject backs up the point made earlier that there was a narrow vertical column in the staff who appreciated the problems, and that few of those outside that column were well informed.

The limitations of aircraft when protecting a force in a narrow seaway were illustrated during Atlantic Fleet exercise AU in October 1930. The objective of this exercise was to screen battleships as they passed, in ones and twos, through a nine mile wide channel.[71] The aircraft were successful in forcing the submarines to operate dived, making only intermittent use of periscopes. The narrowness of the channel, however, meant that the submariner could, even only occasionally using the periscope,

[69] All the following are taken from PRO ADM 116/2862 "Flying Boat Operations", 1932.
[70] It should be noted here that flying boats, until well into the war, did not carry depth charges.
[71] PRO ADM 186/148, CB 1769/30(2).

be fairly sure of spotting the battleships as they passed. In other words, the battleships were forced, by navigational constraints, to put the submarines in the dived danger area, so negating the benefits of forcing them to dive. Defence was thus left to the Asdic screen, which detected only 19 of the 36 attacks. Clearly, in this special instance it would have been most useful for the aircraft to be able to detect dived submarines, as they could in the Mediterranean. Exercise RZ in the Mediterranean in 1933 saw the Battle Fleet successfully defended against submarine attack, and exercises in the Mediterranean in 1934 were again successful in using aircraft to locate submarines and direct depth charge fitted ships on to the target, even indicating the correct time to drop depth charges.[72]

The key point about the use of aircraft in screening operations was that, although they had little hope of inflicting damage on the submarine, they could summon escorts to attack it. In this way, they forced surfaced submarines to dive, so reducing the time they could spend recharging or conserving batteries. Similarly, aircraft could force dived submarines to lower their periscopes, so reducing their chanced of sighting, intercepting and attacking surface units. The ability to see a dived submarine, in conditions such as prevailed in the Mediterranean, was thus not a pre-requisite for the successful employment of aircraft. Further, detection of a submarine ahead of the main body could allow the main body and to alter course, putting the submarine outside the dived or surfaced danger areas, so overcoming the danger presented without having to track or engage the submarine.

One of the difficulties experienced in developing aircraft/escort co-operation concerned the time taken by destroyers, sloops and, especially, trawlers to reach the point being indicated by the aircraft. Clearly, an aircraft detection made in close proximity to the main screen presented few difficulties, but one made some distance off could be more problematic. A submarine which was forced to dive, for example, ten miles ahead of the screen might, as Captain D2 reported in 1932, "not offer sufficient chance of success to justify detachment of a hunting force".[73] If the hunting force were able to steam at 30 knots, it would in this instance take them 20 minutes to reach the last known position of the target, by which time a dived submarine could have moved by as much as two or three miles, making the probability of Asdic detection very slim. The tactic decided on for such occasions was for the aircraft to

[72] PRO ADM 186/515, CB 3002/34 and PRO ADM 186/156, CB 1769/34(2).
[73] PRO ADM 186/151, CB 1769/32(1).

conduct an expanding circle patrol around the last known position of the submarine, so keeping it down, and for the main body to alter course to put the submarine outside the dived danger area. The 1934 amendment to the Battle Instructions discussed the employment of an outer air patrol in conjunction with an extended screen. These instructions specified that when an aircraft made contact the nearest escort was to close the submarine, unless that involved being more than 5 miles out of station or within 3 miles of the main screen. In the former instance the chances of achieving a successful prosecution were not good enough to justify moving the ship, and in the latter the responsibility for engaging the submarine fell to the ships of the inner screen.

The contrast between air operations in the Mediterranean and the Atlantic was demonstrated by the difference between the reports on exercise NX, previously discussed, and TP1. In NX, aircraft working in support of Asdic ships in the Mediterranean were able to guide ships onto submarines, while in the Atlantic exercise TP1 the submarines were lost once dived, leading the Commanding officer of *Thruster* to conclude that "The flying boats, in this exercise, proved of no assistance to the A/S vessels in searching for submarines."[74] Here again the subtlety emerges in the varying utility of aircraft. When escorting a main body, engaged in an essentially defensive operation, the requirement was to deny the submariner the opportunity to work into a firing position, so the aircraft only had to detect him on the surface and force him down to achieve success. In more offensive operations, where the surface ships were required to engage and destroy the submarine, merely forcing him down was not enough; the aircraft had to track the dived submarine for long enough for the surface ships to close and obtain Asdic contact.

By way of an end note it is worth mentioning a technique pioneered in the final months of the First World War and then, seemingly, abandoned, but which might have proved useful in convoy defence. These experiments involved the fitting of hydrophones to seaplanes, which could land on the surface of the sea, shut down their engines to minimise their own noise, and lower the hydrophone on the end of a 10' arm to listen for submarines. These hydrophones were directional and allowed a pair of aircraft working together to localise a dived submarine with some accuracy. Photographs remain of this equipment fitted to type F2 and F3 flying boats as well as

[74] PRO ADM 186/157, CB 1769/35.

a Short seaplane, but there is no evidence that the technique was pursued after the armistice.[75] Attempts were also made to tow hydrophones behind airships, but the noise in the airship cabin meant that this method was found to be useless.[76]

Liaison between carrier aviators and the anti submarine community appears to have been satisfactory, though the links between Coastal Command and the Navy were less well developed. There was at least one attempt by the Admiralty to rectify this shortcoming; a letter from the Admiralty to the Air Ministry in 1936 requested that 217 squadron, which often took part in Portland exercises, either move to a base closer to Portland or provide a liaison officer to the anti submarine school.[77] This liaison, which was felt by their lordships to be "of considerable urgency" was planned to allow investigation of anti submarine cooperation, training of Coastal Command personnel in anti submarine work and instruction of RN officers in the capabilities of anti submarine aircraft. This sentiment was supported by Coastal Command, but when passed on to the Air Ministry, which was dominated by bombing enthusiasts, a sympathetic officer reported that "Unfortunately I have come up against some very heavy artillery and as a consequence have had to retire somewhat hurt. I am very sorry that I have not been able to do any better than this...".[78]

In summary, a requirement was identified in 1926 to study the use of aircraft in conjunction with Asdic destroyers in order to locate and prosecute enemy submarines. The early experiments took place in the fleets, rather than at Portland, and communications between the aircraft and the ships proved problematic. These difficulties were soon overcome, and in 1929 air patrols proved successful in countering shadowing submarines and prosecuting those ahead of the force, to the extent that their use as part of an anti submarine striking force was considered. Over time limitations were identified, these involving the difficulties of providing effective cover at night or in narrow waters, and the fact that detected submarines were escaping because escorts were too slow to reach the position in which the aircraft had forced the submarine to dive. By 1934, however, tactics had become largely standardised, with well trained aircraft and ships able to work in combination to deter or prosecute submarines. The only serious shortcomings, apart from the night

[75] PRO ADM 186/406, CB 865 "Hydrophones in Flying Boats and Float Seaplanes".
[76] PRO ADM 186/434, CB 01412 A/S Division monthly update of experimental work, December 1918.
[77] PRO AIR 20/236 "Anti submarine Work".
[78] Deputy Director Operations (Naval Cooperation) to Air Officer C in C Coastal Command 28/3/39, in PRO AIR 20/236 "Anti submarine Work".

detection problem, concerned the paucity of suitably equipped and trained Coastal Command squadrons, and the lack of effective air launched anti submarine weapons.

However widespread the agreement that aircraft were useful, vital even, for effective anti submarine defence, there remained a number of questions surrounding the availability and provision of platforms. The Commander in Chief of the Atlantic Fleet, in 1931, gave his personal view of the importance of aircraft in the anti submarine role. In prioritising the roles of carrier aircraft he put reconnaissance, which he held to include anti submarine work, ahead of gunnery, spotting or any attack role. In a discussion of the merits of carrier aircraft and those embarked in other types of ship he conceded that a force without an attached carrier was unlikely to be able to mount an airborne anti submarine patrol, from which one can conclude that the majority of convoys, and certainly those in mid Atlantic, would have to operate without air cover.[79]

The whole position was summarised in a 1938 Air Ministry paper on anti submarine tactics and operations, which stated that a battle fleet would generally have enough aircraft attached to it to ensure anti submarine protection. If trade was not in convoy, each of 14 designated coastal anti submarine patrol areas would have an aircraft allocated by daylight hours, while in the event of convoy being used each convoy would have one aircraft for escort during daylight. If the movement of the main body was unrestricted and enemy submarines were working without surface or air cooperation the air escort would work 2 hours steaming ahead of the convoy to interfere with surfaced approach. If the enemy was thought to have enough information to be able to make a dived approach the aircraft would work in an inner patrol area just ahead of the convoy.[80]

As will be shown, in the early weeks of the war aircraft carriers were employed on offensive anti submarine operations, but not as escorts. Although there was no question that any force would enjoy more solid anti submarine protection if there was a carrier in the group, the major fleet carriers were too few and too valuable to be used on convoy escort work. It must be remembered that the loss of *Courageous*, which at the time was engaged in anti submarine operations, represented an effective 25% diminution in the RN's available carrier capability. Although occasional references

[79] PRO ADM 116/2792 "Shipborne Aircraft", report by CinC Atlantic 8/5/31 "Review of the Situation Regarding Aircraft in the Fleet".
[80] PRO AIR 15/38 "Air Tactics, A/S Operations", 1938.

have been found to the desirability of having aircraft carriers attached to convoys to provide constant air cover, it seems clear that a navy which, when it came to war, could not provide two destroyers for every convoy, was in the inter-war years in no position to start building dedicated escort carriers.

Hague[81] writes of "treasury parsimony" being behind the failure to develop an escort carrier, but Admiralty and Air Ministry documents tell another story. An October 1935 Admiralty paper[82] argued for light carriers of 14 500 tons carrying 15 light aircraft, which could support striking forces or escort convoys. The supporting argument asserted that "The most effective use must therefore be made of our Asdic forces, and aircraft will be needed for sighting and directing the Asdic groups towards enemy submarines." The Air Ministry, in the personage of a certain Group Captain A T Harris, countering with the line that "The Navy never regard aircraft as otherwise than an ancillary weapon mainly for reconnaissance and defensive work, and the idea that every aircraft allotted to such duties is a dead loss from the total offensive power available from our strained resources simply does not sink in at all",[83] argued that shore based aircraft were in fact more mobile than carrier borne ones, and that "the Admiralty paper is a typical example of the senseless and greedy waste of national resources in purely defensive measures."[84] The invective continued at some length, and if it does not tell the whole story, which lies outside the proper scope of this dissertation, it must at least give some background to the lack of escort carriers in 1939.

Surfaced Night Attack

Surfaced night approach could be used by submarines to attack any kind of target, warships, troopships and mercantile convoys. There is a common theme in the literature surrounding this subject which holds that the inter-war Admiralty failed utterly to appreciate the dangers posed by U-boats attacking on the surface under cover of darkness. Specifically, the accusation is frequently levelled that there was no awareness that a surfaced U-boat presented a poor Asdic target. Roskill writes of the

[81] Hague, op cit, p77.
[82] PRO AIR 2/2729, "Proposed squadrons and Aircraft required for Sea Communications and Trade Protection in Time of War", 1935. Contains Admiralty and Air Ministry papers on the subject.
[83] Ibid, memorandum signed by Harris, 1/11/35.
[84] Ibid.

"failure to appreciate that (Asdic) was useless against a surfaced submarine",[85] while Peter Padfield refines the accusation by suggesting that the Admiralty assumed that U-boats would attack dived.[86] David Henry claims that the "First use of night surface attacks by German U-boats in the Second World War was to come as a surprise to British anti submarine forces"[87], and Hackmann states that "during the inter-war years the anti submarine forces were not equipped or trained to counter night tactics"[88]. Terraine notes that Asdic was "demonstrably useless against a submarine on the surface"[89], but makes no suggestions about the Admiralty's perception of likely German tactics, or any proposed solution.

In this section it will be argued that there was some official awareness that surfaced submarines were poor Asdic targets, that they are hard to see at night, and that they could have posed a very potent threat. Hackmann's comment that the RN was unprepared for night surfaced attack will be consolidated, but it will be argued that this was not for lack of trying, and that until the development of radar it was simply impossible to counter this threat.

It seems that in the early days of Asdic it was indeed not appreciated that surfaced submarines gave worse returns than dived ones. The report on a 1921 exercise involving two P boats noted that "P40's Asdic was working well, P38's indifferently, and no echo could be obtained from the submarine, *even when on the surface after the exercise*" (author's italics).[90] A year later, however, evidence was emerging that Asdic was not fully effective against surfaced submarines, a report on one set of 1922 trials stating that "The submarine was first picked up at 1000 yards on the surface, and again at 1800 yards after diving to periscope depth, the echoes now being distinctly better"[91]

Understanding of the properties and behaviour of underwater sound was, at this stage, basic, and in particular there was no real appreciation of the effects of vertical stratification of the water column. It had been noted that Asdic ranges could drop significantly during hot weather, especially in warm climates, and trials were carried out in 1931 into Asdic detection ranges in the Mediterranean. The reports on these

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[85] S W Roskill, "Naval Policy Between the Wars", vol 2, p228.
[86] Padfield, op cit, pp 22-24.
[87] David Henry "British Submarine policy", in Bryan Ranft (ed) "Technical Change and British Naval Policy 1860-1939", p 93.
[88] Hackmann op cit, p132 .
[89] Teraine, op cit, p178.
[90] PRO ADM 1/8609/138, "Asdics; anti submarine flotilla – state and proceedings, w/e 9 Jul 21".

trials[92] indicated that, depending on conditions, sound in water could be refracted up or down. The scientists expected, among other conclusions, to find that ranges increased as the submarine dived from periscope depth, and it does not seem an unreasonable leap to conclude that they expected echoes from a surfaced submarine to be even worse than those from one at periscope depth. Regrettably the report concluded that there were "insufficient trials to give conclusive evidence", and there is no indication that trials were carried out against surfaced submarines.

By 1935 staff at the Admiralty Research Laboratory at Teddington were beginning to understand the refractive paths taken by underwater sound, and the deleterious effects of a negative velocity gradient were becoming apparent[93]. A substantial section of that year's CB3002 was dedicated to the peripheral benefits which might be gained from Asdic equipment. While the majority of this section is of minimal interest for the purposes of this study, one paragraph does stand out as being particularly revealing: "Whether surface craft can be detected, when their whereabouts are unknown, at ranges usefully in excess of low or night visibility will be matter for experiment".[94] Although specifically directed at destroyers and small torpedo boats, the results of such experiments would have given information about the usefulness, or otherwise, of Asdic in detecting submarines making surfaced night approaches. Regrettably no evidence has been found of the results of these experiments (assuming they took place) but it would be difficult to imagine them coming up with any other conclusion than that a contact on the surface gave a worse return than a dived one. Circumstantial and uncertain as this evidence is, it does provide another suggestion that there was an institutional and official awareness of the difficulty of using Asdic to detect vessels on the surface.

There is further evidence in this report that doubt already existed about the efficiency of Asdic against surfaced submarines. During an exercise in harbour defence it was decided, for reasons of safety, that the submarines would attack on the surface. Little success was had against these surfaced targets, and the conclusion drawn was as follows:

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[91] PRO ADM 186/758, HM Signal School Experimental Department Quarterly Report, March 1922.
[92] PRO ADM 186/479, CB 1835(2), "Reports on A/S work; investigation of conditions affecting Asdic results during summer months".
[93] See Appendix A for an explanation of basic Asdic theory.
[94] PRO ADM 186/522, CB 3002(35).

> It was suggested that submarines on the surface, and trimmed down, make bad Asdic targets, but it is more probable that the difficulty of detection is due rather to the submarines being able to see the patrols (which were using navigation lights), to keep continuously end on and to avoid close approach, and the difficulties of the patrol would not be so great in war[95]

Someone in the Portland organisation clearly recognised the advantages the submariner had when making a night surfaced approach, but the collective solution in this instance appears to have leant on a simple act of faith and a good deal of optimism. There was, however, undoubtedly an official awareness of the possibility that surfaced submarines made bad Asdic targets. In discussing static harbour defence Asdic, the 1937 CB 3002 noted that a dived submarine could be detected at 5000 yards, as against 4000 yards for a surfaced one.

It is of note that although none of the CB 3002 series or other Portland reports made any differentiation between night and day tactics, the fleets used very different dispositions for daylight and darkness. Fig v gives fairly typical examples of the difference between day and night dispositions. The enemy forces for both these exercises included submarines and surface forces, and a great deal can be deduced from analysis of the screens used. In both cases the destroyers were stationed, by day, in accordance with the contemporary Portland doctrine, with cruisers being placed further out to counter the surface threat. By night, however, the destroyers are moved to the flanks of the convoy, in a classic disposition to achieve their primary aim of defence against enemy torpedo carrying destroyers. The policy of screening for destroyer attack by night and submarine attack by day had been refined for the Atlantic fleet exercise MA of January 1929, during which different night dispositions were ordered, depending on whether the primary threat was believed to come from surface units or submarines, as shown in fig vi. Two conclusions can be drawn from this; the first, which should surprise nobody, being that the threat from destroyers was greatest at night. The second is that while there was some merit in forming a screen ahead of the force by day, the chances of detecting a submarine by night were so small as to make the screens designed at Portland worthless. Further, it is not inconceivable

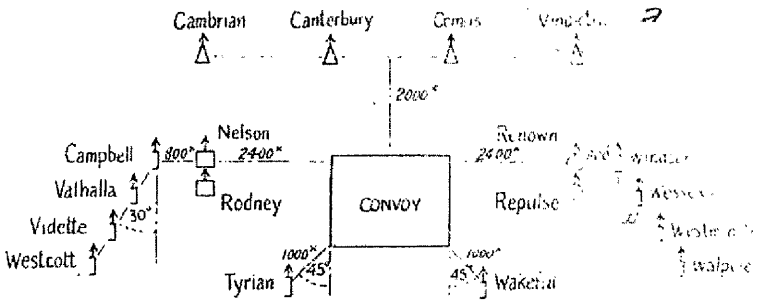
[95] Ibid.

Cruising Dispositions for Exercise OD, June 1929
CB 1769/29(1), PRO ADM 186/145
Fig v

Diagram 4.

CRUISING DISPOSITION Nº 13.

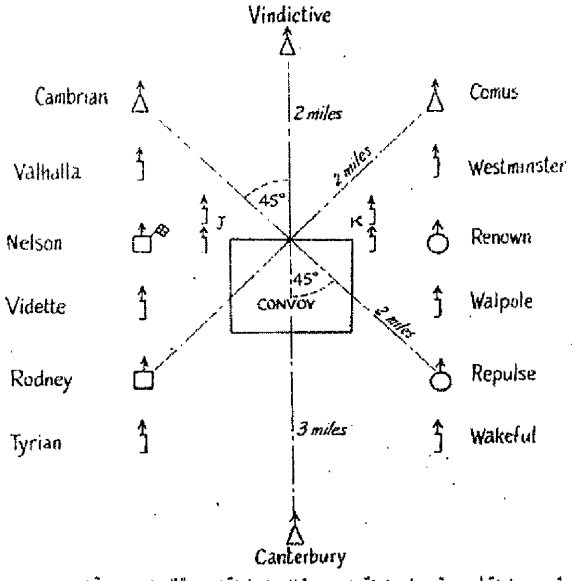
(FOR NIGHT WHEN ONLY SUBMARINES ARE EXPECTED).



SCREENING DIAGRAM Nº 22.

(FOR NIGHT WHEN ANY ENEMY FORCES MAY BE EXPECTED).

Diagram 7.



J. "Campbell" and "Westcott." K. "Windsor" and "Wessex."

On night of 16th/17th January, "Campbell" and "Wessex" took "Vindictives" place.

Cruising Disposition for Exercise MA, January 1929
CB 1769/29(1), PRO ADM 186/145
Fig vi

that the night screens were specifically aimed at surfaced submarines which, with their increased speeds, could approach even a relatively fast moving main body from the flanks or the rear. Thus, defence against a slow dived submarine during the day would call for an Asdic screen to work within the dived danger area, as in fig v, diagram No 12, while defence against a submarine able to operate at greater speeds on the surface at night would require an all round visual screen. There is no positive evidence that this was the principle employed in the design of day and night screens, but in the absence of any explanation of the underlying theory we can only rely on conjecture.

There were further indications of awareness within the Naval Staff that surfaced night attack presented a real problem. It was not uncommon for a submarine to be able to penetrate convoys or battle fleets by night. A fine example, far from unique, was L26 which, during the Mediterranean fleet exercise OC in May 1929, passed right through the fleet, on the surface at night, "probably passing within a few hundred yards of Valentine".[96] OC's post exercise report, which will have been a widely read document, made no attempt to shy away from the difficulties inherent in countering a submarine attacking or shadowing on the surface by night. The Captain of the first submarine flotilla wrote that "It is not only obvious, but has already been clearly established in many exercises, that submarines, with their low freeboards, should always be able to remain unseen at night"[97]

The Rear Admiral commanding the first battle squadron summed up that "This exercise has opened up a large field for investigation in regard to the tactical use of Asdic vessels in anti shadowing operations against submarines"[98] To a serving officer, this reads like a pretty good senior officer's euphemism for "we are getting our tactics wrong, and risk leaving ourselves in a vulnerable position". The following year, during exercise AS, the submarine L26 was able to spend the whole night tracking a cruiser from a range of 1/4nm without being detected[99].

In 1932, the utility of a surfaced submarine at night had not been forgotten, the Commander in Chief of the Mediterranean Fleet writing in his report on exercise QS

[96] PRO ADM 186/145, CB 1769/29(1).
[97] Ibid.
[98] Ibid.

that "A submarine after dark becomes virtually a slow and unhandy torpedo carrier which, due to her low silhouette, is unlikely to be spotted by enemy forces".[100] It is clear from this that there was a practical understanding of the problems posed by surfaced submarines. Still in question, however, is the extent of this crucial awareness within the wider navy. Significantly, the instructions for exercise AS in 1930 specified that submarines, for safety reasons, were to remain on the surface at night. There is evidence that this was a standard exercise instruction, which would indicate that night attacks by surfaced submarines would have been a familiar experience for the men of the fleets. The only surviving set of standard anti submarine exercise instructions are those contained in CB 4000, dated 1938.[101] These specified that

> In peace, submarines are not allowed to dive during dark hours, except in purely submarine and anti submarine exercises in accordance with the instructions in Chapter 7
>
> They are, however, allowed to operate on the surface during dark hours but should, as far as possible, be kept clear of areas where surface forces are likely to make contact.

The instructions in chapter 7, referred to above, made it clear that diving a submarine at night was to be an exceptional practice more than the norm. They specified, among other things, that the anti submarine ships should have special look outs posted, clear weather was required (not something to be relied on in the Portland areas), the area should be relatively free from shipping (again, not a condition often found at Portland), the target ships should be on a steady course at a maximum speed of 20 knots and the submarine Commanding Officer was to be on the bridge for diving. In all, then, the vast majority of tactical night time exercises carried out by submarines must have been conducted on the surface.

The limitation of the CB 4000 evidence is that it specified the regulations as they stood in 1938, and gives no firm idea of when these restrictions were instituted. Given that submarines were being held on the surface in exercises at least as early as

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[99] PRO ADM 186/147, CB 1769/30(1).
[100] PRO ADM 186/152 CB 1769/32(2).
[101] AL, CB 4000, "Instructions for Submarine and Anti submarine Exercises, 1938"

1930[102], that increasing familiarity with anti submarine procedures will have decreased rather than increased the risk involved, and that no specific incidents or collisions took place which might have forced a tightening of the regulations, it is reasonable to infer that the instructions detailed in the 1938 edition of CB 4000 were extant in previous editions of that book some time before that year.

In exercise ZP in 1938, which involved large numbers of ships, the danger of collision between ships and submarines was so great that the latter were ordered to keep clear and not participate at night. From this one can strongly infer a further acceptance that, with or without Asdic, it was difficult to detect submarines by night.

Vice Admiral Sir Ian McGeoch remembers exercising his submarine on the surface against ships in the Mediterranean during the inter-war period. Although he reports that navigation lights were generally used by submarines and ships alike, he does remember one exercise during which, as a Midshipman on the bridge of *Devonshire*, he saw a darkened submarine operating on the surface.[103] The rules laid out in CB 4000 certainly provided for submarines to operate darkened on the surface, but specified that they should only do so when the CO was on the bridge.[104]

The collective implications of this evidence are that fleet exercises, very few of which were pure anti submarine exercises, would have been conducted with submarines on the surface, and where necessary for training, the submarine would have been allowed to approach the surface ships at night, generally but not invariably showing navigation lights. Further, the conditions required for night diving were far from guaranteed in the Portland area, so many of the Portland exercises conducted at night would have been against surfaced submarines. Certainly among the Fleets, then, and probably among the Portland community, there was a substantial corporate experience of night operation against surfaced submarines. This finding is in direct conflict with Padfield's unprovenanced assertion that, during the inter-war period, "Night surface attack was not practised."[105]

In 1938 Admiral McGeoch, then a Sub Lieutenant serving in submarines in the Mediterranean, submitted a paper for publication in the RUSI journal on the subject of the offensive potential of the submarine. Among other points, Admiral McGeoch suggested that the Royal Navy could benefit from making more use of surfaced night

[102] PRO ADM 186/147, CB 1769/30(1).
[103] Author conversation with Admiral McGeoch, 6/9/2000.
[104] AL, CB 4000, "Instructions for Submarine and Anti submarine Exercises, 1938", p40.

attack. The RUSI submitted the paper to the Admiralty for approval in accordance with regulations still in force today, and the Admiralty refused permission for publication. Padfield has made much of this refusal, claiming it as evidence that "Another fatal flaw in the Admiralty's Asdic-induced complacency was the assumption that enemy submarines would only deliver submerged attacks".[106]

Closer analysis, however, points to a different conclusion. Some ten years later Admiral McGeoch was appointed to the Admiralty, where he was able to examine the docket concerning his paper. He found that permission had been refused on the recommendation of the Director of the Operations Division, who had described the subject as being "more suitable for a Staff College Lecture than a published paper." From this it is difficult to impute that there was an objection to Admiral McGeoch's ideas being promulgated within the service. The more likely conclusion, with which Admiral McGeoch agrees, is that there were at least elements in the Admiralty which were aware of the surfaced submarine's offensive potential, but that it was not desirable to have the implicit vulnerability of the Royal Navy's surface ships highlighted by the publication of the paper in an open document such as the RUSI journal.[107] As an aside, the mere fact of the paper having been circulated within the staff for vetting approval will have gone some way to spreading the word about vulnerability to surfaced night attack, although the relevant section, on which Padfield bases his conclusion, comprises a mere seven lines in a fifteen page paper.[108]

Much has been made of the blindness of the Admiralty, and specifically of the Naval Intelligence Division, in their failure to make a proper analysis of a book written by Doenitz, in 1939, on the subject of U-boat warfare. The passage which has caused particular excitement is one in which he writes that

> The U-boat which is surfaced at night has the very great advantage over surface ships of a smaller silhouette. At night the hull of the U-boat is generally invisible, and if there is any sea there is no silhouette ..... Thus the

[105] Padfield, op cit, p21.
[106] Padfield, op cit, p24.
[107] Author conversation with Admiral McGeoch, 6/9/2000.
[108] Admiral McGeoch's paper survives in IWM P/347.

night attack delivered on the surface provides the U-boat with a particularly effective method.[109]

There is no documentary evidence of the Naval Staff having made an analysis of this book, but such an analysis would hardly have changed the position with respect to surfaced attack; the navy, as has been demonstrated, was aware of the vulnerability and did not need to read books by foreign admirals to learn that surfaced submarines were hard to see.

Some evidence does exist that the Air Ministry had given thought to the night time conduct of U-boats. An Air Ministry memorandum written in April 1939 stated that "It is assumed that the tactics of enemy submarines will be similar to those employed in the War 1914-1918, in that they will operate at periscope depth during daylight and at dusk will surface to charge batteries."[110] This paper was circulated to and commented on by the Admiralty, but no note was made to contest this assertion. It is not a tremendous leap to conclude that an Admiralty which expected German submarines to patrol on the surface also expected them to attack on the surface at night.

To summarise, the published literature holds that a surfaced submarine was invisible to Asdic, hard to see in the dark, and had been successfully used by the Germans during the First World War to make night attacks. The inter-war Admiralty, according to this literature, was not aware that surfaced submarines made bad Asdic targets, conducted no exercises against surfaced submarines at night, ignored the lessons of the 1914-1918 war, and was taken entirely by surprise when the Germans succeeded in repeating the tactic in 1940.

The evidence of this dissertation, on the contrary, indicates that the degraded performance of Asdic against a surfaced target was understood, the fleets and the Portland organisation frequently exercised against surfaced submarines at night, and were only too aware that they were difficult to detect. From this evidence the lack of available countermeasures in 1940 can be explained in one of two ways. The first is that the Royal Navy, aware both of a critical weakness and Germany's history of exploitation of that weakness, was guilty of the most monumental, almost wilful,

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[109] "Die U-bootwaffe", Doenitz, published by E S Mittler & son, Berlin, 1939. Translation taken from CHURCH ROSK 4/92.
[110] PRO AIR 15/34, "Trade Protection – Convoy Organisation", 1939.

blindness and stupidity in failing to devise counter measures. The second explanation, which seems more plausible to the author, is that the available technology allowed for no countermeasures; there was simply nothing that could be done to prevent a surfaced submarine making an approach and successful attack at night. Hydrophones would not detect a surfaced submarine against the background noise generated by merchant ships or heavy fleet units, the submarine could not be seen, nor could it be reliably detected by Asdic, and until the development of radar there was no other sensor which could give warning of the approaching boat. Even in the pressing conditions of war no other antidote than radar was developed to detect the approaching boat, but various methods were devised of illuminating the scene once the attack had been made. This, however, was a risky tactic as it enabled the submariner to see his targets and pursuers better, and might alert other submarines in the area to the presence of the convoy.

Warship and Troopship Defence

Convoy defence differed fundamentally from troopship or major warship defence in two major regards. Mercantile convoys, at anything between 6 and 14 knots, were appreciably slower than Battle Fleets or troop convoys, and being of less direct military significance would have fewer assets allocated to their defence. The Royal Navy has been the subject of much vilification for concentrating overmuch on the defence of warships and fast troopships to the detriment of the more pedestrian aspects of trade defence. While it was undoubtedly the case that great, almost fatal, harm was done to the war effort by the U-boat attack on trade, it is worth speculating briefly on what might have happened had the Germans been successful in sinking a significant number of heavy warships.

In the First World War the Grand Fleet, without the benefit of Asdic screens or the thoroughly researched tactics discussed in this section, was left extremely vulnerable to submarine attack. This weakness so influenced Jellicoe's thinking that he felt himself to be severely constrained in the North Sea, and it is arguable that it was this constraint which denied him the opportunity to engage the High seas Fleet on a number of occasions. It is unlikely, however, that freedom from such restriction would have had a significant effect on the overall conduct of the war; the Grand Fleet

was, after all, despite the submarine menace, successful in denying the High Seas Fleet the freedom of the seas.

Much of the Royal Navy's strategic planning in the 1920s and 1930s was aimed at a war in the Pacific against the Japanese. Such a war against a powerful surface fleet that would be virtually impossible to blockade, and a submarine force directed at attrition of enemy warships, would have been a very different matter from the Grand Fleet/ High Seas Fleet conflict in the North Sea. Absolute freedom of manoeuvre would have been vital if the RN was to prevent the Japanese fleet from interfering with Britain's very long lines of communication. Had the British Fleets failed to develop effective anti submarine measures, such freedom of manoeuvre would have been denied, as it was to Jellicoe, possibly with disastrous consequences.

At risk of straying further into the counter factual, it seems reasonable to suggest that had the capital ships of the Home Fleet been vulnerable to submarine attack in the early days of the second war, the great German raiders might have had a very much better time of it. At the very least, awareness of such a weakness would have denied the Home Fleet the ability to deploy on a purely offensive basis, as they did, for instance, in reaction to the sailing of the Bismarck in May 1941. In the worst case successful U-boat operations against the Fleet might have caused the losses by attrition of which Tirpitz had dreamed, and while it is inconceivable that the Germans would ever have been in a position to offer a Battle Fleet action, the operation of individual capital ships or raiding groups in the Atlantic would have been much less restricted.

Regrettably, from the historian's point of view, the widespread failure of U-boat torpedoes in the Norwegian campaign, which was the only concerted U-boat attack on warships, prevents useful conclusions being drawn about the utility of the U-boat in that role, and the value of the tactics employed by the Royal Navy, but the actions described in Chapter 3 give some idea of the level of protection afforded to warships. Faced, thus, with the alternatives of attacking heavily defended warships or lightly protected convoys the Germans opted for the less valuable but more vulnerable target.

The assertion that the Royal Navy concentrated on the defence of warships and fast troopships to the detriment of mercantile defence seems to be justified, whether or not the strategic thinking behind this policy was flawed. While Roskill's contention that the protection of slow merchant convoys was never practised will be shown to be palpably untrue, one can not dispute that the majority of the surviving records describe

exercises using escorts of a scale and strength undreamed of by Atlantic Convoy Commodores. These escorts would only have been provided for heavy fleet units, troop carriers, or exceptional convoys such as those to relieve Malta. The conclusion often drawn, however, that such a policy was misguided and that grand strategy would have been better served by a withdrawal of the emphasis on warship defence does seem open to question. The fact that few warships were sunk by submarines does not in itself mean that efforts made to defend the warships were wasted, rather it would indicate that the defensive tactics used were successful in at least discouraging submarine attacks.

Further, the fact that the RN's freedom of action prevented the German raiders from fulfilling their potential seems to support the assertion that sound anti submarine tactics led, in part at least, to the failure of the German surface fleet. The assertion that German U-boats would, out of preference, have conducted operations against Allied Naval forces is backed up by the German Naval History of the U-boat:

> During the critical days before the annexation of Czechoslovakia in 1938 there were so few boats that they could not have had any appreciable effect on shipping. If war with England had resulted, they would have operated only against her naval forces[111]

> In general U-boat operations against naval forces promise little hope of success. On the surface the U-boat has no margin of speed to haul ahead for attack; enemy escorting aircraft could generally forestall such action. The low underwater speed of the U-boat does not permit attack on fast warships except when the boat is directly in the path of the enemy, and that happens very seldom.[112]

It is further worth noting that during the period of tension at the end of August 1939 U-boats in the Baltic were tasked to intercept three Polish destroyers. When the destroyers escaped from the Baltic on August 30 the U-boats were moved to the west, despite the continued presence of lucrative Polish merchant traffic in the Baltic.[113]

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[111] "The U-boat War in the Atlantic", German Naval Staff History, published by HMSO, 1989, p4.
[112] Ibid, quoting from the war diary of SO U-boats, 7/9/39.
[113] Ibid.

It was generally, and not unrealistically, assumed that a Battle Fleet at sea would have at least two flotillas of destroyers available to screen it. The spacing of ships within the screen was discussed in the "General Principles" section of this chapter, but the actual placement of the screen, or screens, has yet to be covered.

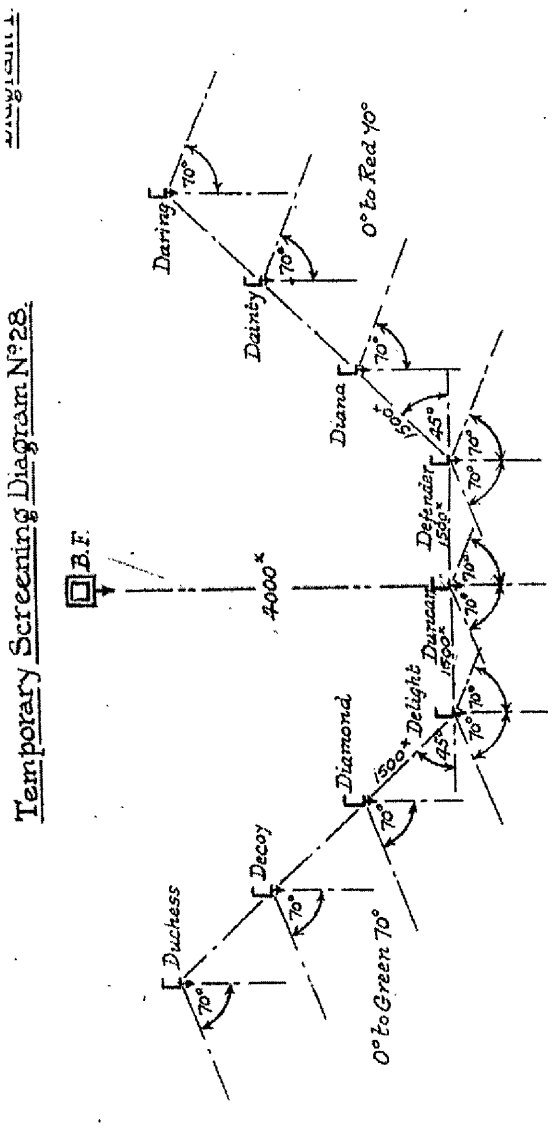
In general, the philosophy was to place the screen in such a position that any submarine lying within the submerged or surfaced danger areas ahead of the fleet had a good chance of being detected. Clearly, surfaced submarines operating in the surfaced danger area could, by day, be detected by aircraft or non Asdic fitted ships, which could force them to dive, so denying them an opportunity to press home an attack on the main body.

The role of the Asdic screen, therefore, would be to search ahead of the fleet in the submerged danger area, where detection could only be reliably made by Asdic.[114] The question, thus, which had to be addressed revolved around the distance ahead of the fleet at which the screen, or screens, were to be placed.

If the screen was too close the submariner would be able to fire through it to hit his target without having to fight through the screen. Place the screen too far ahead, though, and the submariner could dive deep while it passed over him, coming to periscope depth between the screen and the main body to reposition himself for attack. A screen placed some miles ahead, however, might force the submariner down before he had sighted the main body, thus causing him to miss it altogether.

The 1925 CB 3002, without making any recommendations, stated that the issue of distance between the escort and the main body was "a current tactical question". In the 1929 edition the Commander in Chief of the Atlantic Fleet stated that a "close screen" should be used in preference to the standard screen "whenever conditions for Asdic operating become unfavourable, or when a meeting with enemy surface craft is expected". He also noted that, if there were surplus destroyers available when the main screen had been formed, those spare ships should be employed as a striking force rather than as a close screen. This striking force would be held in reserve behind

[114] Although a submarine working in to attack from the dived danger area would have to use its periscope, so presenting a counter detection opportunity, visual detection of a periscope from a ship is at best a haphazard business, and even the early Asdic sets presented a more reliable means of detection. Visual detection of dived submarines from the air could, likewise, not be relied on.



Disposition for Exercise RZ, August 1933
CB 1769/34(1), PRO ADM 186/155
Fig vii

the screen, ready to prosecute any contacts gained by the screen ships. An obvious benefit of the maintenance of such a striking force was that they need only have their Asdic sets operating when there was known to be a submarine in the vicinity, so the Asdic crews would be fresh and alert when most needed.

By 1934, however, it was accepted that a close screen was, irrespective of conditions, a better use of assets, and the debate revolved around the position of that screen. That year's CB 3002 stated that there should be sufficient sea room between the main body and the close screen for the screen escorts to be able to fall back to prosecute a submarine without getting mixed up with the main body. The report concluded that the position of the close screen depended largely on the prevailing Asdic conditions, and that on a good day it could be efficiently stationed up to four thousand yards ahead of the main body. In his report on exercise EC of June 1934, the Commander in Chief of the Home Fleet found that his close screen had been placed too close to the Battle Fleet, allowing the *Achilles* to be torpedoed from outside the screen.[115] His conclusion was that the escorts should not be placed less than 1500 yards from the main body units.[116] These thoughts were then tested in August 1933, when the Mediterranean Fleet took part in exercise RZ. The Fleet was screened by a single destroyer flotilla in the formation shown in fig vii. There were also two aircraft screens, one just ahead of the destroyers and one 15 miles ahead. A succession of submarines were positioned ahead of the fleet in order to attack, and all were spotted by the patrolling aircraft. With the exception of one submarine these were "handed over" to screening destroyers, which were considered to have carried out successful Asdic and depth charge engagements. One submarine did penetrate the screen to attack the heavy units, having been detected but then lost by the aircraft screen. The exercise regulations did not allow the main body to zig zag or to make evasive alterations of course, and it was considered that when this submarine was originally detected the fleet could, in war, have altered course to put it outside the surfaced or dived danger areas.[117]

By employing the tremendous number of escorts that would be available to the battle fleet, it was possible to establish two or even three screens ahead of the main

[115] This must have caused considerable embarrassment for the Commander of the Achilles, Cdr P F Cooper, who was one of the Navy's most senior A/S experts!
[116] PRO ADM 186/155, CB 1769/34(1).

body, so circumventing much of the debate about screen position. Certainly up to the mid 1930's the principle was that where two screens were available the outer, advanced, or extended screen would be tasked merely to keep the submarines down, so reducing their chance of seeing the main body in time to manoeuvre for an attack. The inner screen would form a ring of steel ahead and abeam of the main body, which it would be near impossible for the submarine to penetrate.[118] The importance of the role of the advanced screen was highlighted in 1934 when it became policy to maintain its integrity even when in contact with a dived submarine. The escorts were permitted to make one counter attack, after which the target would be handed over to dedicated hunting units held in reserve behind the advanced screen. If such a reserve were not available, the unit in contact would continue to prosecute its target and the screen would be reconfigured to close the gap. If the Fleet was anticipating attack from enemy surface units, the traditional A-K line could be deployed with a secondary role as the extended anti submarine screen. These ships would not normally have been fitted with Asdic, but would be in a position, at worst, to force the submarines to dive, so upsetting their attack, and might be able to sight the submarine, so allowing the Fleet to steer an evasion course. No mention is made of the fact that these valuable units, not being Asdic fitted, would themselves have been extremely vulnerable to submarine attack.

The truly fortunate commander, who had a useful number of escorts left over after the formation of the advanced and close screens, could afford the luxury of an intermediate screen. This was placed such that the submariner was given the choice of going for a very long range shot from beyond it, or he could attempt to penetrate it. Should he attempt the latter, however, he would be forced to do so at that stage of an attack when his mind was most concentrated on the development of a firing solution. By forcing him to think about evasive steering at this stage it was hoped either to upset his firing solution, or cause him to reveal himself.

A novel tactic attempted during 1933 was to form the escorts into a ring around the main body, preferably in pairs, and then "expand" the ring, prosecuting any submarines found and leaving the main body in the middle of a circle of sanitised water. By rapidly contracting the ring at dusk it was hoped that undetected alterations of the main body course could be achieved. This "ring" tactic was tried in one

[117] PRO ADM 186/155, CB 1769/34(2).
[118] PRO ADM 186/106, CB 01821, "Battle Instructions", June 1928.

exercise, and it was reported that all shadowing submarines were successfully detected, but there is no evidence of it ever having been tried again.[119]

Throughout this discussion it has been assumed that the screen around the main body was established to counter submarine attack only. Clearly, while commanders would sometimes be faced with only one threat, the enemy could reasonably be expected to concentrate all his available force in attack, so consideration would have to be given to stationing for defence against surface and air attack. For a troop convoy or main fleet unit this would not present a serious tactical difficulty as fleet units such as cruisers would be available to counter surface and air threats, leaving the destroyer escort to concentrate on the anti submarine effort. For a mercantile convoy with an exclusively destroyer escort, however, a requirement to counter an air threat would invlove tactical compromises. Although there was a clear awareness in fleet exercises of the need to prepare for a multi threat attack, the first indication that the Portland organisation was giving thought to convoy defence against combined air and submarine attack came as late as the 1936 CB3002, which stated that "the whole question of trade protection has recently been under review for the purpose of correlating the methods of protecting it from attack from submarines and aircraft". The measures taken in the early stages seem to have involved additions and alterations to ships' weapon systems rather than tactical adjustments, so do not affect the subject matter of this dissertation.

It is possibly not surprising that Portland did little work on multi threat tactics, as the organisation was tasked and resourced to develop anti submarine tactics only, though the directors of the Tactical Division of the Naval Staff were in a position to direct the development of co-ordinated tactics. While the more rigorous recording facilities and the availability of a pool of anti submarine experts at Portland might have enabled full analysis of exercises in defence against combined threats, the size and composition of 1 A/S meant that it was not able to mount such ambitious projects. A major Battle Fleet exercise conducted at the direction of the anti submarine experts might well have achieved useful results, but there is no indication that such an exercise was ever planned or took place. One can only speculate that this was because of the lack of influence of the anti submarine community within both fleets and the Naval Staff. The 1937 CB 3002 noted that there was a conflict between the anti

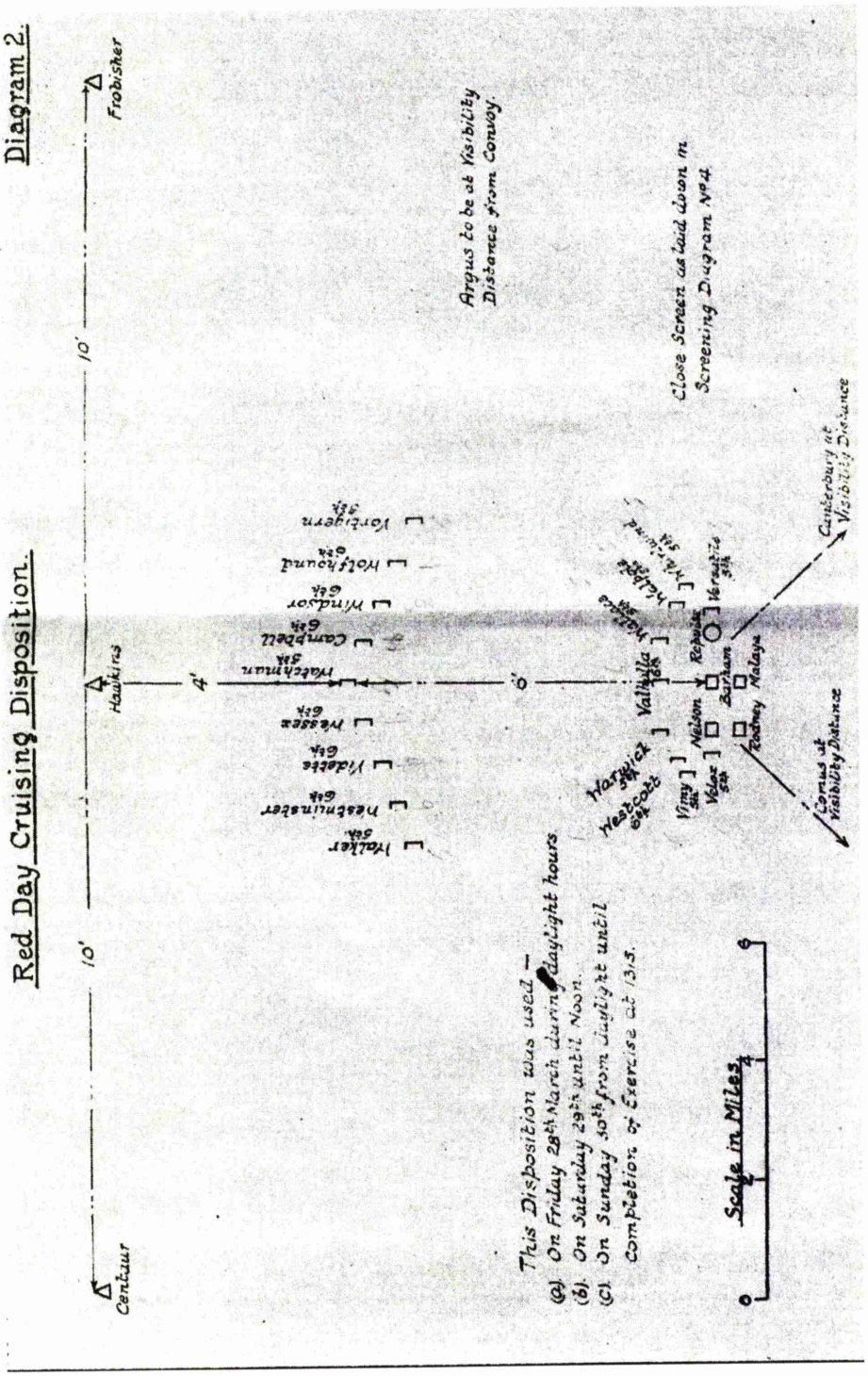
[119] PRO ADM 186/153, CB 1769/33(1) and 186/515, CB 3002/34.

aircraft requirement to keep the escorts within the convoy, and the anti submarine requirement to keep the screens external to the convoy, but offered no solution.

These tardy rumblings of awareness at Portland contrast markedly with the attitudes in the Fleets. A good number of the fleet exercises during the period under study, especially its earlier part, involved defence of the main body against combinations of surface, sub surface and air attack. A typical example of such an exercise was NP, undertaken in the Mediterranean in January 1928. In this exercise six battleships, one battlecruiser, four cruisers, one destroyer flotilla and RAF aircraft defended a convoy of 16 ships with a maximum speed of 7 knots. The attacking force comprised five battleships, one battlecruiser, four cruisers, two destroyer flotillas, one aircraft carrier and four submarines. The screens for this exercise were designed for defence against surface rather than submarine attack, and all the attacking submarines managed to get themselves into firing positions against either the convoy or the heavy surface units. In the post exercise report, however, the Commander in Chief stood by his identification of the enemy surface force as the major threat.[120] This statement would seem to be a pointer to the Commander in Chief's strategic rather than tactical thinking. In 1927 the main naval threat to the empire came from the increasingly hostile Japanese, who were in possession of a number of capable heavy surface warships, but whose submarine service was largely unproven, and not considered to pose a serious threat. The Commander in Chief Mediterranean, who could expect to find himself taking his fleet to the Far East in the event of a war with Japan, would be more concerned to defend himself against battleships and cruisers than submarines. Mindful of this, his dispositions in OC were not configured to provide for anti submarine defence, and it was thus hardly surprising that the submariners found little difficulty in working themselves into firing positions. Eight years later, in exercise FC, a single submarine was able to make a good attack on a battle fleet steaming at 17 knots, and scored three hits on the Hood. Once again the screen was configured solely for surface ship attack. There were no destroyers or Asdic fitted cruisers in the surfaced danger area, so the submariner's success, while commended, was unsurprising.[121]

The reports on the vast majority of battle fleet anti submarine exercises contrast markedly with that of exercise OC and FC. Typical examples were the

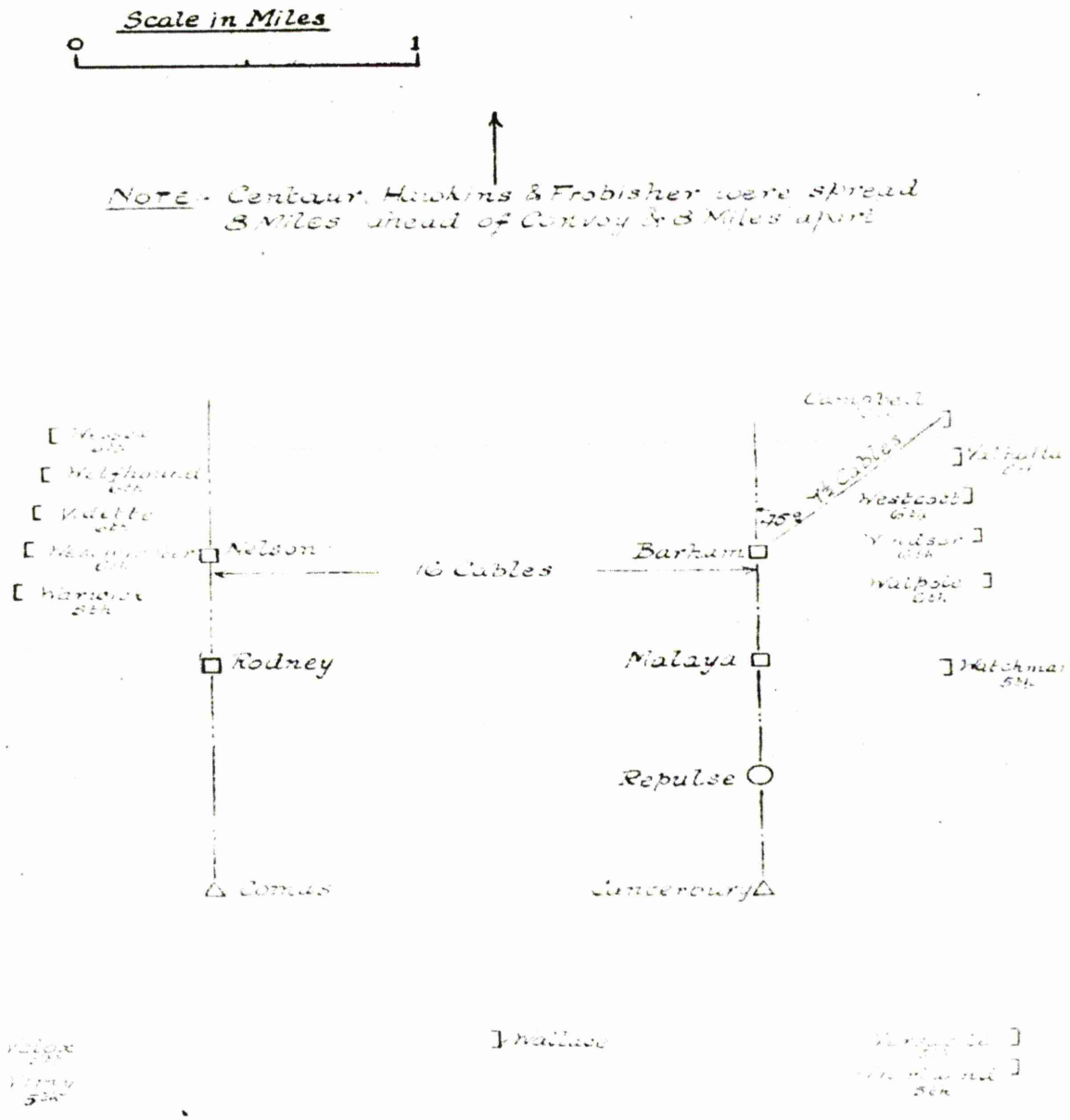
[120] PRO ADM 186/143, CB 1769/27(2).
[121] PRO ADM 186/157, CB 1769/35.



Day Disposition for exercise AS, March 1930
CB 1769/30(1), PRO ADM 186/147
Fig viii

Red Night Cruising Disposition

Diagram 3.



Night Disposition for Exercise AS, March 1930
CB 1769/30(1), PRO ADM 186/147
Fig ix

Mediterranean Fleet exercises NO in 1927 and SF in 1934. In NO the battle fleet was escorted by three flotillas of destroyers. Despite the submarines being placed directly in front of a fleet which was not permitted to zigzag, only one of the six managed to penetrate the screen.[122] In SF, the battle fleet was defended by three flotillas of destroyers, and attacked by four submarines. All the submarines were detected early, and it was, quite reasonably, concluded that "it is unlikely that in war they would have survived to fire their torpedoes at the battle fleet".[123]

Another general tactical question revolved around the use of non Asdic fitted ships to augment an Asdic screen, and was first raised in 1932. One answer to this problem underwent trials in exercise CB[124], when an extended screen of four pairs of Asdic destroyers over a 10 mile front was placed 10 miles ahead of the force, and the close screen was formed of non Asdic fitted destroyers. In the case of this exercise "a submarine patrol line was encountered, and the fleet passed through the gap provided by the submarine that had been successfully attacked by one pair of destroyers".

This seems an odd tactic because the extended screen, without overlapping Asdic, was lucky to detect a submarine, and the close screen might easily have been penetrated by a submarine operating at periscope depth. The better answer, thus, would seem to be to put the non Asdic fitted ships in the distant screen, to keep the submarine down in the hope of it missing the main force altogether. Closer in one could form a close screen of Asdic fitted destroyers with overlapping search areas to prevent a dived or periscope depth approach to the main force. As the proportion of Asdic fitted destroyers increased this problem diminished, and by the time war broke out virtually all of the RN's destroyers were fitted with an Asdic set of some sort.

Troop convoys, with their greater importance and increased speed, were treated in anti submarine terms more like battle fleets than true convoys. The screens for a 1930 exercise in defence of a troop convoy, shown in fig viii and fig ix, once again show the classic Portland close and distant screens being used by day, while the night screen was clearly set up, again, to deter shadowing and allow for counter attack.[125] Exercise SK, in August 1934, practised the protection of a slow (nine knot) but valuable troop convoy, using three battleships, five cruisers and three flotillas of destroyers. The destroyers were ranged in screens four and eight miles ahead of the

[122] PRO ADM 186/143, CB 1796/27(2).
[123] PRO ADM 186/158, CB 1769/34.
[124] PRO ADM 186/1769/32(1).

convoy to protect against submarines, as well as in columns down both flanks for air defence. The battleships were close on the beams and astern, and the cruisers further out on the flanks and astern. Not surprisingly, none of the attacking submarines got through to the convoy, only one managing to score a hit on a flanking cruiser.

In summary, the issue which caused most debate in the area of Battle fleet anti submarine defence was the positioning of the screen ahead of the fleet. There was little doubt that the Asdic screen should cover the dived danger area, but quite some debate about how far ahead of the main body it should be placed. By 1929 it had been established that a close screen was the optimum if Asdic conditions were poor, and by 1934 the doctrine was to give the Battle Fleet a close screen whenever there was a submarine threat. In good Asdic conditions this screen could be placed 4000 yards ahead of the main body, and on a bad day as close as 1500 yards. Any screen closer that 1500 yards was deemed impractical as it would allow a shot to be take at the main body from outside the screen. This was still the accepted doctrine at the outbreak of war in 1939.

The Portland establishment, tasked solely with anti submarine, devoted very little energy to the problems of multiple threat attacks, but these were addressed by the fleets in their exercises. The broad conclusion was that it was impossible simultaneously to provide for effective defence against submarines and other threats. The commander should thus establish the nature of the main threat to his force and configure his defence for that threat, accepting that his ships would then be vulnerable to other forms of attack. It was, however, generally believed that a close Asdic screen would detect a high percentage of attacking submarines.

Convoy Defence

There was an acceptance, certainly after the 1935 German declaration of an intention to rebuild a submarine service, that on the outbreak of war convoy was likely to be adopted. This position was made clear to the public at large, and specifically to merchant ship owners: "The Chairman took this opportunity of assuring members at the second meeting of the committee that the convoy system is considered by the

[125] PRO ADM 186/147, CB 1769/30(1).

Admiralty to be the most effective form of protection against surface, submarine or air attack"[126]

The stated policy was that, in the event of a submarine attack on trade which was conducted in accordance with the London treaty[127], convoy would not be used. If the enemy resorted to unrestricted submarine warfare, however, convoy would be adopted. This was correctly extended to cover RAF Coastal Command strategy; in the event of a restricted submarine attack shore based aircraft would patrol areas through which trade was passing, while an unrestricted attack would be met by attaching aircraft to individual convoys.[128]

The assumption was that Germany and Japan would embark on unrestricted campaigns, and in fact naval control of shipping was taken as early as 26 August 1939, with the first formed convoy sailing on 2 September, the day before war was declared[129]. It is agreed, therefore, that convoy was anticipated, but it has been widely argued that the defence of convoys against submarine attack was neglected in favour of the Battle Fleet defence.

Whatever the consequences of the concentration on warship defence, the reasons for bias away from trade protection were disparate and many. There was a feeling in the inter-war Royal Navy that it was inconceivable that the UK would, in violation of the London treaty, resort to unrestricted attack on enemy merchant ships. The doctrine for RN submariners was, therefore, almost exclusively aimed at attack of warships, preferably capital ships.[130] In view of this, if an anti submarine exercise was to be of any benefit to the submariners, it would involve them attacking the battle fleet. However aware the anti submarine community might have been of the requirement to defend against foreign unrestricted attack on trade, participation in repeated battle fleet anti submarine exercises will have concentrated minds on that area. Inevitably the preoccupation of the ambitious seagoing officer is success in the

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[126] PRO ADM 116/3635, Minutes of 2nd meeting of the Shipping Defence Advisory Committee, 31/7/37.

[127] The London treaty allowed submarines to attack without warning warships, merchant ships in convoy or merchant ships committing hostile acts, such as firing on the submarine or making a distress call indicating the submarine's position. An independent merchant ship which committed no hostile act had to be stopped, and the crew had to be allowed to disembark to the boats, before the submarine could sink the ship. The submarine commander also had a duty to ensure that the crew had a reasonable chance of survival. A campaign not in accordance with these rules was known as an unrestricted campaign.

[128] PRO AIR 2/3101, "Coastal Command Plans for Reconnaissance, Convoy Escort and Anti submarine", 19/12/38.

[129] Hague, op cit, p23.

next exercise, not the war that may or may not occur in five or ten years time, and provided with this motivation surface ship anti submarine officers could be forgiven for concentrating on warship attacks.

Under the strategic guidance of the Admiralty, who anticipated the institution of convoy, the anti submarine establishment and the fleets did devote energy to trade defence, and as will be shown there was significant tactical progress over the period under study. A development which is first shown up in the 1928 CB 3002 is the suggestion that it was important to have at least one escort placed astern of the convoy in order to "retaliate on a submarine that has just attacked the convoy and also to keep a look out for submarines shadowing from the rear of the convoy"[131]. This was a departure from the current thinking, which put all assets ahead of the main body, and was the first of a number of developments that gradually moved the whole convoy escort to positions abaft the convoy's beam before they once again, in 1935, moved to positions on either bow. The first change in thinking may well have been fed by the results of exercise LA in January 1928. The escort dispositions for this exercise in defence of a slow (8 knot) convoy, shown at fig x, allowed one submarine to work its way into the convoy during the night. She shadowed the convoy from a position on the surface slightly astern, before dropping out of sight at daybreak.[132] Such night shadowing would have been made very much harder had more of the Destroyers been stationed astern of the convoy. The gap of 6nm between *Tetrach* and *Tyrian* would have allowed the submariner to shadow with impunity.

The next development in this direction came in 1929 when, as a result of exercises in convoy defence with small numbers of escorts, it was decided that it was best to keep the escorts on the quarters or astern of the convoy[133]. The theory was that with a small number of escorts it was not possible to prevent a determined submarine commander from making an attack, but by placing the escort astern of the convoy one put it in the optimum position to make a counter attack against the submarine. This may have provided little comfort to victims of the first, essentially unopposed, attack, but as the 1930 report said, somewhat hopefully "if a good proportion of the ensuing hunts are successful, the object will ultimately be achieved by moral effect". The

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[130] Author conversation with Admiral McGeoch, 6/9/2000.
[131] PRO ADM 186/468, CB 3002(28), p36.
[132] PRO ADM 186/143, CB 1769/27(2).
[133] PRO ADM 186/476, CB 3002/29.

Disposition for exercise LA, January 1928
CB 1769/27(2), PRO ADM 186/143
Fig x

tactic did, however, carry the cautionary comment that, "when sufficient escort vessels are available, the positions ahead should be filled, but not to the exclusion of positions on the quarters and astern". The disposition shown in fig vi, designed to counter submarine attack by night, shows the theory of stationing escorts on or abaft a convoy's beam. It seems to have been accepted in designing this screen that there was virtually no chance, by night, of detecting an attacking submarine until it had revealed its presence by firing torpedoes, usually from inside the screen. The four Asdic fitted destroyers on each flank would then be in an ideal position to turn in and hunt the attacker. The two destroyers astern of the convoy were clearly stationed to deter shadowers.

The exercises carried out in 1931 led to the somewhat equivocal conclusion, in that year's CB 3002, that: "...the escorting anti submarine ships were disposed in positions ahead, beam and on the quarter or astern of the convoy. These positions would seem to be most advantageous for an A/S escort unit."[134] That report did, however, note the merits of positioning the fastest units ahead of the convoy, in order to deliver a rapid counter attack. It is important to stress here that a counter attack was not necessarily, as one might expect, an attack executed once the submarine had made an attack of its own. Rather, a counter attack was any rapid attack made on a submarine that had been detected or had revealed itself at close range or in circumstances where urgency prevented a steadily and deliberately developed attack. In a counter attack speed was of the essence, in order to seize the initiative, and the accuracy of the depth charges could be compromised. Thus, detection of a submarine close ahead of a convoy, in the area of the ahead escorts, would lead to a very rapidly delivered anticipatory *counter attack* to interfere with the submarine's own attack. In order to expedite such an attack the fastest escorts would take the ahead sectors. It would also have been an advantage to put the fastest escorts ahead of the convoy so that they could sprint to attack any submarines detected by the air escort, which worked well ahead of the convoy.

The 1932 CB 3002 gave a good summing up of the broad position with respect to the state of anti submarine defence of ships in the open ocean. While the men of the battle fleets could have taken comfort from the reassurance that they possessed "a

[134] PRO ADM 186/491, CB 3002 (31).

high degree of anti submarine protection by reason of high speed and the light craft and aircraft normally in company", any merchantman would have found it stark reading. He would have discovered that "A/S protection will be afforded to mercantile convoys primarily by evasion" and that "it is not envisaged that the escorting vessels will be able to prevent a submarine attacking the convoy", but that reliance would be put on the subsequent counter attack. This attitude would harden in the following years, with the policy being stated in 1933 that, by counter attacking the submarine once it had revealed its presence by initial attack, the escorts would "provide A/S protection to our convoys, not only by destroying enemy submarines but also by acting as a deterrent."

That this was Admiralty, rather than merely Portland, policy is indicated in a note written by the Director of the Tactical Division on a staff requirement for sloops: "Small numbers of the usual escort rule out any attempt at direct protection of the convoy, and make the detection of the submarine before firing largely a matter of chance"[135]

The progressive hardening of the Admiralty line is illustrated by the comments of a later Director of the Tactical Division in another staff requirement: "To protect convoys against attack by submarines involves screening, for which the number of vessels required would be prohibitive. The anti submarine requirement is therefore limited to the location and destruction of enemy submarines detected in the vicinity of the convoys"[136] This opinion was duly reported at Cabinet level in a 1937 CID paper: "Complete reliance can not be placed on detecting a well executed submarine attack prior to its delivery. On the other hand, once the attack has been delivered, the submarine's chances of avoiding destruction by Asdic fitted escorts should not be too great."[137]

This was in agreement with the contemporary views of the RN's submariners. Admiral McGeoch talks of the "childlike belief that we were not going to be detected". He states that "we had a very good chance of getting in unseen and undetected", but that "the chances of a submarine being destroyed once it had fired and revealed its position were high".[138]

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[135] PRO ADM 1/9341, "Staff requirement for Asdic sloops", 21/6/32.
[136] PRO AMD 1/9424, "Escort vessels – staff requirements", 17/2/37.
[137] PRO CAB 4/26 "Defence Against Submarine Attack", 24/3/37, para 16.
[138] Author conversation with Admiral McGeoch, 6/9/2000.

In order to provide for this attack of the detected submarine, it was felt that two Asdic fitted escorts would be required for a convoy of 20 merchantmen. If one considers that the hunt success rate at this time was running at 54% this does not seem such an unreasonable conclusion; few powers would persist in a submerged attack on trade if their submarines had a 54% chance of being destroyed every time they attacked a merchant ship. Notwithstanding this logic there was clearly some doubt about the value of the two sloop escort, and the 1935 CB3002 promised investigations into "the extent to which an escort of only two ships may be expected to result in the destruction of attacking submarines, and the measure of protection given to convoys thereby" [139]. This compares with the 1924 projection of five escorts per convoy,[140] a reduction which reflected the fact that, by the mid 1930s, most escort vessels were fitted with Asdic. The exercise planners, particularly within the fleets, do however seem to have allowed themselves occasional flights of fancy; exercise ZP in 1938 saw a 20 ship merchant convoy being protected by no less that 14 destroyers! It should be noted here that when the Washington restrictions on construction applied the RN was limited to 100 destroyers, which accorded roughly with the number that the Admiralty believed to be needed for convoy defence. With the lifting of the Washington restrictions, the limitation on destroyer numbers became purely budgetary.

The defence of mercantile convoys, therefore, was afforded a good deal less effort than that of Battle Fleets or troop convoys, but work conducted over the period of this study did lead to substantial changes in tactics. In 1924 the practice was to station all the available escorts ahead of the main body, as one would for a Battle Fleet, but to accept that the screen would be thinner and less effective than one ahead of the Battle Fleet. In 1928 it was suggested that at least one escort should be kept astern of the convoy to deter shadowing submarines and in 1929 the whole escort was moved astern of the convoy in a major change of philosophy. From this date it was implicitly accepted that it was impossible to keep submarines from attacking convoys, and the emphasis was placed on killing the submarine once it had revealed its presence by attacking. In 1931 this was refined by the suggestion that in some cases there might be enough escort vessels available to put some ahead of the convoy, preferably the fastest, in order to attack any submarine clumsy enough to reveal itself during its approach. In 1932 came overt acceptance that trade defence relied primarily

[139] PRO ADM 186/515, CB 3002/34.
[140] PRO ADM 1/8672/230, "Construction programme, light cruisers, destroyers, minelayers etc, 1924".

on evasive routing, and that U-boats were not likely to be detected before putting in their first attack on a convoy. In 1935 came a change of tactical doctrine, with the escorts being placed on either bow of the convoy where they would at least interfere with a submarine by forcing it to dive early in its approach.

The view that convoy escorts existed only to prosecute submarines which had disclosed themselves by attacking meant, in the extreme case, that there was no need to put any effort at all into convoy screening. In pursuance of this logic it was decided in 1937 that only two escorts, the minimum needed for co-operative hunting and attacking, would be required for a 20 ship convoy. This clearly assumed that the enemy would attack with only one submarine at a time, and reservations about the value of a two ship escort were voiced as early as 1935.

OFFENSIVE TACTICS (Area Patrols and Striking Forces)

While the debate about how to form the screen was still ongoing, the increased use of aircraft which could search ahead of the screen for submarines on the surface or at periscope depth once again offered up the possibility of forming offensive hunting groups.

Once the clearly overambitious idea of sending groups of ships out to sweep the high seas clean of submarines had been abandoned, the distinction between a patrol and a hunting group became blurred. In general, hunting groups, or striking forces, would be held in reserve to be ordered to a position or area where a submarine was known to be operating, or had been detected, while escorts would be attached to specific ships for their defence. Patrols, however, would be sent to cover a limited area, with the objective of rendering a specific piece of water untenable for submarines. Extensive use had been made of patrols during the First World War, and they had generally proved ineffective. Although initial optimism about the performance of Asdic led to a resurgence of belief in patrol, by 1925 the policy was fairly clear: "(Patrol) is defensive in conception and by itself it is uneconomical of fighting ships and unreliable as a protection against attack. It is therefore only effective when used in conjunction with other measures, such as convoy and cover".[141] This assumed there would be sufficient anti submarine ships to provide

[141] PRO ADM 186/66 "Naval War Manual, 1925".

escorts and patrols, which was clearly optimistic. This view did persist for a while, and was verbalised by Vice Admiral Sir Osmond de B Brock: "The main point of the Asdic system is that until something better is discovered, it does afford a satisfactory means of attacking submarines operating off a Port or in a focal Trade Area".[142] While Admiral Brock seemed, encouragingly, to understand the limitation of the equipment, especially for large scale searching operations, he evidently still believed in its utility for small area patrols.

One difficulty with offensive hunting operations was that, in order to cover meaningful areas of water, they had to search at considerably greater speeds than ships that were engaged in convoy or even battle fleet escort. The downside of this speed requirement was that the faster they were forced to steam, the greater was the noise made by the water as it flowed over their ASDIC domes. Thus, when steaming at high speeds the performance of the equipment was severely degraded. In 1922 it was found that the prototype set in *Rocket* was virtually useless at speeds greater than 12 knots.[143] Designs did improve, and in 1925 it was thought that performance degraded very little up to 14 knots, but the achievable range at 16 knots was 80% of that when standing in the water, and at 20 knots range was down to 30% of the maximum.[144] This difficulty was overcome to some extent through the development of streamlined domes. By 1937 the type A/S 15 dome had been developed, which was appreciably better than previous models, and was to remain the standard until wartime experience led to modifications in 1943.[145]

In 1930 the first properly analysed experiments were carried out with a "High Speed Asdic Sweep" consisting of a number of vessels in line abreast at 1250 yards spacing sweeping across an area at 18 knots. This might represent the conventional operating mode of escorts screening ahead of a battle fleet, or sweeping any area that was believed to contain a submarine. Although it was conceded that these exercises were "set pieces", and so necessarily artificial, an impressive success rate of 77% was claimed over 67 exercises, though the efficiency of a high speed sweep degraded quickly in unfavourable weather conditions.

If specific information was available about the position of a submarine, for instance if an aircraft had recently reported its position, it might be necessary for a

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[142] PRO ADM 116/2410, "A/S Depot Portland", letter dated 10/10/27.
[143] Hackmann, op cit, p173.
[144] PRO ADM 186/444, CB 3002(25), p25.

striking force to sprint to that position before commencing its search. In this case the requirement was for a high sprint speed which took no account of the effectiveness of the Asdic set at that speed, as the search would not start until the striking force was in the vicinity of the submarine's reported position, known as the search datum. In order to achieve this high sprint speed Asdic domes which could be withdrawn into the ship's hull were designed for destroyers, allowing a maximum Asdic speed of 20 knots and a maximum speed with the dome withdrawn of up to 32 knots.[146] It was anticipated that this type of sprinting operation would most often be undertaken in coastal waters, especially in areas around harbours or convoy forming up points. It was unfortunate, therefore, that the defence of these areas was to be consigned to trawlers, sloops and other vessels considered inadequate for ocean escort work, many of which had maximum speeds lower than those of the submarines they were supposed to chase.

The tactics for the approach to the datum were laid out in a 1938 Air Ministry document[147] which refers to CB 3024, the "Manual of A/S Warfare", no copies of which appear to survive. This specified that the largest possible number of ships should be engaged in the initial search, but once the submarine had been located only two should stay to conduct the hunt. If the searching ships were initially more than 10nm from the datum they should approach in line abreast at 3000 yard spacing, if closing from within 10nm they should be at 1500 yard spacing. The more precisely known position in the latter case allowed for the reduced front, and the closer spacing increased the chances (80% for 1500y against 40% for 3000y) of detecting a submarine which attempted to pass under the formation. These figures seem to result from generalised calculations based on the effective angle/effective width theory outlined in the "General Principles" section of this dissertation.

During the 1914-1918 war much use was made of hydrophone fitted trawlers, and a good deal of work went on, during the inter-war period, with a view to using Asdic fitted trawlers. Special trawler Asdic sets were developed and tactical trials were carried out. Their fundamental problems revolved around their being much slower and more susceptible to a heavy sea than destroyers and other naval vessels. This meant that the pitch, roll and yaw in anything more than a very moderate sea reduced

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[145] Hackmann, op cit, pp171-180.
[146] Ibid, pp171-180.
[147] PRO AIR 15/38, "Air Tactics, A/S operations", 1938.

Asdic detection ranges dramatically, and the trawlers were so slow that hunts usually degenerated into tail chases, with the submarine often able to out run its pursuer.

As a result of these limitations it was early accepted that trawlers were suitable for harbour defence and limited coastal escort duties only, and should not be used for open ocean operations. The 1932 CB 3002 noted with evident exasperation that the results being achieved by trawlers were "inferior to the equivalent efficiency of Asdic fitted destroyers... this is unsatisfactory and tactics differing materially from those hitherto employed by trawlers will be tried out". They were, however, considerably cheaper than warships, and in time of conflict could be bought, fitted with Asdic and readied for action in a very short time.

Tactics employed by groups of trawlers engaged in search or escort duties were also limited by their maximum speed. In the event of one destroyer in a hunting formation obtaining an Asdic contact the procedure was for that ship to drop back to investigate. If the contact turned out to be a submarine the other escorts would turn back to help, and if not the destroyer could easily increase speed to catch up with the rest of the formation (screen speeds were usually around 12 knots, and destroyer maximum speeds were of the order of 30 knots). In the case of a trawler screen, or patrol, which might well be proceeding at a maximum speed of 10 knots, there was no possibility of a vessel which had fallen back catching up. The entire formation would thus have to stop and investigate each possible contact, much reducing the speed of sweep, and making direct escort duties impracticable.

The rudimentary electrical equipment fitted to trawlers also caused tactical difficulties in that they were generally not fitted with radio equipment to communicate with aircraft, so were largely denied the tremendous advantages which were to be had from close aircraft support.

Very few of the surviving documents give detailed descriptions of exercises involving trawlers and the development of their tactics, but there is no doubt that such exercises did take place, and were mainly directed at the protection of slow coastal mercantile convoys. The 1936 CB3002, for instance, tells us that "An exercise was carried out to investigate the employment of auxiliary A/S vessels (trawlers) for the protection of trade in coastal water". Further, following the establishment in 1935 of the second anti submarine flotilla (2 A/S), comprising ten Asdic fitted trawlers, we know that "satisfactory results (were) obtained with the equipment", though no exercise records remain. High seas work, be it escort, patrol or striking, was the

exclusive preserve of more conventional naval vessels, and much work was done to determine the effectiveness of striking forces comprised of destroyers, often in company with aircraft.

In exercise NX in the Mediterranean in 1928, insufficient destroyers were available to provide a full Asdic screen so consideration was given to their employment as an offensive striking force. The Commander in Chief's comments after the exercise noted that

> The exercise shows that the offensive qualities of even a small number of Asdic vessels may be of great value for the protection of the Fleet, provided that conditions are good for sighting submarines from the air.
>
> It is considered, however, that the standard Asdic screen should be employed under all conditions when numbers permit. This enables the offensive qualities of the Asdic to be fully employed, and at the same time a considerable degree of protection is afforded [148]

It should be noted that conditions in the Mediterranean made submarines very much more visible from the air than they were in Atlantic waters, to the extent that they could sometimes be seen even though dived to depths of up to 100ft. The general view of RN submariners was that in Atlantic waters a dive to periscope depth was sufficient to escape from an aircraft, while in the Mediterranean it was "prudent to go deep when an aircraft was sighted"[149]. The Mediterranean Fleet, therefore, could be expected to be more enthusiastic about the employment of air assets in striking forces than other fleets, although the author has come across scepticism about the claim that submarines could be seen at 100ft.

In March 1935 an exercise, designated TP1, was undertaken to assess the utility of patrols and striking forces in a very local area. Portland was used to represent a fuelling point on an overseas trading route, there being seven independent arrivals and sailings every day. On the first day the two available anti submarine vessels escorted the merchantmen in and out of the area, and on the second they adopted patrolling tactics, trying to sanitise the entire area. On both days the escorts were assisted by

[148] PRO ADM 186/468, CB 3002(28), p25.
[149] Author conversation with Admiral McGeoch, 6/9/2000.

three flying boats of 204 squadron RAF.[150] It was thought that the lessons from this exercise would apply equally to the defence of single ships and convoys.

The first day did not give encouraging results, with the majority of the merchantmen being "sunk" by the submarines. Given, however, the accepted convoy defence doctrine that it was virtually impossible to prevent initial attack, reliance being laid on subsequent counter attack, this inability to defend single ships is unsurprising. Some Asdic contacts were made, however, and three of the subsequent counter attacks were considered to have sunk the submarine. It is arguable, therefore, that had the ships arriving and leaving been in groups, or convoys, the percentage of sinkings would have been much lower, a maximum of one ship from each group having been a casualty.

The second day, when patrolling tactics were used, proved disastrous for the anti submarine forces. The submarines were able to operate virtually unhindered against merchant ships, and the anti submarine vessels gained only one Asdic contact all day. The Commanding Officer of *Thruster*, one of the anti submarine vessels involved, and Captain A/S respectively wrote in their reports that

> The patrol method is considered ineffective for a small A/S force ... It is considered that a small A/S force is of no offensive value unless continually accompanied by a flying boat[151]

> It is not worth setting off at high speeds to search for a submarine at any but short distances[152]

Notwithstanding these conclusions from the anti submarine experts, the Admiralty summed up that, as well as providing for convoys and escorts, Admiralty policy "calls for offensive action to destroy the enemy as being an effective means of defence. To this end the intention is to provide striking force units at selected points around the coast. ....to carry out this intention it may be necessary for the patrol vessels to search a considerable amount of water."[153]

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[150] PRO ADM 186/157, CB 1769/35.
[151] Ibid.
[152] Ibid.
[153] Ibid.

A special short exercise, XTF, was carried out in 1938 in order to test the effectiveness of striking force tactics.[154] Two groups each of five destroyers were formed, one aircraft being airborne and one on the ground at short notice, and five submarines were set to patrol in the area. The objective was for the surface/air force to detect and prosecute the submarines, so clearing the area prior to the arrival of a notional main body. The positions of the first two submarines were reported by the exercise directing staff, and the surface ships set off to hunt their respective targets. Each one found its submarine, and in accordance with the doctrine two ships from each group were designated as the attacking units. In the following actions the two submarines were considered to have been destroyed. One of the other submarines, also reported by the directing staff, suffered the same fate, but the remaining two survived undetected.

Although the tactics were found to be successful from a surface ship point of view, poor air/sea communications meant that the aircraft were able to provide little or no assistance to the destroyers.

To sum up this section, the increasing availability both of shore based and carrier borne aircraft made the use of offensive patrols a more realistic prospect. Various exercises were devised, both to assess the value of offensive operations and to develop tactics, during which it was found that ships given a good positional report of a submarine had a good chance of successfully prosecuting it. The general conclusion of the anti submarine community was that, in the event of an unrestricted submarine attack, anti submarine forces would be more usefully employed in convoy escort than in offensive operations, and that patrolling ships were unlikely to be effective unless queued onto submarines. There remained, however, a misinformed body of opinion within the naval staff which believed that patrol, by dint of its inherently offensive character, would be effective in war.

[154] PRO AIR 15/38, "Air Tactics, A/S operations", notes on exercise XTF, 6-7 December 1938.

THE ATTACK

Time Range Plot

So far the discussion has been about dispositions. We pass now to the actual direct attack by A/S ships on submarines. 'Time Range Plot', or 'TR Plot', was one of several Royal Navy tactics introduced in an attempt to overcome 'dead range' problems of Asdic. One of the main problems discovered during the early days of Asdic was that there is a minimum range at which a submarine can be tracked by a vessel relying on an active sensor. In brief, each of the "pings" sent out by the transducer lasts for a given length of time (in the early inter-war sets this was typically a quarter of a second). While the transducer is transmitting, it can not receive any echo signal. If, therefore, an echo from a close in contact arrives back at the transducer while the transducer is still transmitting, the received echo will be lost. The range at which contacts are lost in this way is referred to as the "dead range", and can be showed to be one half of the pulse (or "ping") length multiplied by the speed of sound in water. For an ASDIC set with a pulse length of 0.25 seconds, the dead range is thus 235m. Clearly, if a ship has to make the final 300yards of its approach with no idea of what the submarine is doing, the problem of hitting it with depth charges which are necessarily launched over the stern of the attacking vessel becomes very difficult.

In the early Asdic sets the transmission was made by the operator using a morse key; this led to variable transmission lengths and unpredictable dead ranges. This was overcome by incorporating circuitry which automatically governed transmission lengths and intervals which could not eradicate the dead range altogether, but avoided some of the problems inherent in non automatic operation. Automatic transmission equipment had, by 1928, enabled pulse lengths to be reduced to 0.05 seconds, below which it became difficult to obtain an echo. This length of pulse allowed a theoretical dead range of 50 yards.[155]

There remained, however, another problem with close range detection that had to do with the amplifiers in the receiving circuitry. In order to detect a contact at distant range it was necessary to use very sensitive receiving equipment and high gain

[155] PRO ADM 186/459, CB 01793, Portland Experimental section quarterly report 30 June 1928.

amplifiers, as the returning echo from a distant target was very weak indeed. Equipment set up, however, to process such faint signals was easily swamped by the relatively loud returns coming from close contacts, so it became impossible to process information about submarines which were nearer than approximately 250 to 400 yards from the transducer. Figures from 1927 indicated that the return from 6000 yards gave an echo strength of 0.014mv, while one from 1000 yards gave 80mv, resulting in a range of input voltages well beyond the capability of any available receiving circuitry.[156] This problem was initially overcome by the installation of a potentiometer which the operator could set to one of five positions according to the range at which he was operating. A later development was introduction of automatic gain control which allowed distant and near contacts to be processed by the same circuitry. Before these technical advances, however, various tactics were introduced in an attempt to overcome dead range problems. The first was the Time Range Plot, or TR Plot.

To execute this attack the escort commander would use the bearing and range information from the Asdic equipment to alter the ship's heading such that the submarine's true bearing from the ship was steady; the ship and submarine were then on a "collision course". As he then approached the submarine he would use a stopwatch to determine the rate at which he was closing the contact. When the submarine was within the blind range he would then use the stopwatch and his estimate of the closing speed to work out when he was "on top" of the submarine, and would drop his charges accordingly. As he became more proficient he learnt to set his course to pass ahead of the submarine, and to drop his charges slightly ahead of the on top time, so allowing the submarine to run on to the charges while they sank to their detonation depth. Even against a "dumb" straight running submarine, such as those used during most Portland training exercises, this process required considerable mental agility and skill in shiphandling.

An experienced submariner, free to make evasive manoeuvres, using hydrophones to assess the range, speed and heading of the attacking ship, could establish the time at which the ship was likely to become "blind", and could then manoeuvre violently. As the TR Plot relied on the submarine having constant speed and course, such evasion clearly made the attack highly unlikely to be successful.

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[156] PRO ADM 186/455, CB 01793, Portland Experimental section quarterly reports 30 June 1927 and 31 December 1927.

Pounce

It was in an effort to overcome the clear shortcomings of the TR Plot that the tactic of the "pounce" was developed in 1925. The principle of the pounce attack was that the ship would approach the submarine very slowly, thus quietly, hopefully making it harder for the submariner to use his hydrophones. As the ship reached the dead range, at about 500 yards from the target, it would pounce, increasing to maximum speed and covering the distance to the submarine in as little time as possible. As the ship was blind over the final approach the degradation in ASDIC performance consequent on the high pounce speed was not important, and the object was to be on top of the submariner before he had had time to react.

The initial difficulty with the pounce lay in the fact that it is not easy to assess the distance covered by a ship which is rapidly changing speed. Thus, although the Captain might know when he started his pounce that the target was, say, 500 yards ahead of him, he had no reliable way to tell when he had covered that distance and was in a position to drop his weapons. For this reason the 1926 report states that the pounce, although promising, was proving no better than the TR Plot. With the development of the Chernikeef log (an impeller fitted to the hull which gave an accurate reading of the distance the ship had passed through the water, under development in 1926) it was hoped that the pounce would become more effective. By 1928 the pounce had indeed become the standard method of attack used at Portland and recommended to the fleets. The Chernikeef log was proving successful, and the combination of automatic pulse generation and amplifier gain reduced the dead range, so making the pounce more accurate. Although no figures are available for the success of exercise attacks in 1929, the texts of various reports indicate that the pounce was working well.

Up to the late 1920's ASDIC operators determined a submarine's position by timing the return of the echo with a stopwatch and noting the direction in which the transducer was pointing. With the pounce attack's increasing requirement for accurate positional information came a need to automate the plotting of the submarine's position. Among the benefits of such an automated plotter would be the ability of the ship's crew to determine whether the submarine was moving. Although it is possible to sit a submarine on the sea bed, it is very hard for it to keep depth off the sea bed

without making way through the water. If the ship could determine, using an automatic plotter, that the target was not moving through the water, it was hoped that it could be made easier to discriminate between submarines and non sub echoes from rocks, wrecks and other stationary objects.

As the technique of the pounce was honed and the necessary equipment developed, so the submariners were exploring their own countermeasures. By 1928 some of the tactics still familiar today had been discovered. The first of these was to develop what would today be called an active intercept sonar; this lent the submariner the capability to listen to the ASDIC transmissions of the hunting ship. By listening to these transmissions he could establish the bearing of the attacking ship, and from the strength of the signal he could get a feel for its range. The second technique was to keep either their bow or stern on to the hunting vessel, thus reducing the area off which the ASDIC pulse could be reflected. To further confuse the hunter's ASDIC it was discovered that one could "proceed with bursts of high speed and large alterations of course" to form a series of disturbances in the water which would reflect sound, so presenting the operator with a number of promising reflections, only one of which would be the submarine. Another tactic, and one which required a good deal of skill and luck, was to sit directly under another surface vessel. Any hunter would then see a reflection from that piece of water and assume it came from the surface vessel, rather than the submarine under it.

Most crucially, though, submariners learnt to keep a constant speed and course until they heard an appreciable increase in the rate of turn of the hunting ships' propellers. They knew that this represented the rapid phase of the pounce, when the ship was blind, so they could manoeuvre violently to avoid the imminent depth charge attack. Alternatively, if they could hear ASDIC pulses but no propeller noise, as the ship was steaming very slowly, they knew to manoeuvre violently when the propellers or engines became audible. This countermeasure was found to be so successful that a new tactic was developed, the Medium Range Constant Speed attack, first reported in 1930.

Medium Range Constant Speed

The technique of the MRCS attack is best described in the words of the 1931 progress report:

> An attacking vessel lies about 900 yards from the submarine and estimates her movements. When these have been satisfactorily determined, the attacking vessel increases to maximum operating speed and closes the submarine on a steady bearing. This results in the target being closed for the last 700 yards of the run in at a speed of 18 knots. Any additional movements of the target during the run in can be corrected for during this short interval. The time of fire is estimated by a time range plot[157]

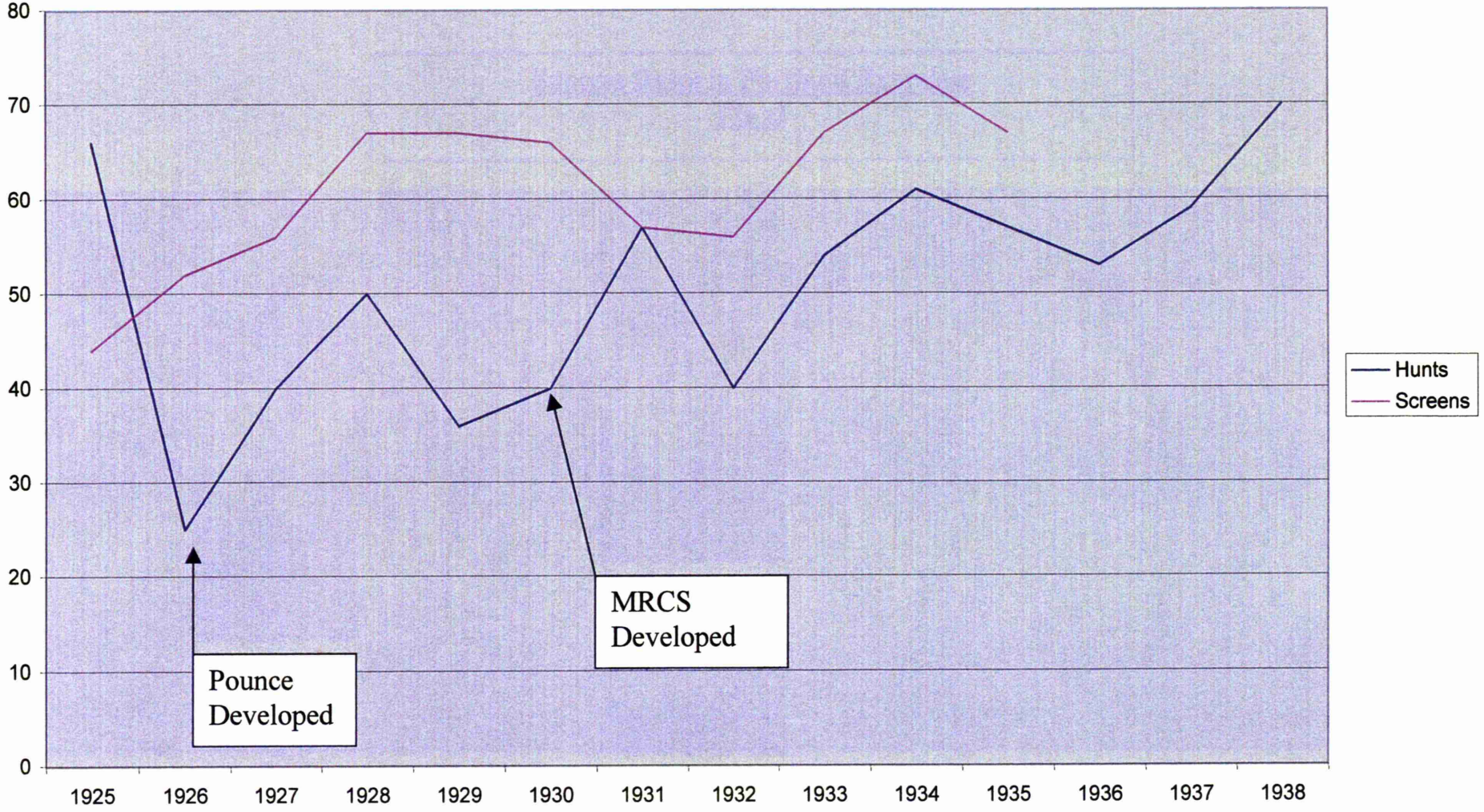
The reader will immediately recognise similarities between the MRCS and the original TR Plot, which was abandoned in 1925-6. The intervening 5 years had, however, seen the introduction of new equipment which made the MRCS very much more successful than the original TR Plot. The first of these was the development in streamlining of domes which increased the speeds at which contacts could be held. While the ships running a TR Plot attack in 1925 were limited to 12 knots if they wished to keep contact, those running an MRCS attack in 1932 could make 18 knots, thus reducing the reaction time available to the submariner.

Increases in speed and reductions in dead ranges achieved by automatic transmission timing and amplifier gain control discussed gave the submariner much less time to manoeuvre to avoid depth charges.

The third equipment advance was the automatic Asdic plotter. This gave the officers of the ship a graphical representation of the positions of the ship and submarine, so making it much easier to determine the course to steer and the time to drop the depth charges, reducing the need for precise mental arithmetic in the heat of battle. The first automatic anti submarine plotter was fitted to *Thruster* in early 1929. This equipment took feeds from the ship's compass and Chernikeef log to put a pencil mark on the plotting sheet once every minute. Information drawn from the Asdic equipment guided another pencil to mark the submarine's position, so showing the true course and speed of the submarine and allowing an accurate MRCS run to be made. When *Thruster* steamed in a 7500 yard circle the pencil returned to within 25 yards of its starting point, and submarine positions were found to be plotted with a

[157] PRO ADM 186/491, CB 3002/31,

Success Rates in Portland Exercises
Fig xi



maximum error of 0.5 degrees in bearing and 10 yards in range.[158]

The MRCS technique was honed with increasing success, and by 1934 improvements in detection ranges meant that ships were commencing their run in from 1200 yards, further decreasing the likelihood of the submariner detecting them before the attack. It is worth noting that when the MRCS attack was first introduced only A/S 1 and D4 were fitted with streamlined domes. The ships of D2 and D6 could not hold a contact at the required speed, so continued to rely on the pounce attack. No figures are available for the success of exercise attacks for 1931, but in hunting exercises those using the MRCS achieved a 60% success rate, while those still relying on the pounce managed only 48%. While not a clinching statistic, this would seem to indicate that the pounce had been rightly superseded. This was confirmed the following year when the MRCS ships achieved a 44% success rate against the 30% of those using the pounce.

It must be born in mind, when considering these statistics, that the methods of analysis still took no account of the relationship between depth charge depth setting and submarine depth, or of the movement of the submarine between depth charge launch and detonation.

Fig xi shows the fluctuating rate of success enjoyed by 1 A/S and the Asdic fitted destroyers in the fleets. It shows how the effectiveness of each tactic declined as submariners devised countermeasures, and how by the time war broke out 70% success was being achieved. Moreover, these were hunts against submariners who understood Asdic and had long experience of operating against it.

Aircraft

While, as has been discussed, the value of an anti submarine aircraft was principally as a means of detecting submarines, forcing them to dive, and guiding anti submarine forces to their positions, this value would clearly be increased if they could themselves attack. A discussion therefore follows of the efforts to develop an airborne attack capability. The progress made was not impressive, and mainly centred around the development of a suitable air launched weapon.

[158] PRO ADM 186/465, CB 01793, Portland Experimental section quarterly report 31 March 1929.

The early inter-war years saw some acrimonious correspondence between the Admiralty and the Air Ministry, the latter having all responsibility for the development of air launched weapons. After repeated prompting the Air Ministry stated in 1920 that a bomb would be developed with the option of an instantaneous impact fuse for a submarine on the surface or a tail impeller delay fuse for a dived target.[159] The Director of the Tactical Division suggested that a single bomb might be developed with a combined fuse. In November 1922 the Air Ministry acceded to this request, but at the bomb conference of 1923 there was no mention at all of anti submarine weapons.

At the 1924 bomb conference it was decided that 250lb and 500lb light case bombs should be developed for anti submarine attack. The following year there was a debate between the Admiralty, who favoured the increased probability of a hit given by a stick of 100lb bombs, and the Air Ministry, who believed the killing power of a single 500lb was more useful. The Admiralty appear to have won this argument, but progress was slow. Draft specifications were ready by May 1928, trials started in September 1930, and the first bombs were introduced in March 1931. It was, however, not until 1934 that the Royal Armaments Establishment began to investigate underwater explosions.[160]

In 1928 it was reported that a fuse which would detonate on contact with a surfaced submarine but also had a variable delay mechanism allowing it to detonate at a given depth below the water, seemingly the one grudgingly agreed to in 1922, was under trial.[161]

In his comments on exercise RW in 1933, the Commanding Officer of *Glorious* stated that there was an urgent need for air launched depth charges, and was backed up in this by his Commander in Chief. This was in the wake of an anti submarine exercise during which aircraft from *Glorious* had detected many of the attacking submarines, both at periscope depth and dived, but had been able to take no action against them.[162]

When war broke out the debate over whether to use 100lb, 250lb or 500lb bombs was still under way, but no progress at all had been made in the development of air

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[159] PRO ADM 116/2089 "Aircraft Bombs and Torpedoes; Conferences with the Air Ministry"
[160] CHURCH ROSK 14/4.
[161] PRO ADM 186/174, CB 01831, "Memorandum on Armour, Shells, Fuses and aerial bombs 1928".
[162] PRO ADM 186/154, CB 1769/33(2).

launched depth charges. It seems that carrier borne aircraft tended to carry 100lb A/S bombs, while Coastal Command aircraft still preferred to use the larger weapons.[163]

While the question of which weapon to use was discussed, very little if any work appears to have been done on the tactics of the attack itself, presumably because one can only reasonably develop tactics if one understands the weapons to be employed. An Air Ministry paper of December 1939 thus finds Coastal Command discussing such questions as whether to attack across or along the line of advance of a submarine[164], and a paper written in November 1939 suggests that experiments be carried out to determine the best height at which an aircraft should patrol in order to see a submarine without itself being seen.[165] This latter came from HQ 15 Group to HQ Coastal Command, and it is unclear whether the information required was generally unknown, or whether it had just not been transmitted to 15 Group. In either case it would appear to have been something of a basic oversight.

Seemingly without irony or self consciousness, an Air Ministry paper of July 1939 told the reader that "The bombing of submarines demands great skill...it requires great practice".[166] Further evidence of RAF unpreparedness for combined operations came when, as late as May 1939, the CO of 16 Group requested the production and issue of cards showing the flag hoists used by hunting ships so that aircrew could contribute to the hunt.[167]

[163] PRO AIR 14/184 "Anti submarine Patrols", 1939.
[164] Ibid.
[165] PRO AIR 15/63, "Air Operations, Policy".
[166] PRO AIR 14/279 "A/S Tactics", Coastal Command paper dated 1/7/39.
[167] PRO AIR 15/38, "Air Tactics, A/S Operations", note by CO 16 Gp, 12/5/39.

Chapter 3

WARTIME EXPERIENCE

In the preparation of this chapter information has been taken from published sources, private papers, ships' logs and reports of proceedings to give as clear an account as possible of every significant or instructional interaction between U-boats and anti submarine forces between the outbreak of war and the end of May 1940. Direct reference has not been made to U-boat war diaries, the majority of which remain untranslated from the original German, but Clay Blair appears, in his book, to have made extensive use of this material, so the source may be described as having been indirectly consulted. Blair's book, however, should be treated with some caution as many of the narratives therein differ radically from those in other available and authoritative sources such as logs and reports of proceedings. The extent to which this is due to the authors of the war diaries adding their own embellishment or supposition is unknown, but those accounts which differ most wildly have been disregarded.

WARSHIP AND TROOPSHIP DEFENCE

On 14 September 1939 *Ark Royal*, in company with *Faulknor*, *Foxhound* and *Firedrake*, her escorting destroyers, was conducting offensive anti submarine operations to the west of the Hebrides when she was attacked by *U 39*[168]. Although not flying at the time, *Ark Royal* was steaming at speed so the escorts were going too fast for their Asdic to be fully effective. Also, oddly for a force which was not engaged in flying, the force was not zig zagging, so provided he was within the dived danger area the submariner would not have had a particularly difficult approach. Blair has the destroyers 4nm away from the carrier at the time of the attack, which was certainly further that they should have been according to Portland doctrine. He believes that this was due to the carrier "falling behind" while conducting flying operations, which would seem odd as it was the escort commander's responsibility to keep his ships in station on the carrier, whatever she did. The author of this

dissertation does, however, have experience of modern carriers turning in unexpected directions and increasing speed without warning, making it very difficult for the escort to stay in station, particularly if running on an engine configuration which does not allow maximum speed to be rapidly achieved. In *Ark Royal's* case, however, all three destroyers had been steaming at a steady 24 knots ever since flying operations had been completed, an hour before the attack, so doubt must be cast on Blair's assertion. In any event, the attack failed, the torpedoes exploding some hundreds of yards from their target, and the escorts slowed down to close the believed position of the submarine and commence a classic Portland hunt. The logs of all three escorts survive, and although many of the timings shown are contradictory, it seems clear that the submarine was rapidly detected and depth charged. The initial attack by *Foxhound* damaged the boat's electrical systems, and the follow on attacks by the other two escorts forced the boat to the surface, where it was engaged by guns. Some forty minutes after firing her torpedoes *U 39* was on her way to the bottom and her crew were in the water.

Steaming at speed in a straight line, with Asdic ineffective but all ships making enough noise to be detected by the submarine's hydrophones, was not an activity in accordance with the normal anti submarine doctrine, but would seem to have been forced by circumstances. The submariner would have been extremely reluctant to use his periscope for fear of being spotted by aircraft, but could have made most of his approach using hydrophones. The force commander thus had to accept the risk that if a submarine found itself within the narrow dived danger area ahead of a ship steaming at 24 knots he would have a good chance of making an attack. It does seem, however, that the escorts were distributed over a wider front than was necessary to cover only the dived danger area, so with better positioning might have been able to detect the submarine before its attack, notwithstanding the degraded performance of their Asdic. Once the submariner had revealed his presence by attacking, a hunt was initiated in accordance with the doctrine and the submarine was destroyed.

U 29 was nearing the end of an already successful patrol when, on the 17th September, she happened across the carrier *Courageous* which was engaged in anti submarine patrol, in company with two of her four escort destroyers, the other two

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[168] Roskill, War at Sea vol I, p68, Wynn, "U-boat Operations of the Second World War", Chatham Publishing, 1997, p28, Blair,PRO AMD 53/108689, Firedrake log, ADM 53/108783, Foxhound log, ADM 53/108656, Faulknor log, ADM 53/107522, Ark Royal log.

having parted company to assist a merchantman.[169] The submarine commander tried to work himself into a firing position, but as he was outside the dived danger area he was unable to do this, and after an hour he had only succeeded in closing the range from ten to seven thousand yards. He estimated the carrier to be making 20 knots, and all he could do was attempt to stay in touch. After a further twenty minutes the carrier suddenly altered course by 70 degrees towards him and reduced speed, so putting him in an ideal position to attack. One of the two escorting destroyers is reported to have passed within 500 yards of the approaching submarine without having detected it, so it is unlikely that a fuller screen would have hindered the attack. Two of the three torpedoes hit home and the carrier sunk. The submarine was subsequently detected by the escort, and reported having been heavily depth charged, the Commanding Officer at one stage believing that the submarine was about to be crippled, but the boat eventually got away.

Following the air raid on Scapa Flow on the night of 16 March, the German Naval Staff anticipated that the Home Fleet would put to sea, possibly returning to the relative safety of the West Coast. Anticipating this movement four U-boats were stationed to the west of the Pentland Firth to intercept the heavy units when they exited the anchorage. The only one of these boats to have any contact was U44, which, while attempting to attack the battlecruisers, was detected and sunk by the screening destroyer *Fortune.*[170]

The first part of the British expeditionary force to Norway left the Clyde and Scapa in the heavily escorted convoy NP1. The passage went largely without incident, but as the convoy approached the Norwegian coast it was reported that a U-boat had been sighted from the shore. *Fearless* and *Brazen*, two of the nine escorting destroyers, were despatched ahead to hunt, *Fearless* gaining initial Asdic contact at a range of 1700 yards. A brief hunt followed, and after the first depth charge attack the boat "shot to the surface". Once again, an accurate sighting report had localised the position of a U-boat, enabling a pair of destroyers to initiate a successful Portland style hunt.

The U-boat arm was severely dogged throughout the Norwegian campaign by torpedo failures, so the number of recorded and, for the purposes of this dissertation,

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[169] CHURCH ROSK 4/92 and ROSK 6/5, Roskill "War at Sea", vol 1, pp105-105, Wynn op cit, Blair op cit pp88-90

[170] Roskill War at Sea, Wynn op cit, German Naval Staff History.

useful interactions is low. Of note, though, is that in a number of cases U-boats were able to penetrate screens undetected to make attacks on heavy units, *Warspite* in particular being saved on at least two occasions by defective torpedoes. In those attacks during which torpedoes did not explode the U-boats generally remained undetected, while an exploding torpedo, whether under its target or harmlessly in open ocean, would often lead to Asdic contact and, at least, damage to the boat.

One can conclude that, in general, submarines fortunate enough to find themselves inside the dived danger area of even a heavily defended force were able to make their first approach with relative impunity. Once alerted to their presence, however, escorts were usually able to detect and prosecute them with Asdic, at least driving them off and usually damaging or sinking the boats.

CONVOY DEFENCE

The intention in this section is to examine the success or otherwise enjoyed by convoy escorts in the early stages of the war, thus determining whether the exercises undertaken before the war were reflected in the conditions presented by war, and whether the expected success was actually enjoyed. As stated in the introduction, the object of this dissertation is to examine anti submarine tactics rather than strategy, so it is not the intention to make arguments for or against convoy, that being the decision of the strategist, but rather to look at how successful the Royal Navy was at protecting those ships which it was tasked to escort in convoy.

Any attempt to gather firm statistics about convoyed merchant ships is fraught with difficulties as convoys did not all passage together from one port to another. Some assembled at sea, many dispersed at sea, most had ships which "straggled" behind, some had ships which "romped" ahead, and escort from end to end was very far from being guaranteed. For the purposes of this section the Admiralty definition of "one or more merchant ships or auxiliaries sailing under the protection of one or more warships" has been adopted. Thus unescorted convoys, convoys which had dispersed when the action took place, and ships which were separated from the escort will not be considered. As the dissertation is concerned primarily with Asdic related tactics, convoys escorted by non Asdic fitted ships will not be considered either.

The first source to which one naturally turns is the Naval Staff History[171], this however includes stragglers in its figures. Numerous books and records have been published since 1945 showing details of merchant ship sinkings, few of which agree with each other, but probably the most reliable, and certainly the most recent, is Arnold Hague's[172], which represents some 50 years of research. The method adopted, therefore, has been to use his information as a baseline but to check all information against Kenneth Wynn's near definitive U-boat history[173], the British Naval Staff History and the German Naval Staff History[174]. A number of primary documents have been consulted, including ADM 53 series of ships' logs, incomplete before January 1940 and nearly all destroyed after that date, and ADM 199, 217 and 237 series of convoy records and escort reports of proceedings. Where no discrepancy is highlighted, these sources can be assumed to have been in agreement on the relevant details.

Hague's listings of "losses incurred in convoy, excluding stragglers" details the following sinkings for the period between the outbreak of war and the end of May 1940:

Ship Name	**Convoy**	**Submarine**	**Date**
Yorkshire	HG 3	U37	17/10/39
City of Mandalay	HG 3	U46	17/10/39
Clan Chisholm	HG 3	U48	17/10/39
Malabar	HX 5	U34	29/10/39
Bronte	OB 25	U34	30/10/30
Royston Grange	SL 8	U28	25/11/39
Navasota	OB 46	U47	5/12/39
Keramiai	OA 80 G	U55	30/1/40
Vaclite	OA 80 G	U55	30/1/40
Armanistan	OG 16	U25	3/2/40
Beaverburn	OA 84	U41	5/2/40
Pyrrhus	OG 18	U37	17/2/40
British Endeavour	OG 19 F	U50	22/2/40
Orangemoor	HG 31	U101	31/5/40

Thus, German U-boats sank 14 allied or neutral merchant ships in allied convoys between the outbreak of the war and the end of May 1940. A close examination of each sinking indicates the efficacy and relevance of the Portland doctrine and training.

[171] "The Defeat of the Enemy Attack on Shipping", originally CB 3304 dated 16 April 1957, an edited version of which was published by the Naval Records Society, 1997.
[172] Arnold Hague, op cit.
[173] Wynn, op cit.
[174] German Naval History "The U-boat War in the Atlantic 1939-1945", HMSO, 1989

The first three ships pose no problem at all for analysis, as the convoy was not escorted when attacked, and scattered after the first attack. A local escort had been provided on departure from Gibraltar, and it was planned to provide another escort as it entered the western approaches, but none was in the area when *U 46* sank Yorkshire, its first victim. *Escort*, *Electra* and *Wakeful* were despatched to the scene but did not arrive with the reassembling convoy until the following day. For completeness of evidence it should be noted that Blair[175] describes this convoy as having been "heavily escorted by British destroyers transferring from the Mediterranean to home waters", but the reports of proceedings[176] make it quite clear that the convoy was not escorted between the departure of the local Gibraltar escort during the night 13-14 October and the arrival of *Escort* and *Electra* on the 18th. The convoy was thus unescorted when attacked on the 17th.

The next ship, the Malabar, was escorted by two destroyers, *Grafton* and *Gallant*. The escorts' logs, which would normally be the best record of an inconclusive anti submarine action, do not survive, but there is nowhere any indication that they gained contact on the submarine. This action, then, can be taken to be a square failure of the anti submarine escort.

The Bronte, although listed as having sunk on 30 October, was actually attacked early in the morning three days before. The convoy had an escort of two destroyers, *Walpole* and *Whirlwind*, both of which gained good contact on a submerged object, before attacking using patterns of five depth charges. The only evidence of success was an oil slick and bubbles on the surface, and the surviving U-boat records do not indicate that *U 34* was damaged in the attack. Indeed, she went on to attack Malabar two days later, and given that U-boats frequently released oil and air to simulate a hit one can conclude that, again, the escorts failed to achieve any positive result. Even if the oil was deliberately released, however, this would indicate that the destroyers were at least attacking the U-boat, rather than a false contact, so preventing it from making another attack on the convoy.

Royston Grange was sunk in similar circumstances and the two escorting destroyers, *Versatile* and *Witherington*, detected and prosecuted a contact which let out oil and water after being attacked. The hunt continued from 1320 until 1655, a total of 15 depth charges being dropped in four attacks on *U 28*. Again, there is no

[175] op cit, p113.
[176] PRO ADM 116/3809, Reports on HG convoys.

evidence of significant damage to the U-boat, which went on to lay mines off Swansea and returned to base on 18 December. There is no doubt, however, that the U-boat was prevented from taking further action against the convoy.

Navasota was sunk in a homebound convoy not far East of the line where they usually met their escorts. *Escapade* was "in the vicinity", and half an hour after the attack she "attacked a very poor contact with no results". The reader will remember that when a single ship made an attack she necessarily lost contact, and following her attack *Escapade* is reported to have "failed to regain contact in a very big sea". Some hours later, when she had ceased hunting and taken station on the convoy, she was joined by *Walpole*. The attack on the submarine is reported to have been "desultory".[177]

Vaclite was sunk at 7 o'clock in the morning while, apparently, in convoy OA 80 G. The escorting vessels, *Fowey* and *Whitshed*, whose logs survive, make no mention in those documents of her sinking. This indicates very strongly that either Vaclite or the escorts were not with the convoy at the time. Roskill tells us that the convoy had been placed in some disarray by bad weather[178], and it seems likely that Vaclite and the escort were not in company at the time of the sinking.

Having sunk Vaclite with impunity, the U55 returned four hours later to attack again, this time sinking the Keramiai. On this occasion she was not so fortunate; she was immediately detected by *Fowey*, who was soon joined by *Whitshed*, the other escort, and seventeen minutes after hitting the Keramiai the U-boat suffered her first depth charge attack. In a familiar pattern, the destroyers saw oil and water on the surface but after several attacks disengaged. On this occasion, however, the U-boat was damaged and forced to the surface, where she was detected by a Sunderland flying boat. The Sunderland and the two escorts re-engaged the submarine, which was then scuttled by the Commanding Officer, the only one to lose his life.

The Armanistan was sunk while in a convoy which was being escorted by non Asdic fitted French ships, and so does not enter our statistics.

The Beaverburn was sunk while in a convoy with an escort of only one destroyer, the *Antelope*, which detected the submarine soon after it had attacked. The destroyer then conducted an eleven hour hunt, during which twenty one depth charges were

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[177] Blair, op cit, p 120.
[178] S W Roskill "The War at Sea", vol I, p129.

fired in six attacks, and at the end of which the U-boat was destroyed, all hands being lost.

The Pyrrhus, like the Armanistan, was being escorted by two French vessels which did not have Asdic equipment. Further, the convoy had substantially scattered in heavy weather so the French escorts were not able to provide proper protection. The Commodore of the convoy in fact reported that he did not see the escorts at all on the day the Pyrrhus was sunk.

Although Hague lists the British Endeavour as having been sunk while in convoy, both the First Sea Lord's daily intelligence summary and the Naval Staff's contemporary record state that, in company with one other merchant ship, she had fallen well astern of the convoy during the previous night. Hague highlights a difficulty of definition in that the commanders at sea tended to call any ship which had detached from the convoy a straggler, while the Naval Staff, and Hague, define a straggler as a ship "that has definitely become separated from a convoy and is out of sight of her convoy and all escorting vessels"[179]. It can thus be taken that when she was torpedoed the British Endeavour was within sight of the tail end of the convoy, but beyond the range at which the escort could reasonably provide protection or commence an effective hunt.

Orangemoor was attacked and sunk while being escorted by *Arabis*, a newly constructed Flower class corvette. *Arabis* detected the boat and pressed her attack home. Roskill[180] states that *U 101* was slightly damaged in this attack, and his original notes give this information as well[181] but provide no provenance. Certainly the damage can not have been severe as *U 101* went on to sink another five merchant ships before returning to base a month later. In any event, however, the *Arabis* undoubtedly prevented her from putting in further attacks on that convoy.

In conclusion, then, up to the end of May 1940, a total of six merchant ships were sunk by U-boats while in convoys with Asdic fitted escorts. Of these six sinkings, two led to the destruction of the U-boat, three led to the U-boat being detected and attacked with possible damage being inflicted, and in only one case did the U-boat escape without being detected on Asdic. In none of these cases was the submarine able to press home a second attack on the convoy. To put these statistics into

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[179] Hague, op cit, p16.
[180] S W Roskill "The War at Sea", vol I, p133.
[181] CHURCH, ROSK 4/92.

proportion, U-boats sank a total of 72 merchant ships during this period. The information provided by Hague, subject to close analysis, can thus be presented as shown below.

Ship Name	Convoy	Submarine	Date	Comments	U-boat Fate
Yorkshire	HG 3	U37	17/10/39	Convoy unescorted, and scattered after first attack	
City of Mandalay	HG 3	U46	17/10/39		
Clan Chisholm	HG 3	U48	17/10/39		
Malabar	HX 5	U34	29/10/39	2 destroyer escort, no A/S success	Undetected
Bronte	OB 25	U34	30/10/30	2 destroyer escort, possible A/S success	Possible damage
Royston Grange	SL 8	U28	25/11/39	2 destroyer escort, possible A/S success	Possible damage
Navasota	OB 46	U47	5/12/39	Attack in very poor weather	Possible damage
Vaclite	OA 80 G	U55	30/1/40	Single escort, ship and escort separated	
Keramiai	OA 80 G	U55	30/1/40	U-boat sunk by escort and aircraft	Sunk
Armanistan	OG 16	U25	3/2/40	French non Asdic fitted escort	
Beaverburn	OA 84	U41	5/2/40	U-boat sunk by destroyer	Sunk
Pyrrhus	OG 18	U37	17/2/40	Convoy scattered, French non Asdic escort	
British Endeavour	OG 19 F	U50	22/2/40	Detached from convoy	
Orangemoor	HG 31	U101	31/5/40	Single corvette escort, possible success	Damaged

There were of course other interactions between U-boats and merchantmen which resulted in loss of or damage to the submarines, some of which are worthy of report. One of the earliest such came when *Imogen* and *Ilex* were in the vicinity of the Stonepool, which had straggled from convoy OB17. Accounts of this action are contradictory. Wynn[182] reports that the submarine attacked the merchantman with gunfire but was met with return fire which forced the boat to dive and damaged her steering gear. When she resurfaced the two destroyers appeared and she was easily sunk. According to the diary of the first lieutenant of *Imogen*[183], Stonepool's lookout saw the boat, which was reported to the destroyers, then some seven miles distant. On closing, *Imogen* gained Asdic contact and became directing ship. *Ilex* then gained contact and pressed home a five charge attack, following which the boat came to the surface and both ships engaged it with gunfire, *Ilex* then ramming. This version is

[182] Wynn, op cit, p29.
[183] IWM DS/MISC/31, diary of Vice Admiral Sir Atastair Ewing.

backed up by surviving anti submarine division papers,[184] and Blair's account, which also specifies that the depth charges ruptured the submarine's stern ballast tanks, forcing the CO into an emergency surface to save the boat.[185]

On 31 May, the last day of the period under study, *U 13* was working her way in to attack an east coast convoy when the sloop *Weston,* the convoy's sole escort, saw her against the sunset and closed to hunt. The boat dived but was detected on Asdic. In the following hunt *Weston* showed remarkable tenacity, dropping a total of 31 charges in five attacks, losing contact on every attack but managing to regain each time, eventually destroying the submarine.

A 1940 review drew one conclusion which coincided with the pre war Portland doctrine, and one which modified it:

> It must not be supposed that an escort provides physical protection to a convoy; to do this the number of escorting vessels would, in most cases, have to exceed the number of ships in convoy ... It is therefore of utmost importance that escorts should be operated offensively and that any U-boat which attacks a convoy should be hunted relentlessly until destroyed[186]

The latter part of this statement highlighted the only real discrepancy between pre war assessments and wartime tactics, which was brought out in the aftermath of the attack on the merchant ship Teakwood on 21 September 1939.[187] Teakwood was in a convoy being escorted by *Acasta* and *Ardent,* one of which was on each bow of the convoy, when she was torpedoed but not sunk by a single torpedo from *U 35. Ardent* immediately altered towards the stricken ship while *Acasta* commenced an Asdic search around convoy. After searching in Teakwood's immediate vicinity *Ardent* took some men off and detached from the convoy with the intention of escorting Teakwood to safety. Some fifteen minutes later she obtained a moderate Asdic contact and fired a single charge. Contact was lost and she continued on her way with Teakwood. She was not to know it, but she had successfully detected the boat and caused sufficient

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[184] CHURCH FWCT 2/4/7a, "Reports of Successful attacks on U-boats", kept in the personal papers of Cdr Fawcett, who was at the time in the A/S division.
[185] Blair, op cit, p112.
[186] IWM, Memoirs of Vice Admiral Sir A G Talbot CB DSO, paper entitled "Review of methods of dealing with the U-boat menace", February 1940.
[187] PRO ADM 199/62 "Reports on Convoys" and ADM 53/107294, HMS Acasta log.

damage for the submarine to have to sit on the seabed for some hours effecting repairs. The CO of *Ardent* was roundly condemned for not continuing the hunt:

> It is clear that the CO failed to pay attention to the imperative need for seizing every opportunity for destruction of enemy submarines[188]

> To those officers whose employment has so far been mainly on submarine hunting operations the golden opportunity of a submarine being definitely within striking distance is so evident as to leave no shadow of doubt. To those whose work has been exclusively with convoys, the responsibility for 'safe and timely arrival' may have affected their judgement.[189]

The C in C Plymouth noted that he had interviewed the CO and that "he is now, however, quite clear as to what his duty is." Not, one imagines, an entertaining interview for the CO!

Here we see the difference between the pre war doctrine, under which a submarine abaft the limiting lines, no longer presenting a threat, could be left alone, and the overarching wartime requirement to prosecute submarines whenever the opportunity arose.

OFFENSIVE PATROL

On 14 September aircraft from *Ark Royal*, engaged in anti submarine patrols, sighted *U 30* on the surface. She was attacked, without success, by Swordfish and Skuas. Two of the Skuas, which appear to have conducted their bombing run at very low altitude, actually had to ditch owing to damage caused by their own bombs. The remaining aircraft were, however, able to transmit a good positional report and three destroyers were ordered to close the position. The two which were detailed to hunt the submarine found it and conducted a number of attacks during which dials were shattered and cracks appeared in the torpedo tubes and the engine room. The boat, however, managed to escape after 6 hours.

Vice Admiral Sir Alastair Ewing, who was, during the early months of the war, first lieutenant of *HMS Imogen*, kept a very detailed diary which allows us some

[188] Cdr P J Oliver in ADM 199/62.

interesting glimpses into the beliefs of the time.[190] On September15, the day after *Ark Royal's* aircraft and attached destroyers had attacked *U 30*, Ewing's destroyer was in company with the carrier *Hermes* carrying out anti submarine sweeps. One of the aircraft signalled that it believed it had spotted a submarine but the destroyers were not sent to prosecute the submarine, instead being kept close for protection of the carrier. This policy would have rendered the entire carrier group sweeping operation useless as it was only by detaching destroyers to prosecute submarines that there was any chance of sinking the submarines. The following day the carrier signalled to its escorts that if an aircraft spotted a submarine three of the destroyers were to detach to search, the fourth remaining with the carrier to screen. A day later the *Courageous* was sunk; the reader will remember that two of her four escorts had been detached to assist a merchantman. In reaction to the sinking of the *Courageous*, the *Hermes* made a further signal stating that "Ships are not to part company without orders or act on aircraft reports. Two destroyers only will be sent if prospects appear favourable."

Some days later, seemingly under Cabinet pressure, the First Sea Lord instructed that aircraft carriers were no longer to be employed in anti submarine hunting operations.[191] Admiral Forbes, then Commander in Chief Home Fleet, although well aware of the risks that such operations held for his ships, felt this to be an error. He wrote to Roskill some time after the war that "I was told by the Admiralty not to use the Ark Royal for hunting submarines again which nearly broke my heart as I was of the opinion that aircraft (with) destroyers with Asdic was the method of sinking U-boats"[192]

Aside from the sinking of *U 39*, which for the purposes of this dissertation has been considered as an action in defence of a warship, the first success enjoyed by surface attack groups was that of *Fortune* and *Forester* which sank *U 27* on September 20. The ships had been directed to the vicinity of a reported U-boat,[193] but as they closed the area they were seen by the boat. As it was approaching midnight the CO of the submarine decided to make a surfaced attack on the destroyers, but his attack failed, the torpedoes either missing or detonating early. Almost immediately the destroyers saw the boat, which dived, but the destroyers gained early Asdic

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[189] Capt C Caslon, Capt D 18 in ADM 199/62.
[190] IWM, DS/MISC/31, Diary of Vice Admiral Sir Alastair Ewing.
[191] Roskill, War at Sea, vol I, p106.
[192] CHURCH, ROSK 6/30, letter from Forbes to Roskill 10/2/50.

contact. The ensuing hunt lasted nearly four hours, during which time the ships carried out five attacks, each one using a full pattern of five charges, after the final one of which the boat was forced to the surface. This action followed the classic Portland pattern in which destroyers start with the advantage of good positional information, in this instance one of them seeing the boat on the surface, and hunt the boat to destruction.

The next success by a patrol group came on October 14 when *Inglefield, Ivanhoe, Icarus* and *Intrepid* were on patrol in South Western approaches[194]. Having left Plymouth the previous evening, they received a report from a merchant vessel that she was being chased by a submarine. On closing the position, at around 1010, *Inglefield* saw the submarine on the surface. Almost exactly as *U 27*, above, had done, U45 dived and was hunted by the four destroyers. Again, several attacks were made, only wreckage coming to the top; U45 was later assessed to have been sunk with all hands. Two contrary arguments come out of this engagement; the first is that if there had been no patrol in the area the U-boat would probably have succeeded in sinking the merchantman with impunity, the second that if she had been part of a convoy the problem would not have arisen in the first place.

Early in the morning of November 29 *Icarus* was in the North Sea attempting to round up the convoy which she had been escorting the previous day and which had become scattered when she sighted a U-boat against the rising sun[195]. She closed rapidly, gained an Asdic contact and attacked with one pattern of five charges. She judged the attack to have been unsuccessful, but was unable to follow it up as her Asdic set became defective. She remained in the area, however, until *Kingston* and *Kashmiri,* which had been on patrol close by, arrived some three hours later, upon which she left the scene to rejoin her convoy. The two new joiners soon gained an Asdic contact and attacked, damaging the boat and forcing it to the surface. *U 35* finally sunk, but all 43 of her crew were captured. It seems likely that the U-boat commander was still in the area as he was following the current U-boat doctrine of going to the bottom and remaining silent when attacked, which was based on the belief that Asdic was a passive listening device rather than an active search tool. Once

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[193] CHURCH FWCT 2/4/7a "Reports of successful attacks on U-boats", drawn up by Cdr Fawcett of the A/S Division, and kept in his personal papers.
[194] Roskill, War at Sea, Wynn op cit, PRO ADM 53/109305 Inglefield Log, PRO ADM 53/109348 Ivanhoe Log.
[195] Roskill, War at Sea, Wynn, CHURCH FWCT 2/4/7a, PRO ADM 53 109255 Icarus Log.

again, a patrol group was able to claim a success, but only against a submarine which had previously been detected by a means other than Asdic.

Gleaner, an Asdic fitted minesweeper, was on patrol inside the Clyde over the night 11/12 February when, at 0350, she saw a periscope wash in her searchlight. She turned to search, and at a range of 3000 yards gained contact on *U 33*, which had been attempting to lay mines. During the ensuing hunt, which lasted over two hours *Gleaner* dropped a total of ten depth charges in three attacks, the last of which put her own Asdic out of action and forced the U-boat to the surface. Seventeen of her crew were captured, the remainder being lost. Doenitz is reported to have decided after this action that he considered minelaying in such confined waters should be stopped as it was too hazardous for the submarines. The *Gleaner/ U 33* action is of particular interest as the boat is reported to have been employing the then current anti Asdic tactic of sitting on the bottom when *Gleaner* gained contact. This shows that Asdic was effective in picking out a boat against background returns from the bottom, and that the German tactics were fundamentally mistaken.

Gurkha appears to have been on passage on 24 February when she saw U53 on the surface at close range. An initial attempt to ram failed, and as the boat dived *Gurkha* dropped a pattern of charges based on a visual reckoning of the submarine's position. The destroyer then gained Asdic contact and conducted three more attacks, after which contact was lost. The submarine never returned home, and is assumed to have sunk with all hands in 1800 feet of water.

There are many recorded instances of Coastal Command aircraft on patrol sighting submarines on the surface[196], notably in the North Sea. As the aircraft themselves were not fitted with an effective weapon, and there was a paucity of surface escorts, very few of these encounters ended with the submarines being damaged. Admiral Talbot, reviewing the situation in February 1940, concluded that "It is essential that fast striking forces should be provided for the Northern part of the North Sea, as soon as possible"[197] in order to work with the aircraft and take full advantage of the sightings which were being achieved.

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[196] PRO AIR 2/2925 "Attacks by Aircraft on Enemy Submarines, reports 9/9/39 to 1941" lists 82 such attacks between the outbreak of war and the end of May 1940, none of which resulted in sinking or severe damage to a submarine.

[197] IWM, Papers of Vice Admiral A G Talbot, CB DSO, "Review of methods of dealing with the U-boat menace", Feb 1940.

Chapter 4

ANALYSIS

Much of the currently accepted wisdom is based around Roskill's famous contention that "not one exercise in the protection of a slow mercantile convoy against submarine or air attack took place between 1919 and 1939"[198], so it seems sensible to start the analysis by making a close examination of the facts as they relate to this statement. First one must look at the provenance of the statement itself.

Roskill quotes two authorities, the first of whom, Admiral Sir Geoffrey Miles, wrote that "I do not remember an exercise with a slow convoy screened by destroyers against submarine attack". Admiral Miles was a navigation specialist, and as such served on the staffs of the RA(D)s of the Atlantic and Mediterranean fleets between 1920 and 1925. After that he was appointed to *Iron Duke, Barham, Hood* and the Plans Division before going on to command a minesweeping squadron. He did not, therefore, serve on destroyers at any time after 1925, nor was he directly involved with destroyer exercises, so it would have been surprising if, fifteen years after the event, he had had any memory of specific exercises in the defence of slow convoys.

Roskill's second authority was Rear Admiral JHF Crombie, who is quoted as speaking of the "total lack of convoy exercises". Crombie was a specialist communicator whose seagoing appointments between the armistice and 1934 were to *Birmingham, Resolution, Hood and Repulse*. He was, from July 1934 to August 1935 CO of *Thruster* in 1A/S, and later commanded the destroyer *Boadicea*.

During nearly all his time in *Thruster* the ship was alongside at Portland or day running for repetitive and not very demanding exercises, many of which are thought to have been in support of anti submarine school training. The ship did, however, participate in a few Home Fleet exercises, one of which was TP1, previously discussed in the "Offensive Tactics" section.[199] During this exercise *Thruster* escorted a number of ships in and out of Portland, and it was the intention of the exercise planners that the ships should simulate either individual merchant ships or convoys. Three months later *Thruster*, still under the command of Cdr Crombie, took part in exercise AD4, during the course of which she spent most of one day escorting the

[198] SW Roskill, "Naval Policy Between the Wars", vol 1, p536.

Italia at 10.5 knots. While both these exercises involved the escort of single ships, it was the habit at the time, for reasons of economy, to use single ships to simulate convoys. Indeed, the Admiralty definition of convoy was "one or more merchant ships or auxiliaries sailing under the protection of one or more warships", and under this definition both these exercises were convoy defence exercises. It is thus surprising to read of Admiral Crombie's "total lack of convoy exercises".

In order to look for exercises which may, contrary to Roskill's statement, have taken place, one must define slow. In the inter-war years there was no formal definition of a slow or a fast convoy, but Roskill was writing from a post war perspective so it would seem reasonable to take the wartime definitions. When convoys started to become classified as fast or slow, for instance the HXF and HX series, the limiting speeds were 12-15 knots and 9-12 knots respectively[200]. As these brackets also applied to other convoys, it would seem that we can safely define any convoy with a mean speed below 12 knots as being slow. Hague's exhaustive analysis of convoy statistics, however, shows that actual speeds were appreciably slower than this. Average voyage speeds of HX (slow) convoys were around 9 knots, and SC convoys were even slower at around 7.5 knots. If one allows, as Hague suggests, a one knot reduction to take account of zig zags etc, one can conclude that the actual speed through the water of a slow convoy was usually between 8.5 and 10 knots. To make a conservative verification of Roskill's assertion, then, we will look for inter-war exercises with convoy speeds of 9 knots or less.

With a very few exceptions, the only surviving exercise records are those which were collected in the CB 1769 summaries. These covered only a selected few of the most significant, but still give us details of a number of exercises in the defence of slow convoys against submarine attack. The following lists those which are relevant:

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[199] PRO ADM 53/99864, HMS Thruster log, March 1935.
[200] Hague, op cit, pp 109.

Year	Exercise	Attacking S/M Force	Defending A/S Force	Convoy Speed	Notes
1927	NP	4 Submarines	12 Destroyers	7	
1928	LA	4 Submarines	4 Destroyers	8	
1929	OD	S/M 1	17 Destroyers	8	
1929	MA	9 Submarines	D6 and A/S 1	11	
1930	AS	10 Submarines	D5 and D6	15	
1933	AF	U/K	4 Destroyers	9	
1933	RT	U/K	D1 and D4	U/K	Submarines targetted escorts, not convoy
1934	SK	3 Submarines	3 Flotillas	9	Heavily defended, but slow, troop convoy
1938	ZP	U/K	14 Destroyers	10	Pack attack failed

Many of the above exercises also included other units, but they were all to some degree exercises in the defence of convoys against submarine attack, and five were without question slow convoys. It is conceded that five exercises over the period of thirteen years studied in this dissertation is not a tremendous number, but these five come from only a small sample. The direct records outlined above are further supported by other more oblique references in the source material, such as in the 1929 CB 3002: "Several convoy exercises were carried out ... The exercises were chiefly designed to discover the best dispositions for a small escort of A/S vessels such as might be expected in war".[201] In any event this evidence undoubtedly undermines Roskill's contention that no such exercises took place, and by extension the subsequent literature which follows Roskill's line.

In the introduction it was promised that the dissertation would attempt to answer five key questions, and these will now be addressed in turn.

i) Did the anti submarine organisation of the Royal Navy make thorough studies of the likely tactics and strategy of the anticipated enemy, and were the studies realistic?

[201] PRO ADM 186/476, CB 3002/29

The RN practised anti submarine defence of warships, troopships and convoys. All three would undoubtedly be attacked by any one of the three rising enemies of the period. Further, it was correctly judged that the future war would involve an unrestriced submarine attack on trade, so overall one can conclude that the appreciations of the enemy's likely strategic stance were correct. There does not, however, appear to have been any real effort to study German, Japanese or Italian submarine tactics. No clear idea developed about whether boats would attack singly or in groups, whether attacks would be conducted at long range or from inside the convoy, or whether there would be an effort to pick off the escorts before moving in to attack the convoy. Rather than rely on intelligence assessments of likely enemy actions, it was left to the RN's submariners to work out how they would go about attacking the various targets, and the tactics thus developed were then countered by the anti submarine community. The criticism has been levelled that this method led to an assumption that German submariners, like their British counterparts, would be more inclined to attack heavy warships than merchant vessels. The fact is that, while the majority of German submarines were indeed tasked to attack merchant traffic, no opportunity to mount an ambush or an attack on warships was missed, and the public lionising of the COs who sank the *Royal Oak* and the *Courageous* leaves one in no doubt that they were considered valuable targets.

Study of attack tactics would have been impossible before the Germans started to redevelop their U-boat arm in 1935, and might anyway have led to misapprehensions as to what the German submariners would actually do in an attack. Doenitz insisted in training that U-boats should press in to attack from very close range, but in war the range of the attack depended vastly on the experience, skill and determination of the CO and crew of the attacking boat. A uniform assumption, therefore, that all boats would attack in accordance with the Doenitz doctrine might have led to mistaken countermeasures.

The only real shortcoming of practising against the RN's own tactics was that it presupposed an enemy understanding of the still very secret Asdic. In the event, the Germans clearly did not understand how Asdic worked, and devised inappropriate countermeasures, which made the British anti submarine methods more successful than peacetime exercises might have suggested.

ii) Did the exercises and trials carried out test the conditions anticipated, and did they prepare personnel for the anticipated war?

The Portland hunting and searching exercises almost all started with the submarine in a known position anything between 2 and 20 miles from the escorts which were to hunt it. In some cases the submarine started off dived, and in some it dived when seen from the destroyers. This is exactly what happened in war, escorts and patrolling ships going to the position of a submarine that had made an attack or been detected by aircraft, and it is unsurprising in these conditions that such a high proportion of the submarines so hunted were destroyed or badly damaged. The hunting exercises fell down, however, in the single but important fact that the potentially variable depth of the submarine was not taken into account when assessing the success of depth charge attacks.

Exercises in attacks on formations of ships were generally conducted in a manner consistent with the subsequent war experience, with the exception of the inevitable compromises for peacetime safety. Ships at night, for instance, operated with their lights on, and submarines tended to be kept on the surface when they might otherwise have dived to evade after detection or attack. There were few exercises in patrol tactics, the only recorded one being that in which the relative values of patrol and escort were investigated.[202] The only part of a patrol which merited much practice was the search for a localised submarine and its subsequent prosecution, and this was well practised in the hunting exercises.

Exercises in the employment of aircraft to search were frequent and realistic, though geography dictated that there was an unsatisfactory degree of liaison between RAF aircrew and ships' officers after combined exercises. Exercises were carried out both with and without air support, so the mid Atlantic action away from shore based air support was allowed for. The only real failing of exercises in air operations was the practice of declaring carriers to be "out of the exercise" and thus unsinkable, for safety reasons, when launching or recovering aircraft. This meant that carriers got into the habit of moving out of formation and away from escorts with impunity, which would make them unnecessarily vulnerable in war.

[202] Exercise TP1, March 1935.

iii) Were the wider navy, the relevant sections of the air force, and policy makers outside the services kept aware of progress in, and limitations of, anti submarine capability?

There is no doubt that the community of anti submarine specialists, and some other involved officers, were aware of the limitations of the equipment. There is also little doubt that there were large numbers of influential officers who did not appreciate what Asdic could and could not do. The first reasons for this would appear to lie in the organisational make up of the Naval Staff, and the tribal branch structure of the Royal Navy.

To take the first point, it has already been given that the anti submarine expertise of the Naval Staff was limited to a core of officers who would frequently return to the same area, concerned primarily with procurement and tactical development, and that there were few if any in the Operations and Planning Divisions who had understanding of or experience in anti submarine matters. From this comes the natural conclusion that those who conducted the strategic planning did so without the benefit of an appreciation of Asdic's capabilities and limitations. What is less obvious is the reason why the officers of the planning and operational divisions should have been optimistic any more than pessimistic about the performance of anti submarine forces. For this one must look to the branch structure.

All Commanding Officers of ships, the vast majority of Admirals, and virtually all officers of influence in the staff were of the executive, or seaman, branch. After about five to eight years in the service, non submariner executive branch officers tended to specialise either in gunnery, torpedoes (which included electrics), navigation, communications, or anti submarine. Specialisation would involve a course of about one year's duration, at the Alma Mater of the chosen branch (HMS *Excellent* for gunners, *Vernon* for torpedomen, *Mercury* for communicators, *Osprey* for anti submarine officers etc), after which the Navy list would show the officer's specialisation, he would time and again be appointed to specialist jobs, and he would feel very much part of a tribe. Different branches affected small uniform variations; gunnery officers for example carried black silk handkerchiefs, supposedly so they could wipe the cordite from their faces without soiling their handkerchiefs, while communicators, who as flag lieutenants held themselves to be the aristocrats of the service, carried white silk handkerchiefs and wore black silk ties. A constructive

tension built up between the tribes which meant that designs, plans, strategy etc were generally the result of compromises between the requirements and desires of different branches. The sketch estimates for a new destroyer, for instance, would carry the gunnery officers' opinion that the ship would be useless without large calibre primary armament and effectively directed high angle secondary armament, while the torpedoman would point to the benefit of having large numbers of torpedo tubes and the communicator would insist that both these should be compromised to allow for an effective communications outfit. The resulting destroyer would be a sensible all round compromise.

Into this scene of established and senior branches came the new, junior, and slightly quirky anti submarine expert. For the first few years no qualified anti submarine officer was senior enough to be part of the staff decision process, so their corner was fought by torpedo specialists, but as time progressed qualified anti submarine men entered the debates. In the normal course of things the anti submarine man would have lobbied for greater and greater provision for his discipline, but what actually happened was that, having as they did to fight the more senior branches for influence, they tended to emphasise the effectiveness of their equipment. The gunnery officers, who for no better reason than tradition largely owned the plans division, were keen throughout the period to centre the navy around big gun battleships, and were very ready to leap on any support this cause was given. When a Portland report told them, for instance, that a destroyer on the quarters on a convoy would "be in a position to obtain contact at once with a submarine attacking a convoy"[203], they hardly questioned it but instead jumped to the conclusion that the submarine menace was dealt with, so they could get on with developing a battleship and cruiser based fleet.

The subject of anti submarine, therefore, became an area where the usually productive system of constructive tension broke down and the two naturally opposing sides of the debate came up with the same argument, that anti submarine methods were more effective than was in fact the case. In this way a spiral of self deception developed which finally led wartime planners to send out groups of ships to hunt for dived submarines, a role for which they were entirely unequipped.

[203] PRO ADM 186/476, CB 3002 (29).

iv) Were the procedures developed by the anti submarine specialists understood by and integrated into the operating procedures of the wider navy?

As has been shown, there were a number of anti submarine specialists serving with the fleets, in flagships, destroyer and submarine squadron commands and ships within those squadrons, all of whom had regular contact with Portland and were employed to disseminate the latest tactical procedures and conduct training of ships' teams. Any seagoing officer who had a need to ask questions about procedures or tactics had access to a trained expert, and procedures do seem to have been well disseminated. There were of course exceptions. Lt Cdr A Layard, CO of *Walpole*, implicated himself in his own diary after a 1933 exercise: "It was a desperate failure as we never got the ghost of a echo. I just don't understand this pinging business"[204]. Lieutenant Commander, later Vice Admiral Sir, Alastair Ewing was first lieutenant of *Imogen* when war broke out and soon found himself getting frustrated with the CO of a senior ship who had detached one of the four destroyers of a patrolling group to prosecute a submarine that had been reported by an aircraft:

> Why in god's name he didn't take all of us to search I cannot understand ... sending one destroyer to find a submarine after half an hour is fantastic. However he is in charge – passed over (for promotion) three years ago. He is obviously out of touch with things.[205]

Interestingly, the following day the C in C signalled to the CO in question that "When report (sic) of a U-boat is definite your whole force should be sent and remain until she is destroyed"[206]

Anti submarine tactics, however, were generally well understood in the fleets, reactions to an attack took place with the minimum of fuss and signalling, standard screens were well known and understood, and those commanders who took the trouble to consult their experts very rarely found themselves at a loss. On a tactical level, then, the system and the individuals do seem to have served the navy well. On a

[204] NML, Diaries of Lt Cdr A Layard.
[205] IWM DS/MISC/31, diary of Admiral Ewing, 20/9/39.
[206] Ibid, 21/9/39.

strategic level, though, as has already been discussed, things were clearly less well arranged

v) Did the conditions anticipated actually materialise?

The expectation was that unrestricted submarine attack on trade would start early, if not immediately, on the outbreak of war with Germany. That is what happened. Attempts to attack heavy fleet units and, where available, troopships, were anticipated and did occur. In the wake of the Anglo German naval agreement in 1935 a number of appreciations were made of the German ability to build submarines, and it was concluded that by the end of 1939 they would be able to operate between 56 and 66 U-boats. In the event, Doenitz had 56 boats available in September 1939, so the level of attack was, initially, as predicted. Given the strategic assumption that France would not fall, the RN anticipated that the majority of submarine attacks would take place around Britain's coasts and in the Eastern Atlantic approaches to the UK, and again this was the case until the basing of U-boats in the French Biscay ports radically changed the geography of the attack on trade.

In practical terms, the manuals published between the wars, even in the late 1930s, indicated that ships escorting a convoy could not reliably expect to detect a submarine before it attacked, but once it had revealed its position Asdic would allow the escort a good chance of prosecuting it. This, broadly, proved to be the case in war; there is no recorded instance of any Asdic fitted ship stumbling unexpectedly across a dived submarine, but those submarines which had revealed their approximate positions generally suffered at least some sort of Asdic directed attack.

It was anticipated that submarine attack on convoys would not be profitable, and as has been shown the attrition rate of those boats which did attack escorted convoys was entirely unacceptable for the German navy.

On the contrary, it was expected that the large numbers of escorts which were provided for fleet units and troopships would make submarine attack virtually suicidal. It is an inescapable fact that the speed available to warships and troopships made them harder targets for submariners. The expectation, however, that with a large number of escorts one could build a wall of steel ahead of such a force proved to be misguided. The actual experience was that, much as with convoy defence, it was only the submarine which initially revealed an approximate position that would be

detected and attacked. Although the many ships of a Battle Squadron screen would make the initial search and detection of the localised submarine easier, the doctrine was for only two ships to conduct the attack. The heavy warship with a squadron of destroyers in a screen was thus actually little better off than the convoy with an escort of two.

Independently sailed ships and unescorted convoys were expected to be vulnerable, but the scale of shipping loss among these classes was not foreseen, and the introduction of special slow convoys on the HX, HG and SC routes was an acknowledgement that the initial speed bracket of 9 to 15 knots for convoyed ships left too many slow ships sailing without protection. The feeling about vulnerability was summed up by the First Sea Lord when writing to one of his Commanders in Chief in the early days of the war: "I am surprised that we have not suffered more than we have because there really have been a large number of ships roaming about the ocean".[207] Offensive patrols were thought by the experts to be ineffective, but actually proved more fruitful than had been anticipated, for the simple reason that more boats than had been expected revealed themselves either by attacking using gunfire or moving on the surface during daylight hours. The best an Asdic patrol could do, however, was to patrol an area of likely U-boat activity waiting to receive a sighting report. Attempts to use Asdic to search expanses of water for dived submarines which may or may not have been there were both over optimistic and misguided. This was not fully appreciated by some in the navy and many outside it. What Donald Macintyre describes as Churchill's "considerable military knowledge and experience misapplied to naval matters"[208] led the latter to declare that

> Nothing can be more important in the anti submarine war that to try to obtain an independent flotilla which could work like a cavalry division on the approaches, without worrying about traffic or the U-boat sinkings, but could search large areas over a wide front. In this way those areas would become untenable to U-boats.[209]

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[207] Pound to Forbes 15/9/39 in CHURCH ROSK 4/19.
[208] Donald Macintyre, "The Battle of the Atlantic", p29.
[209] Churchill as First Lord to Pound as First Sea Lord, 20/11/39 in CHURCH ROSK 4/15.

The employment of a carrier as part of such a patrolling group would allow a greater chance of detecting a boat on the surface, as would proper integration of shore based aircraft patrols, and might have been a useful way to guide patrolling destroyers towards their targets, but such carriers were withdrawn as being too much at risk after the sinking of the *Courageous*.

Captain John Mosse, an experienced inter-war anti submarine officer, served in the war as anti submarine and Senior Staff Officer to a striking group based on the *Havelock*. He sums up the problem faced by hunting groups in his memoirs:

> The convoys had their own close escorts, but we were to be an independent striking force, putting ourselves between the reported positions of U-boats and the convoys they were trying to intercept..... For various reasons this policy was not very successful. The Atlantic is a big ocean and the range of Asdic was only about one mile.[210]

It has been established that when a submarine was detected in the vicinity of surface ships it was likely to be attacked with some success, indeed one wartime review assessed that "To sum up, the first six months of the war have shown that if the position of the U-boat is revealed close to A/S vessels the chances of destruction are high. The main problem is one of initial detection."[211]

This reflected the position as anticipated by the anti submarine organisation and as predicted by Portland exercises. Wartime conditions were, however, slightly different from those found at Portland for two reasons. First, the Portland analysis methods assumed that all depth charges were set to the correct depth, which was optimistic at a time when Asdic gave no indication of target depth. In the relatively shallow waters of the English Channel and the southern North Sea a charge set to around 100ft would detonate moderately close to the depth of the submarine, but in the Western Approaches and the Bay of Biscay the greater depth increased the problem. Associated to this was the fact, apparently not properly considered at Portland, that the submarine could alter course to evade after the charges had been dropped. A Type VII U-boat, the main ocean going class, could dive to 750ft, and in

[210] IWM 90/23/1, Memoirs of Captain John Mosse.
[211] IWM, papers of Vice Admiral Sir Peter Cazalet, undated "Brief review of anti submarine operations in the first six months of the war".

the 75 seconds it took a depth charge to fall to that depth[212] a submarine travelling at 6 knots could have moved 250 yards, making it virtually impossible to drop a charge within the 10 yard lethal range of its target, even if the depth had been correctly set.

Acting against this disadvantage was the fact that Asdic had been successfully shrouded in secrecy. The Germans thus had no idea at all how it worked, were unable to devise effective countermeasures, and made much better targets that the RN submariners which were used as practice targets at Portland. An RN submariner would try to keep end on to the transducer, so reducing the area against which the pulse could echo, and knew at what stage during an MRCS to increase speed and alter course. The German, meanwhile, would slow down, keep his rudder amidships, and if possible lie silent on the bottom to reduce his own radiated noise, believing as he did that RN measures relied on passive detection. The fate of *U 33* at the hands of *Gleaner* illustrates the inutility of these tactics.

These two factors, certainly in the early months of the war, effectively cancelled each other out with the result that the Portland hunt success matched wartime success with impressive accuracy.

While the situation around a previously detected U-boat was as anticipated, the performance of screens against dived boats making their initial approach fell well below that which had been hoped for. The wartime report quoted above also stated that "In first considering the Asdic..... it can be said that it has provided results approximating to those expected" but of the specific problem of false contacts it conceded that "Although this was fully realised in peace, it required the war to bring this out in relief".[213]

The CB 3002 reports included figures for "flotilla operating hours per false report", which usually hovered at the one to two hour level. Given that a flotilla was held to comprise six ships, this implies that each ship would gain Asdic contact on something which turned out not to be a submarine two to four times a day. Wartime logs, whose narratives reported "Investigating Asdic contact ..... contact assessed non sub" on at least a daily basis indicate that the predicted false report rate was approximately correct.

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[212] Pre war depth charges fell at 10 feet per second. The Mk VII, which fell at the faster rate of 16.5 feet per second, was not introduced until well into the war. See Hackmann, op cit, p304.
[213] IWM, papers of Vice Admiral Sir Peter Cazalet, undated "Brief review of anti submarine operations in the first six months of the war".

The Portland assessment of the operational impact of these false reports, however, may have been less satisfactory. In a four hour exercise during the course of which one expects to be attacked, each contact will be thoroughly and tenaciously investigated, the main body will be moved to avoid it, and it will be treated as a submarine until definite evidence emerges that it is a rock, a shoal of fish etc. Faced with this level of vigorous prosecution, submarines are unlikely to be able to penetrate a screen.

On the other hand, during the third week of a period of escort duty, when false contacts have been appearing on at least a daily basis and there has been no attack or other definite sign of a submarine, minds are likely to become less focused on each contact, notwithstanding the danger presented by wartime conditions. Under these circumstances it is hardly surprising that U-boats, despite appearing on Asdic, were sometimes dismissed as false contacts and allowed to penetrate screens.

It can thus be shown that Roskill's second contention, subsequently adopted by the vast majority of writers, that the RN over estimated the effectiveness of Asdic is, in all areas other than that of false contacts, largely untrue. The view among anti submarine experts was that Asdic was useful for short range hunting and prosecution of submarine contacts, but could not be profitably used for general searches. Wartime experience proved this to be the case. The only people, therefore, who overestimated Asdic's capabilities were those who had neither studied the subject nor consulted the experts. It was these people who, having spent the inter-war years blind to the progress which was taking place in anti submarine warfare, adopted the misguided and costly strategy which favoured inefficient offensive hunting groups at the expence of defensive but effective convoy escort.

The fact that someone enjoying Roskill's gifts and deserved reputation as a historian and an officer could be so ignorant of the progress is symptomatic of the problem itself, and backs up the evidence in this dissertation that the tools required to combat the U-boat threat existed in 1939, but were misapplied.

EPILOGUE

Having read all of the above the reader might be forgiven for thinking that the submarine attack on trade was easily mastered and never presented a serious threat to the security of the UK. This was clearly not the case, and to provide balance a short study follows of what actually happened in the months and years after June 1940.

First came the capture of the Biscay ports, which allowed the U-boats to work in the mid and western Atlantic for longer periods than had previously been the case. This meant that convoys could be attacked when they were without air cover, that escorts had to stay with convoys all the way across the ocean, so increasing the numbers of escorts required, and that outbound convoys had to stay together for the whole crossing rather than splitting to run at best speed once they were west of the U-boats' operating area. Second came the mass production of U-boats and the training of large numbers of crews, which allowed Doenitz to deploy boats in packs in the mid Atlantic, so swamping the escorts. Under these conditions, losses to independents and escorted convoys in the mid Atlantic rose to unacceptable levels.

In response to this situation the allies developed ahead thrown ship borne weapons, which meant one could attack without putting the submarine in the blind zone of the Asdic, and aircraft started to carry depth charges, so could attack submarines more effectively. The introduction of long range aircraft meant that convoys were afforded airborne protection in the mid Atlantic, and the fitting of radar to ships and aircraft made the surfaced U-boat very much more vulnerable, while also allowing convoys to be turned away from a potential attacker before he was in sight. The fitting of radio direction finding equipment to ships (HFDF) gave them an indication of the presence of a U-boat if it was transmitting on radio, which it would have to do to orchestrate a pack attack, and again allowed offensive action or evasive steering. Finally, the developing ability to penetrate German ciphers and thus read their signal traffic allowed areas of U-boat activity to be avoided entirely.

This clearly very abridged account of the swings which took place in the Atlantic does at least show briefly how it was that a grave situation which had not been anticipated developed and was then overcome.

Appendix A

THEORY OF ASDIC

Propagation of Sound Underwater

It has been assumed in the preparation of this Appendix that the reader understands the basics of how Asdic works, but may not be fully conversant with the problems presented by a body of water which contains discontinuities. It is worth noting that the theory described in this annex represents, roughly, the state of understanding in the mid to late 1930s, but is far in advance of what was understood in the late 1920s. The scientists at the Admiralty Research Laboratory, Teddington, conducted much of the pioneering work in this field in the inter-war years precisely in order to make best use of Asdic.

In an homogenous body of water sound travels, over the distances with which Asdic theory is concerned, in straight lines. In a body of water where the properties of the water differ with depth or horizontal displacement, however, sound will be refracted or reflected. Appreciable horizontal differences only tend to occur at ocean fronts, and are sufficiently rare and complex to be disregarded for the purposes of this dissertation, so we will here be concerned with the differing properties of the ocean as one goes deeper.

As light refracts when passing from air to the glass of a prism, so sound in water refracts as it passes from one part of the water to another. The refraction is caused by differences in the velocity of sound in the different parts of the water, which in turn are caused by differences in pressure, temperature and salinity. The key point, which should be remembered, is that sound will be refracted towards a region of lower velocity. Thus, in the body of water shown in fig xii.a, in which the velocity reduces with depth, known as a negative gradient, the sound produced by the Asdic set will be refracted down, as shown, and a submarine in the hatched area may operate with relative impunity, as the Asdic pulses will never reach it. Similarly, in the positive gradient shown in fig xii.b the pulses will be reflected upwards.

Both of the above cases have assumed a water mass of gradually changing velocity. Where a sharp change occurs some of the sound will be reflected off the boundary, as some of the light shone at a prism will reflect off the surface glass,

particularly if at an acute angle, and will never enter the prism. If therefore, if as in the purely theoretical fig xii.c, there is a sharp boundary at a given depth some of the sound will be reflected from that boundary. It should be noted that the air water interface, known to the uninitiated as the surface, represents just such a distinct velocity shift.

The Properties of the Water Column

The negative velocity profile shown at fig xii.a is, in simplification and to the depths to which a German U-boat could dive, the general rule in North Atlantic and the North Sea other than in summer. There are, however, two circumstances which will modify this pattern. The first is most commonly found in the summer, becomes extreme in tropical waters, and is often known as the afternoon effect. The sun, as a warm day progresses, heats up the surface of the water, so producing an exaggerated negative gradient as shown in fig xii.d. In these circumstances the hatched blind area increases and the submarine is even less likely to be detected. The second common modifier is caused by surface agitation, sometimes known as waves, mixing the top few metres of water so that there is no discernible difference in temperature from the surface down to, say, a depth of 5m. In this circumstance the effects of pressure unmodified by temperature will give the profile shown in fig xii.e, thus providing what is known as a surface duct. This condition, caused by anything more than a slight sea, and most pronounced where there is no great heating influence on the surface, is not uncommon in the North Atlantic.

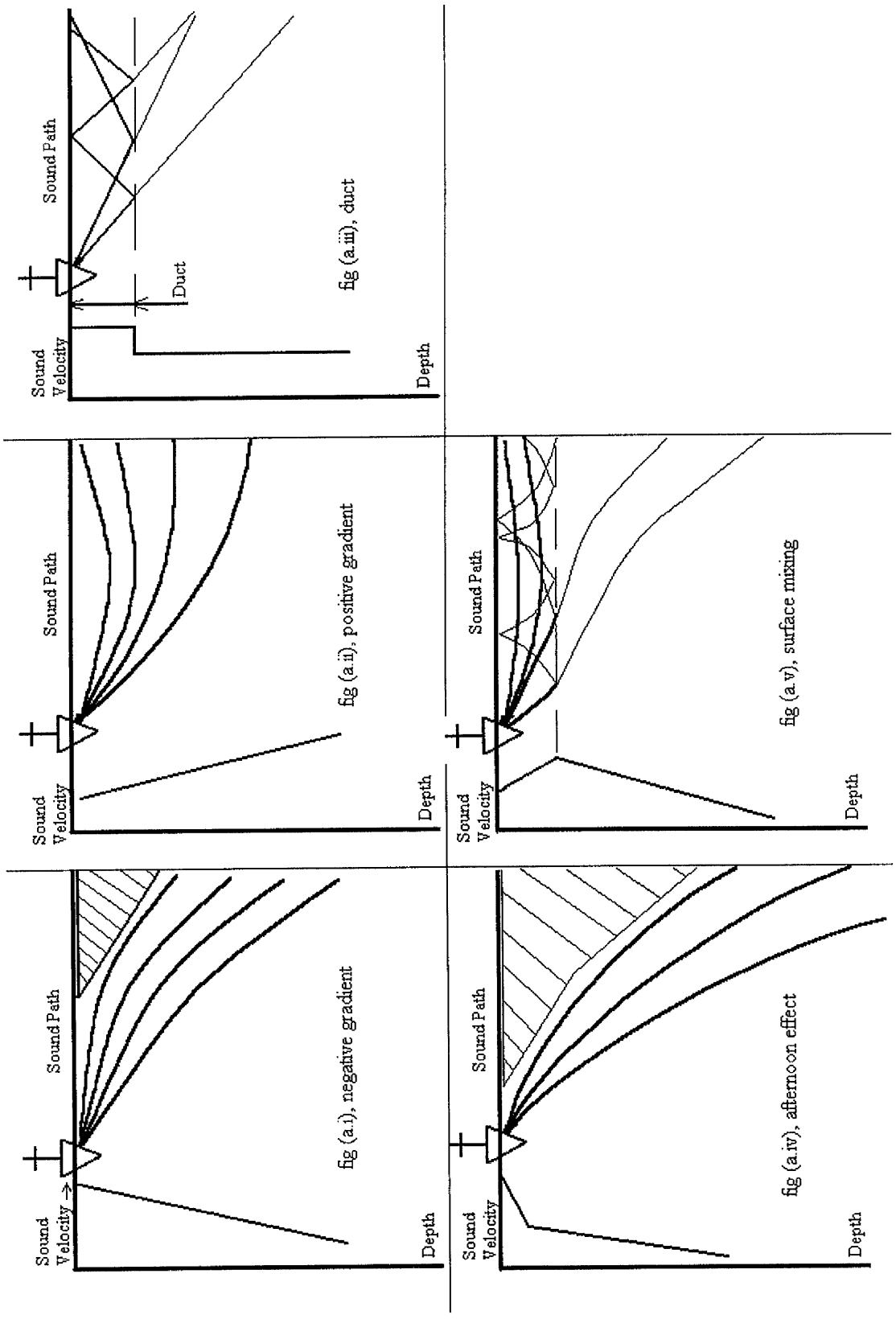
Detection of the Surfaced U-boat

The first point which should be noted about the problem presented by a surfaced U-boat is that the amount of the boat which is under water, and which will thus reflect sound, is less than in the case of a fully submerged boat. The second point is that in conditions of negative temperature gradient, fig xii.a, and especially the exaggerated negative gradient provided by that afternoon effect, fig xii.d, the surfaced boat will be able to operate down to relatively short ranges without serious danger of detection. The third point, and this should be borne in mind by those who describe the surfaced boat as undetectable by Asdic, is that a body at or near the surface may give a good

return in conditions of surface mixing. Indeed, it is the author's experience that in these conditions even small surface vessels, down to large fishing vessels of comparable displacement to a surfaced U-boat, give very definite returns on a modern sonar. While the sceptic will point to the improved transducers and processing techniques now available which make any detection easier, it should be noted that the return from such a fishing boat can be very similar to that given by a small dived submarine. A surfaced submarine, therefore, presents a less satisfactory Asdic target, but is far from being undetectable.

False Contacts

As sound reflects off submarines so it also reflects off other local discontinuities in the water mass, such as whales, shoals of fish, rocks which protrude from the sea bed, bubbles and disturbed sections of water which have been subject to local mixing, for instance from a ship's hull or propellers. To an experienced Asdic operator some of these would appear to be obvious "non sub" contacts, and analysis of the contact's movement, size and echo strength would all help this process. Much time would, however, be spent investigating contacts which were not submarines. Inevitably, this also led to submarines being wrongly classified as non sub and thus being able to escape. An ongoing hunt would present particular false contact problems as the wakes of ships might show up on an Asdic set, as might the very disturbed and aerated water after a depth charge attack. The Asdic operators during a hunt would thus have to be particularly vigilant to ensure correct classification.



Sound Paths in Water
Fig (xii)

Appendix B

LIST OF ACRONYMS

Used in the Text

1 A/S	First Anti submarine Squadron
1SL	First Sea Lord
2SL	Second Sea Lord
A/S	Anti submarine
ACNS	Assistant Chief of the Naval Staff
ARL	Admiralty Research Laboratory, Teddington
Asdic	Submarine detection equipment, now called sonar
C in C	Commander in Chief
Capt A/S	Captain in charge of anti submarine matters
Capt D2	Captain Commanding Second Destroyer Squadron
CB	Charge Book (Classified Admiralty Publication)
CID	Committee for Imperial Defence, subcommittee of the Cabinet
CNS	Chief of the Naval Staff
CO	Commanding Officer
D of P	Director of the Plans Division of the Naval Staff
D of TD	Director of the Tactical Division of the Naval Staff
D2, D8 etc	Second, Eighth etc Destroyer Squadron
DC	Depth Charge
DCNS	Deputy Chief of the Naval Staff
DDA	Dived Danger Area
DSD	Director of the Signal Division of the Naval Staff
DSR	Director of Scientific Research
JPC	Joint Planning Committee
NCS	Naval Control of Shipping
RA(D)	Rear Admiral Commanding Destroyers (one in each fleet)
RA(S)	Rear Admiral Commanding Submarines
RAF	Royal Air Force
RN	Royal Navy
RUSI	Royal United Services Institute
SDA	Surfaced Danger Area
TDZ	Torpedo Danger Zone

Used in The Footnotes

AL	Admiralty Library
CHURCH	Churchill College Archives Centre
IWM	Imperial War Museum
NML	Naval Museum Library
PRO	Public Records Office

Appendix C

PORTLAND EXERCISE SUCCESS CRITERIA

ATTACKS

Successful Attack – An attack in which one depth charge of a pattern of five would have landed within 10 yards of the hull of the submarine

Partially Successful Attack – An attack in which one depth charge of the pattern would have landed within 20 yards of the hull of the submarine

Unsuccessful Attack – An attack in which no depth charge would have landed within 20 yards of the submarine

Doubtful Attack – An attack in which there is insufficient data for analysis

HUNTS

Successful Hunt – A hunt in which one or more successful attacks are carried out, or a hunt in which two or more partially successful attacks are carried out and in which one or more A/S vessels are in contact with the submarine at the end of the hunt

Possibly Successful Hunt – A hunt in which a partially successful attack is carried out, but which does not otherwise comply with the requirements of a successful hunt

Indecisive Hunt – A hunt in which no successful or partially successful attacks are carried out, but in which one or more A/S vessels are in contact at the end of the hunt

Unsuccessful Hunt – A hunt in which no successful or partially successful attacks are carried out and in which no A/S vessel is in contact at the end[214]

These criteria took account only of the plan position of the submarine at the time of launch of the depth charges, and no allowance was made for its depth.

In 1931 the criteria for attack success were changed so as better to reflect the doctrine surrounding depth charge tactics. A deliberate attack would be considered successful if any part of the submarine was within 50 yards of the centre of the pattern, and unsuccessful if not, there being no criteria for "partial success". The criteria for a decisive counter attack was the same as for a successful deliberate attack. A harassing counter attack was one in which the submarine was between 50 and 100 yards away from the centre charge, and anything which missed by more than 100 yards was considered to be fruitless. The document which promulgated these changes in criteria conceded, one again, that "attacks are only analysed and classified according to their position in the horizontal plane. The factor of depth, both of Submarine and setting of depth charge must be borne in mind when drawing any conclusions concerning the question of attacks as a whole"[215]

The same document redefined the criteria for hunt success such that a successful hunt was either one in which three or more successful attacks were made, in which case there was no requirement for any ships to be in contact at the conclusion, or one in which two successful attacks had been made and one vessel was still in contact at the end of the hunt. The criteria for hunt success were thus made more stringent.

[214] PRO ADM 186/457, CB 3002/26, p49.
[215] PRO ADM 186/140, CB 1868/1931 "Anti submarine Practice Memoranda".

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Captain Barrie Kent

Captain Kent was a career communications specialist who in retirement wrote a history of the communications branch of the Royal Navy

Lieutenant Commander D Waters

Lieutenant Commanders was a pre war and wartime Swordfish pilot who went on, to co author the Naval Staff history of the Second World War trade defence campaign

Captain R de L Brooke

Captain Brooke was a pre war destroyer officer and wartime destroyer commanding officer with wide experience of anti submarine operations, including the successful sinking of an Italian submarine in the Mediterranean

Admiral Sir Antony Morton

Admiral Morton was a wartime destroyer officer with considerable experience in anti submarine work who has subsequently made a private academic study of the subject.

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