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AIR WARFARE AND MARITIME OPERATIONS

By

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INTRODUCTION

The twentieth century is notable for the rapid - and radical - societal transformations engendered by broad trends in mechanisation and information acquisition, processing, and management. One of the most remarkable aspects of this development has been the impact of flight upon society, particularly as applied to military and national defence affairs. While the Second World War is often heralded as marking the emergence of air power as a significant force, air power as early as the First World War had convincingly demonstrated its importance in warfare. The roles and missions that air power fulfilled in the Second - and fills today - were first defined, promulgated, and employed in the 'Great War'. Among the most significant aspects of twentieth century military affairs has been how naval and land-based air power have transformed maritime operations.

THE FIRST MARITIME AIR WAR: PRECURSOR TO FUTURE COMBAT

As with the world's more advanced armies, the leading navies of the western world were largely supportive (if not overwhelmingly enthusiastic) about aviation in the years prior to the First World War. Nevertheless, again echoing the experience of the armies, navies little anticipated the radical transformations of tactics and forces that would be forced upon them by the aeronautical revolution; indeed, all initially anticipated that the major - and perhaps only - value of aviation would be in the reconnaissance and observation role. Navies generally underestimated the significance of the submarine as well, considering it primarily a means of coastal defence warfare. Yet the advent of both the airplane and the submarine ushered in the era of large-scale ship sinkings in naval history, for in earlier eras of wooden ship warfare (which dated to antiquity, and extended ultimately through Trafalgar), ships might be disabled, but only rarely sunk, and in the era of the big-gun metal vessels, mass encounters between such vessels (such as Manila Bay or Jutland), while dramatic and attention-getting, were relatively rare.¹

Unlike the armies, which generally saw their future in terms of heavier-than-air biplanes and monoplanes, the navies opted for the long range and endurance inherent in lighter-than-air dirigibles and small non-rigid 'blimp' airships (by 1914, for example, the Zeppelin rigid airship was an intrinsic element of German naval war planning). Supporting these airship forces were small float-equipped seaplanes. With the exception of a few standouts, most of the latter evolved from existing landplane designs. By the war's outbreak, Britain and the United States had already experimented with launching small aircraft from ships, and the first trials were underway of specialised torpedo-carrying strike aircraft. The war rapidly accelerated these trends. By war's end, only a decade after the appearance of the military airplane,

¹ I have drawn on John Keegan's provocative *The Price of Admiralty: The Evolution of Naval Warfare*, Penguin Books, New York, 1990, particularly pp. 98-100, though my claims for the submarine and the airplane are my own. Keegan masterfully shows that in naval actions prior to the twentieth century, naval battles resulted in few ships sunk, but with at times surprisingly high casualties among their crews, and convincingly argues, therefore, that naval battles were won by man-killing, not ship-killing.

aircraft and airships had already been employed for maritime reconnaissance and patrol, and for direct attack upon surface vessels and submarines.

For example, in the Dardanelles campaign, British Short 184 float seaplanes 'launched' from a crude seaplane tender, the *Ben-my-Chree*, torpedoed several Turkish vessels. German reconnaissance Zeppelins furnished tactical information to the High Seas Fleet during the Battle of Jutland and subsequent operations off the British east coast. In the East African campaign, British seaplanes undertook reconnaissance and gunfire spotting missions resulting in the loss of the German cruiser *Königsberg*. The notorious German commerce raider SMS *Wolf* owed at least as much of its success to its airmen and spotter biplane (affectionately dubbed the *Wolfchen*) as it did to its deck crew. During anti-U-boat actions and convoy escort missions, land-based aircraft and blimps markedly reduced sinkings from U-boats by driving them to seek safer operating areas. The Royal Navy made the first tentative use of aircraft carriers, crude though they may have been; in 1918, for example, six British Sopwith Camel fighter-bombers from the carrier HMS *Furious* raided the German airship base at Tondern, destroying two Zeppelins in their sheds.

In all these ways and others as well, aircraft and airships contributed to the war at sea. While aviation's impact was far less than it would be in subsequent years, it nevertheless pointed to a future where the surface ship (and submarine as well) would be far less secure. Imperial Germany had even experimented with crude (if ambitious) command-guided anti-shipping missiles. It should not be surprising, then, that no less a personage than Admiral Lord Fisher, whose name was synonymous with the emergence of the dreadnought battleship, remarked after the Armistice that 'the prodigious and daily development of aircraft' had 'utterly changed' naval warfare.²

THE EMERGING TECHNOLOGY OF MARITIME AIR WARFARE

Significant developments during the interwar years took the airplane from functioning as a mere participant in naval warfare to - together with the submarine - decisively determining the outcome of naval combat. First, the charismatic and controversial American air power prophet, Brigadier General William 'Billy' Mitchell, demonstrated the vulnerability of large anchored capital ships to bombing attacks from land-based aircraft, most notably by his sinking of the captured German dreadnought *Ostfriesland* and the light cruiser *Frankfurt*. Though critics pointed out that the ships were at anchor and not firing back, the surprising success of these strikes sent a disquieting shiver through big-ship partisans. Fear of air attack was a powerful motivation for four notable naval developments in the leading naval nations

² The single best history of the relationship between aircraft and ships is Hezlett, Arthur, *Aircraft and Sea Power*, Stein and Day, New York, 1970, pp 25-103. (The Fisher quote is from p. 103). See also Robinson, Douglas H., *Giants in the Sky: A History of the Rigid Airship*, University of Washington Press, Seattle, 1973, pp 125-138; Layman, R.D., *Before the Aircraft Carrier: The Development of Aviation Vessels, 1849-1922*, Conway Maritime Press Ltd, London, 1989; Hilary St. George Saunders, *Per Ardua: The Rise of British Air Power, 1911-1939*, Oxford University Press, London, 1945, pp 129, 194-203; and Hallion, Richard P., (ed), *Rise of the Fighter Aircraft, 1914-1918*, Nautical and Aviation Publishing Co, Baltimore, MD, 1988, pp 120-121.

after the Mitchell trials: armouring battleships and other surface warfare craft and equipping them with increasingly heavy anti-aircraft batteries; developing dual-purpose anti-aircraft and anti-ship gun systems; designing new classes of anti-aircraft cruisers to protect fleets by barrage anti-aircraft fire; and last, but certainly not least, the development of radar as a means of affording warning of air attack.³

The aircraft carrier emerged as a major element of the world's leading navies in the interwar period. By the late 1930s, the carrier had developed 'generic' features typified by a flight deck surmounting a hangar deck, large elevators to transport aircraft from the hangar deck to the flight deck, an offset bridge 'island' and stack system (varying from the gargantuan as exemplified by the USS *Lexington* and *Saratoga*, to the minuscule as found on Japanese carriers such as the *Akagi* and *Kaga*), and a landing area crossed by arresting landing wires.⁴

Likewise, navies that operated aircraft carriers operated generally similar types of aircraft from them: fighters to protect the fleet, dive bombers to attack enemy ships as precisely as possible, and torpedo planes to attack from just over the surface of the water. These aircraft tended to have features tailored for carrier operations, such as long-stroke rugged landing gear struts and wheels, an arresting hook 'stinger' lowered during final approach, and folding wings for reduced storage space requirements aboard ship. With space on ships at a premium, all were single-engine designs, even those with over two crewmen. As a general rule, the increased weight (and multiple crew requirements) of naval aircraft, coupled with their single-engine layout, gave them inferior performance when compared to their lighter land-based contemporaries. But a notable exception to this was the Japanese Mitsubishi A6M2 Type 0 (the infamous 'Zero', accorded the allied recognition name Zeke) which was, at the time of its appearance in 1940, the finest fighter airplane in service use.⁵ Besides aircraft carriers, cruisers and battleships (and some destroyers) carried light observation floatplanes for gunnery spotting, anti-submarine patrol, and reconnaissance.

Air power at sea involved far more than aircraft carriers, however. By the end of the First World War, long-range land-based aircraft and seaplanes had clearly proven their potential if not always their value. In 1919, two such aircraft crossed the Atlantic: the American Curtiss NC-4 seaplane, and a British Vickers Vimy bomber; so, too, did a British rigid dirigible airship, the R.34. The technological mastery of the long-range all-metal (or nearly all-metal) multi-engine monoplane for both military and commercial purposes, which characterised the so-called 'Golden Age' of aviation

³ There is a succinct and amusing account of the Mitchell trials in O'Connell, Robert L., *Sacred Vessels: The Cult of the Battleship and the Rise of the U.S. Navy*, Westview Press, Boulder, CO, 1991, pp 257-260. See also Hezlett, *Aircraft and Seapower*, pp 132-135; Gebhard, Louis A., *Evolution of Naval Radio-Electronics and Contributions of the Naval Research Laboratory*, NRL Report 8300, Naval Research Laboratory, Washington, D.C., 1979); Baxter III. James Phinney, (ed), *Scientists Against Time*, The MIT Press, Cambridge, MA, 1968, pp 136-169; and Werrell, Kenneth P., *Archie, Flak, AAA, and SAM: A Short Operational History of Ground-Based Air Defense*, Air University Press, Maxwell AFB, AL, Dec 1988, pp 51-52.

⁴ Hezlett, *Aircraft and Seapower*, pp 105-108, 119-136; See also Melhorn, Charles M., *Two Block Fox: The Rise of the Aircraft Carrier, 1911-1929*, Naval Institute Press, Annapolis, 1974; Till, Geoffrey, *Air Power and the Royal Navy, 1914-1945*, Jane's Publishing Company, London, 1979; and Reynolds, Clark G., (ed), *The Fast Carriers: The Forging of an Air Navy*, Naval Institute Press, Annapolis, 1992.

⁵ The Zero story is detailed in a memoir by its designer, Horikoshi, Jiro, *Eagles of Mitsubishi: The Story of the Zero Fighter*, University of Washington Press, Seattle 1981.

in the 1920s and 1930s, set the stage for the emergence of aircraft that would profoundly influence war at sea. By the late -1930s, for example, the American, British, and Japanese already had in service the three great long-range seaplanes that they would use for wartime maritime patrol: the Consolidated-Vultee PBY Catalina, the Short Sunderland, and the Kawanishi H6K (allied name Mavis). All were multi-engine designs that drew from the technology base established by long-range commercial seaplanes. They featured exceptional range; the Catalina and Sunderland could reach over 2,500 miles, and the Mavis over 4,200 miles. Finally, if needed, they could attack submarines and shipping with bombs and torpedoes. But their primary role was that of reconnaissance - to literally act as the eyes of a fleet and thus to extend a battle fleet commander's awareness and control.⁶

Commercial transport aircraft soon to be modified as maritime patrol aircraft were likewise in service - notably the Lockheed Lodestar (soon to reappear in military guise as the Hudson), and the Focke-Wulf FW 200 Kurier (the soon-to-be Condor). So, too, were conventional long-range land-based bombers such as the British Armstrong-Whitworth Whitley and the Vickers Wellington, the German Heinkel He 111 and Junkers Ju 88, the Japanese Mitsubishi G3M (Nell) and G4M (Betty), and the American Boeing B-17 Flying Fortress and Consolidated-Vultee B-24 Liberator. Each of these latter types would be modified for maritime patrol, anti-submarine, and attack operations, with greater or lesser success.⁷ Already, in the Spanish Civil War, land-based aircraft had attacked and sunk ships underway; while this was hardly a major lesson of that tortuous conflict, it was, nevertheless, a reminder that the earlier fears triggered by Mitchell's trials had not, in fact, been without foundation. Though not yet at war, the US Army Air Forces had demonstrated its own ability to seek out and find ships well out to sea, overflying the Italian liner *Rex* with a formation of three Boeing B-17 bombers while it was hundreds of miles at sea. It took little imagination for the observers to realise that a plane overflying a ship today could just as easily attack it under different political circumstances tomorrow.⁸

MARITIME AIR POWER AND THE OUTBREAK OF WORLD WAR II

When war erupted in 1939, the clashing powers clearly had visions of using air power at sea both for defensive and offensive purposes. Having the machines and technology for such warfare, however, was not the same as having operational doctrines to properly use such power. Thus, there was - as with other aspects of the air war - a lengthy period of learning what worked and what did not. The three major European combatants (prior to American entry in the war) all had remarkably similar battles between and within their services over the value and role of air power, so much so, that at times one could be forgiven for believing their histories to be largely interchangeable. As is often the case, services of one nation were often far more critical of their own performance than their enemies', damning their own performance

⁶ Data on these types is drawn from Green, William, 'Flying Boats', Vol. 5 of *War Planes of the Second World War*, Doubleday and Company Inc, Garden City, NY, 1962.

⁷ Technical data on most of these aircraft may be found in Green, William, *Famous Bombers of the Second World War*, Hanover House, Garden City, NY, 1959.

⁸ Details on the *Rex* mission are from Maurer, Maurer, *Aviation in the U.S. Army, 1919-1939*, Office of Air Force History, Washington, DC, 1987, pp 406-408.

even as they overestimated that of their opponents.⁹ For example, the Nazi leadership bitterly criticised the Luftwaffe for a perceived general unwillingness to support the Kriegsmarine, as well as the German Navy's own lack of emphasis upon using aircraft in conjunction with surface and submarine warfare forces, while, at the same time, German naval and commercial shipping suffered the depredations of the Royal Air Force's Coastal Command.¹⁰ Yet, at the same time, British naval authorities saw an opponent that seemingly artfully used long-range landplanes and seaplanes to furnish reconnaissance information, direct U-boat attacks, and directly attack merchant and naval shipping, with potentially devastating effects upon the Battle of the Atlantic and (in particular) the Russian convoys, even as the Royal Navy and the Royal Air Force bickered over air support for naval operations and whether Coastal Command should be an Air Force or a Navy asset!¹¹ In truth, then, the partnerships of both the Luftwaffe-Kriegsmarine and the Royal Air Force-Royal Navy were at once more productive than each believed of itself, while less effective than their opponents believed.

Both viewpoints likewise reflect another general tendency seen through twentieth century air warfare: surface warfare proponents fear an enemy's air forces far more than they respect their own. In a further irony, the very freedom of manoeuvre and execution that they envy in an enemy's air operations tend to be qualities they seek to restrict in their own air forces, out of fear that the air forces will not be around to 'protect' them from the depredations of the enemy air force if they are granted freedom of manoeuvre and freedom of execution.¹²

Before Pearl Harbor and the opening of the great Pacific war, maritime air operations profoundly influenced both European and Mediterranean sea-land warfare, foreshadowing the far more extensive naval air war that would occur subsequently halfway around the world. Indeed, as John Keegan has written, 'Hostile aircraft terrified the seamen of the Atlantic battle, those of the convoys as much as the U-boat crews who were their enemy.'¹³

⁹ See Roskill, Stephen W., *The War at Sea, 1939-45*, 3 vols, HMSO, London, 1954-1961; Ruge, Friedrich, *Der Seekrieg: The German Navy's Story, 1939-1945*, U.S. Naval Institute, Annapolis, 1957; and Bragadin, Marc Antonio, *The Italian Navy in World War II*, U.S. Naval Institute, Annapolis, 1957. In addition to the previously cited Hezlett, *Aircraft and Seapower*, Miller, Nathan (ed), *The Naval Air War, 1939-1945*, Nautical and Aviation Publishing Co, Baltimore, 1991, is a particularly useful survey history of the naval air war.

¹⁰ See, for example, Boog, Horst, 'Luftwaffe Support of the German Navy', in Howart, Stephen and Law, Derek, (eds), *The Battle of the Atlantic, 1939-1945*, Naval Institute Press, Annapolis, 1994, p 317. In one respect they were certainly correct: the lack of support for completing the German aircraft carrier *Graf Zeppelin* as well as a sister ship in time to use these in carrier battle groups with Nazi Germany's powerful battleship, battle cruiser, and cruiser formations. Had the *Bismarck* executed its breakout with a carrier, two or three cruisers, and a screen of destroyers, the outcome might have been dramatically different.

¹¹ See Richards, Denis, 'The Fight at Odds', Volume 1 of *Royal Air Force, 1939-1945*, HMSO, London, 1953, pp 220-221.

¹² For a classic example of this kind of thinking, see Ruge, Friedrich, *Rommel in Normandy: Reminiscences by Friedrich Ruge*, Presidio Press, San Rafael, CA, 1979, p 218. In this work, Ruge - Field Marshal Erwin Rommel's naval deputy - discusses a conversation he had with Rommel after both were exposed to devastating air attacks. Both concluded that the lesson was obviously that in future warfare, the German air force should be subordinate to the German army. In reality, it was precisely because the allied air forces were totally independent of army control (both for the RAF and the USAAF) that they were as successful as they were.

A far from complete list of naval actions having subsequent influence on other events would have to include:¹⁴

- a. The sinking of the German cruiser *Königsberg* by Fleet Air Arm dive bombers;
- b. Germany's use of medium bombers and dive bombers to thwart British efforts to stem the German assault in Norway;
- c. The Royal Air Force's use of land-based bombers to disrupt German naval forces assembling for Operation Sea Lion, the projected invasion of Great Britain;
- d. Maritime reconnaissance that both detected the breakout of the *Bismarck* and subsequently relocated it after the tragic sinking of HMS *Hood* permitting an air strike from the carrier HMS *Ark Royal* that crippled its steering and rendered it vulnerable to surface attack;
- e. The savaging of the Royal Navy around Crete by Luftwaffe air attacks;
- f. The continuous sinkings of German coastal traffic off Scandinavia by RAF Coastal Command Beaufighters;
- g. The terrible toll air attack took of convoys, forcing development of the escort carrier;
- h. The destruction of German and Italian convoys supplying Rommel's forces in Africa;
- i. The imaginative attack upon the Italian battle fleet in harbour at Taranto;
- j. Anti-submarine patrols around the British isles and off the American coast by long-range landplanes and seaplanes;

¹³ Keegan, *The Price of Admiralty*, p 284.

¹⁴ There is a wide body of literature on many of these topics, in addition to previously cited references which cover them as well. Some of the more valuable include: Richards, Denis (ed), *The Hardest Victory: RAF Bomber Command in the Second World War*, Hodder and Stoughton, London, 1995, which has an excellent account of Bomber Command's influence on the maritime war, particularly Sea Lion, mining strikes, the campaign against German heavy fleet units, and the anti-submarine campaign; Nesbit, Roy C., *The Strike Wings: Special Anti-Shipping Squadrons, 1942-1945*, William Kimber, London, 1984; Barker, Ralph, *The Ship-Busters*, Chatto and Windrus, London, 1957, about RAF Beaufort torpedo bomber operations; Barker, Ralph, *The Hurricats*, Sphere Books Ltd, London, 1979, about catapult-equipped merchant ships that carried Hurricane fighters launched on one-way sorties against FW 200 patrol bombers; Lamb, Charles, *To War in a Stringbag*, Bantam Books Inc, New York, 1980, the memoir of a Swordfish pilot who attacked Taranto; Schofield, B.B., (ed), *The Russian Convoys*, Ballantine Books, New York, 1967, an excellent history by a distinguished naval officer and historian; Royal Air Force Historical Society and the Royal Air Force Staff College, Bracknell, *Seek and Sink: A Symposium on the Battle of the Atlantic*, no. 2 of the *Bracknell Paper* series, RAF Staff College, Bracknell, England, 21 Oct. 1991, an excellent series of papers and discussions of the anti-U-boat war; and Y'Blood, William T., *Hunter Killer: U.S. Escort Carriers in the Battle of the Atlantic*, Naval Institute Press, Annapolis, 1983, a thoroughly documented study of a largely neglected area of naval history. Price, Alfred, (ed), 'Dornier Do 217 Variants', No. 261 of the *Aircraft in Profile* series, Hylton Lacy Publishers, Windsor, 1974), has one of Price's typically excellent accounts detailing the early use of precision weapons against allied shipping. Note that the *Königsberg* sunk in World War Two is not the same as the ship of the same name sunk in East Africa during the First World War.

- k. Convoy protection and U-boat hunter-killer operations by escort carriers working with aircraft and destroyers;
- l. coastal operations by strike aircraft and mining aircraft against German harbours, supply routes, and the Kiel canal;
- m. Attacks against allied shipping and military vessels by German medium bombers launching first-generation air-to-surface command-guided precision-guided missiles and glide bombs, which, among other results, sank the Italian battleship *Roma* and damaged the British battleship HMS *Warspite* and the American cruiser USS *Savannah*;
- n. Finally, the bombing campaign (by carrier-based and land-based aircraft) against the battleship *Tirpitz* that eventually resulted in its capsizing at anchor at Trömso, Norway.

These are but a few of the more notable ways in which air power played in the sea war in Europe and the Mediterranean.

The key to many of these uses was the marriage of good signals intelligence with sea and air operations. Early in the war - through the Norwegian campaign, in fact - Germany had been reading up to 30 per cent of British message traffic before the British wisely changed their cyphers. But it was the allied success with Ultra that constitutes the pinnacle of wartime intelligence exploitation. Ultra's significance, generally appreciated only since coming to light in the 1970s, can only rarely be overstated. It played a profound role in many of the actions and incidents mentioned above, clearly offsetting occasional advantages that the Germans and Italians possessed in strength or initiative. Most notably Ultra doomed the U-boats and commerce raiders, and, in the Mediterranean, set the stage for the destruction of Rommel's convoys. This partnership of intelligence and air warfare - and intelligence and submarine warfare, for that matter - proved decisive. In the Pacific, it would be no less decisive in the war against Japan.¹⁵

THE MATURATION OF MARITIME AIR ATTACK

Overall, European and Mediterranean operations confirmed the emergence of three-dimensional attack - attack from above and below the ocean's surface - as the greatest threat to ships at sea. The airplane and the submarine in concert produced a fearsome synergy of effects: the airplane with its speed and quick reach, and the submarine by its stealthiness. Off Norway, German submarines and aircraft nearly triumphed over allied attempts to resupply the Soviet Union by sea. Convoy PQ-17, for example, lost 13 ships (of 35 that began the journey) sunk from air attack (the Luftwaffe lost but 6 aircraft out of 202 in exchange), and a further 10 sunk by U-boats. Thus, for a loss of 3 per cent of its force, the Luftwaffe claimed fully 37 per cent of PQ 17, with U-boats claiming another 29 per cent of the convoy for no losses of their own. The

¹⁵ See Winton, John, *Ultra at Sea: How Breaking the Nazi Code Affected allied Naval Strategy During World War II*, William Morrow and Company Inc, New York, 1988; see also the third volume, part 1, of the British official intelligence history, Hinsley, F.H., et. al., *British Intelligence in the Second World War: Its Influence on Strategy and Operations*, Cambridge University Press, New York, 1984.

sunken ships carried, among other cargo, 430 tanks, 210 aircraft, and 3,350 vehicles.¹⁶ In the Mediterranean, British submarines and aircraft destroyed effective commerce between Italy and North Africa, though here, the constrained waters and often clear visibility into the ocean limited somewhat the effectiveness of submarine operations.¹⁷

For those raised in an era where the surface ship had been dominant, the newly revealed power of aircraft as a means of attacking enemy shipping was nothing short of remarkable. In the Mediterranean theatre, Italy lost 1,324 ships (totaling 2,106,521 tons) to allied action. Of these, only 59 (4 per cent) were lost to surface ships. The vast majority were lost to submarines and aircraft. Submarines sunk 324 (24 per cent), but air attack destroyed 489, 37 per cent of those lost. Accordingly, one Italian naval historian has written:¹⁸

In the final analysis - and such an affirmation does not seem to be an overstatement - the really *decisive* struggle in the Mediterranean War was fought out between the Italian Navy and the Anglo-American air forces. No matter how bitter the naval war itself was, the Italian naval forces would still have been able to carry it on properly and for a long time, if the Navy had not been both directly and indirectly overcome by the overwhelming enemy power in the air.

Indeed, as Admiral Friedrich Ruge, the former German Senior Naval Officer in Italy, recollected:¹⁹

The mere presence of enemy aircraft was itself sufficient to scare the Italian convoy traffic into making wide diversions from the direct route. This caused them and their escorts to consume more fuel and to be exposed for longer periods to attacks by submarines and surface craft. The latter received such accurate reports from their Malta-based air reconnaissance about the convoys' positions, courses, and speeds that they had no difficulty in locating them ... time and again the island's striking forces caused shortages in fuel, ammunition, weapons, and equipment at a critical stage of the Axis operations in Africa.

Air attack worked both ways; Axis air attacks against shipping were also disturbingly productive. Despite training, logistical, organisational, and doctrinal problems, and despite not having sufficient numbers to adequately pursue a naval air war, the Luftwaffe scored notable successes forcing allied countermeasures. In March, April, and May 1941, for example, Luftwaffe crews sank 179 ships totaling 545,000 tons.²⁰ The shock of air attack at least matched the lurking menace of the submarine, and far exceeded that of surface threats. For example, in one notable attack on Convoy PQ 18 northwest of Bear Island, 55 German Heinkel He 111 bombers, each armed with two torpedoes, executed a massive line-abreast attack at low altitude, simultaneously dropping all their 'torps' and sinking no less than eight freighters virtually

¹⁶ Schofield, *The Russian Convoys*, p 102.

¹⁷ A good memoir of the Mediterranean submarine war is Bryant, B., (ed) *Submarine Commander*, Bantam Books Inc, New York, 1989. Bryant commanded two of Britain's most successful submarines, *Sealion* and *Safari*.

¹⁸ Bragadin, *The Italian Navy in World War II*, p 324. Emphasis in original text. The statistics are from p 366.

¹⁹ Ruge, *Rommel in Normandy*, p 249.

²⁰ See Churchill, Winston S., *Memoirs of the Second World War*, Houghton Mifflin Company, Boston, 1987, p 417.

immediately.²¹ Unarmed ships were most vulnerable, but even heavily armed warships were not immune to destruction, whether underway or in harbour.

The terribly costly evacuation of British forces from Crete in May 1941 under punishing German air attacks demonstrated that - even with up-to-date intelligence as to an enemy's intentions - a naval force lacking adequate air cover could not expect to survive without (at least) extensive losses. As Lord Tedder of the RAF recollected in his landmark Lees Knowles lectures at Cambridge after the war:²²

The price in surface ships was three cruisers and six destroyers sunk; one battleship, one aircraft carrier, three cruisers and one destroyer seriously damaged; and one battleship, four cruisers and six destroyers in need of extensive repairs. Against these material losses there was on the credit side a record of wonderful gallantry and determination. Once again, magnificent, but not war.

It should be noted that one of the cruisers sunk was, in fact, a special 'anti-aircraft cruiser' extensively armed with anti-aircraft guns and light cannon and thus, foolishly, ordered to steam 'in harm's way' without friendly air cover.

THE LEVERAGE OF LAND-BASED MARITIME PATROL AIRCRAFT

Because maritime operations did not typically involve the risk of encountering enemy high performance fighters (except directly along an enemy coastline or - for the Germans - after the emergence of the Anglo-American escort carrier) that deep-penetration missions into an enemy's heartland did, single or multi-engine aircraft of modest performance could often make contributions out of all proportion to their true abilities. The Savoia-Marchetti S.M.79-II Sparviero ('Sparrow') torpedo bomber, an Italian trimotor that enjoyed surprising success against allied shipping in the Mediterranean, exemplified this. Armed with two torpedoes, it was largely responsible for the 63 Royal Navy ships lost to Italian air attack in the Mediterranean; indeed, in the words of one British aeronautical historian, 'the exploits of Italy's torpedo-bombing squadrons equipped with this type, the Aerosiluranti, were almost legendary'.²³ The German Junkers Ju 87 Stuka dive bomber and the Heinkel He 111 torpedo bomber, and the British Bristol Beaufort and Vickers Wellington constitute other examples of less-than-fully successful airplanes that nevertheless exerted significant influence within the maritime arena, particularly against merchant convoys.

The Focke-Wulf FW 200 Condor is perhaps the best case. Focke-Wulf first explored a maritime reconnaissance-bomber variant of this somewhat mediocre (if reasonably attractive) four-engine airliner at the request of the Japanese government; the outbreak of the war prevented further work on the FW 200 for Japan, but accelerated German

²¹ Schofield, *The Russian Convoys*, pp 122-123.

²² Tedder, Arthur W. (Lord), *Air Power in War*, Hodder and Stoughton, London, 1948, p 69.

²³ Green, *Famous Bombers*, p 17. See also Bragadin, *The Italian Navy in World War II*, p 364. Italian airmen were responsible for sinking 40 per cent of the British ships and submarines lost to air attack. German airmen claimed the other 60 per cent.

interest in the plane. Though it had numerous deficiencies (including serious structural weaknesses) that hampered its effectiveness, in the absence of allied fighters, the FW 200 became a scourge of allied shipping, drawing the personal attention of no less than British Prime Minister Winston S. Churchill himself.²⁴ Typically, Condors flew long missions between France and Norway; a flight would take off from Bordeaux-Merignac on the French coast, loop far out into the Atlantic until well west of Ireland, and then turn north and east before landing at Trondheim-Vaernes in Norway; a fresh crew would fly a return the next day. In one six-month period, the Condors of one maritime patrol bomber wing, Kampfgeschwader 40, assisted by some smaller He 111's, destroyed 85 ships totaling 363,000 tons.²⁵ Indirectly, by cooperating (however imperfectly) with surface craft and U-boats, they added an important force-enhancing factor in Nazi sea control operations. The success of the Condor directly drove both the rapid development of the small escort carrier, and the purchase, by the Royal Navy, of far more capable shipboard fighter aircraft, notably the American Grumman Martlet (the famed Wildcat, in US Navy service), the later Grumman Hellcat, and the powerful Vought Corsair.²⁶

Nothing so illustrates the desperate mind-set of planners confronting the threat posed by the Condor than the development of catapult-equipped merchant ships carrying a single war-weary Hawker Hurricane fighter, an interim (and near-suicidal) solution pending the conversion of ships into small escort carriers. Flown by remarkably brave pilots, these planes were husbanded from the moment a Condor appeared near a convoy. A 'Hurricat' would then launch, intercept the 'bandit' and, with luck and skill, shoot it down. With no deck to return to, the fighter pilot had to bail out or ditch in the foreboding and frigid Atlantic, to be (hopefully) rescued by a passing ship! In short, the Condor - like the first fighters of the Great War, or the cruise missile of later times - was the perfect example of a low-cost threat forcing a high cost and complicated defence. Once carrier-based fighters appeared, the Condor, quoting Churchill, 'gradually became the hunted rather than the hunter'.²⁷

MARITIME AIR POWER'S RECORD AGAINST NAZI GERMANY AND FASCIST ITALY

The statistical record of allied air operations against Nazi Germany and Fascist Italy bears out the significance of allied air power at sea. A postwar investigation of sinkings of German coastal traffic from the Bay of Biscay to the North Cape over the time period September 1939-January 1945 concluded that of 920 sinkings, submarines and surface vessels were responsible for 22.7 per cent of this total, while direct air attack and mining claimed the remaining 77.3 per cent.²⁸ The official history of the Royal Navy attributes 60 sinkings of 149 Nazi warships of minelayer size or larger to direct air attack, a total of 40 per cent; this does not include those that were destroyed by air-dropped mines, nor does it include submarines. Of the 785 submarines

²⁴ Churchill, *Memoirs of the Second World War*, p 412.

²⁵ Smith, J. Richard, 'The Focke-Wulf FW 200' Number 99 of the *Aircraft in Profile* series, Profile Publications Ltd., Leatherhead, England, 1966, p 7.

²⁶ Churchill, *Memoirs of the Second World War*, p 417; Hezlett, *Aircraft and Seapower*, pp 183-184.

²⁷ Churchill, *Memoirs of the Second World War*, p 417; see also the previously cited Barker, *Hurricats*, passim.

²⁸ Tedder, *Air Power in War*, p 58.

Germany lost in the Second World War, 368 were sunk exclusively by air attack - fully 47 per cent. A further 48 U-boats (6 per cent) fell to combined air and surface ship attack. Thus 416 U-boats - 53 per cent of those sunk - fell before air or combined air-and-sea attack. Of these, 323 - 41 per cent of those sunk - fell before long-range landplanes. The landplane total rose dramatically through the war; of the 140 U-boats destroyed by air attack in the last year of the war, land-based aircraft were responsible for 132 destructions - *over 94 per cent*, both a testament of the significance of the long-range landplane in Second World War maritime operations, and an indication of its importance in the present day as well.²⁹

The record of the Royal Air Force in Northern European and Atlantic maritime operations is noteworthy.³⁰ A total of 1,475 enemy surface vessels (representing 1,654,670 tons of shipping) sank at sea or were destroyed in port by RAF attack, constituting 51 per cent of the total enemy losses of 2,885 ships (totaling 4,693,836 tons) destroyed by allied sea and air action, captured, or scuttled from 1939 through 1945. A total of 437 of these ships (186 of which were warships) sank from direct air attack at sea, while 279 others (of which 152 were warships) were bombed and destroyed in port. Mines laid by Coastal Command and Bomber Command claimed an additional 759 ships, of which 215 were warships. These 759 represented fully 51 per cent of all ships lost to RAF air attack. Indeed, mining was over five times more productive than other forms of air attack; for approximately every 26 mine-dropping sorties flown, the RAF could claim an enemy ship sunk, while it took approximately 148 sorties to generate a sinking by direct air attack.

In no small measure, the mining campaign's success stemmed from strong and constant support by the chief of RAF Bomber Command, Air Chief Marshal Arthur T. 'Bomber' Harris. In fact, before the war, as an Air Ministry staff officer, he had successfully pressed for the production of air-dropped magnetic sea mines. Thus, when war broke out, the RAF already possessed a leader and a weapon suitable for sea denial operations.³¹ As early as the dark days of the Norwegian campaign, mine sorties by Handley Page Hampden bombers resulted in no less than twelve sinkings. In 1940, Bomber Command and Coastal Command combined laid an average of only 100 mines per month; but even so, this small effort generated the loss of 82 German ships sunk, and another 55 damaged, by the end of the year.³²

So fearful were German shipping authorities of the mining campaign that they immediately clamoured for strengthened German nightfighter forces operating along threatened coasts. Consequently, mining loss rates were much higher than losses on direct attacks though, to its dismay, the Luftwaffe found it could only harass and not

²⁹ Statistics are computed on the basis of data from Roskill, *The War at Sea 1939-1945*, Volume 3, Appendixes XX; and Appendix Y, Tables III and IV, pp 457-461, 471-472. One unfortunate torpedo boat was sunk by air attack, salvaged, and bombed and sunk again.

³⁰ For an excellent (and much needed) analytical account of the RAF's anti-shipping war, see Goulter, Christina J.M., *A Forgotten Offensive: Royal Air Force Coastal Command's Anti-shipping Campaign, 1940-1945*, a volume in the Studies in Air Power series, Frank Cass, London, 1995.

³¹ Richards, *The Hardest Victory*, p 47.

³² *ibid.*, p 236.

prevent British mining sorties. Overall, the RAF lost one mining aircraft for every 38 sorties, while the service lost one strike aircraft for every 56 direct attack sorties.³³

In conjunction with direct bombing and torpedo attacks, RAF mining operations seriously constrained the movement of German capital ships, minimising their value to the Reich. Indeed, cognisant of this, the Royal Navy made increasingly heavy demands upon Bomber Command throughout the conflict up through the sinking of the *Tirpitz* for raids against German harbour, shipbuilding, and repair facilities, as well as on specific ships themselves. As a result, Germany's surface naval forces were effectively held in check throughout the war by air action. In one notable case, the threat posed by the RAF to the battlecruisers *Scharnhorst* and *Gneisenau*, and the heavy cruiser *Prinz Eugen*, then bottled up by air attack in Brest, France, forced the Nazi naval leadership to order the three ships on a risky dash through the English Channel to safety in German ports. Even then, both the *Scharnhorst* and *Gneisenau* struck mines that forced repairs. Though this escape constituted a public relations coup for the Nazis, all three ships subsequently had little influence on the war. *Scharnhorst* remained in port for a year, while a subsequent air raid effectively ended sister-ship *Gneisenau's* career as a warship. *Prinz Eugen* impotently finished its days in the Baltic before serving as an atomic bomb target in the Bikini atoll postwar tests.³⁴

Mining made other important contributions that further fragmented the Nazi war effort. Much as the bomber offensive against Germany forced the production of defensive weapons (such as interceptors and anti-aircraft artillery) at the expense of offensive weapons (such as bombers, tanks, and submarines), the mining campaign forced the German Navy to use up to 40 per cent of its personnel on mine clearance operations. Likewise, it forced planners to divert ever-larger portions of the German maritime effort to building replacement ships and repairing others damaged by mine attack.³⁵

Direct air attacks and mining together sapped the German maritime war effort, delayed and disrupted logistical flow, and disheartened the German military leadership. For example, between 1943 and 1944, transit times to German ports from Trondheim, Norway, more than doubled, from 14 to 31 days. Northerly voyages in 1944 took an additional 24 days on average over 1943 figures.³⁶ In the Baltic, minelaying so discouraged the German naval liaison officer assigned to the Luftwaffe's operations branch that he wrote to his naval superiors in September 1944:³⁷

Without training in the Baltic, and safe escort through coastal waters and the routes to and from operations in mid-ocean, there can be no U-boat war. Without seaborne

³³ Statistics are computed on the basis of data from Saunders, Hilary St. George, 'The Fight is Won', Volume 3 of *Royal Air Force, 1939-1945*, HMSO, London, 1954, Appendix VII, p 405. Data on the German response to the mining campaign is drawn from Harris, ACM Sir Arthur, *Dispatch on War Operations: 23rd February, 1942, to 8th May, 1945*, first issued in classified form in October 1945 and recently reissued under the same title, edited by Sebastian Cox with additional material by Horst Boog, eds, Frank Cass, London, 1995, p 174.

³⁴ Richards, *The Hardest Victory*, *passim*.

³⁵ See Harris, ACM Sir Arthur, *Bomber Offensive*, Collins, London, 1947, p 39.

³⁶ Goulter, *A Forgotten Offensive*, p 294.

³⁷ Harris, *Dispatch*, p 174.

supplies, it is impossible to hold Norway. Without freedom of movement in the Baltic, we cannot use transport in German coastal waters. But already we no longer command the sea routes within our own sphere of influence, as is shown by the day and week long blocking of shipping routes in the Baltic approaches.

The experience of other countries makes for interesting comparisons. Russian airmen sank at sea or destroyed in port 159 of 328 German warships or merchant vessels sunk, destroyed, or captured by Soviet forces in the Second World War. This represented over 48 per cent of the Soviet total; mines claimed an additional 25 per cent, submarines 14 per cent, and 'coastal' forces but five per cent. (The remaining eight per cent came from miscellaneous causes such as shore artillery, scuttling, capture, or unknown events).³⁸

Overall, German (and Japanese) air operations were far less productive than allied ones, once those nations were forced on the defensive. Throughout the Second World War (and in all theatres, including the Pacific), German and Japanese military action resulted in the sinking of 5,150 allied merchant ships totaling 21,570,720 tons. Of these, 820 merchant ships, totaling 2,889,883 tons, sank under air attack, representing nearly 16 per cent of all allied merchant vessel losses. (Of the rest, German and Japanese submarines claimed nearly 55 per cent, surface attackers nearly seven per cent, mines over ten per cent, and unknown or other causes over 12 per cent).³⁹

What does this imply? Why were Axis aerial attackers so less effective overall than allied ones? In part, it reflects the rapid evolution of the war, in that German and Japanese air operations, which were so effective at the war's outset, were overtaken after 1942 by allied counters that forced these countries into a defensive war in which their previous strong maritime air presence withered, leaving only the submarine as a significant means to prosecute their war. The Russian-bound convoy experience of 1941-1945 illustrates this. During these convoys, 100 allied ships were sunk. Of these, 38 were destroyed by air attack, and 42 fell to U-boats, representing, respectively 38 per cent and 42 per cent of the total. But 1942 was the peak year of German convoy depredations off Norway; in that year, 37 of the 38 air losses occurred. After that time, only *one* other ship sank under German air attack.⁴⁰

THE PACIFIC THEATRE: MARITIME AIR WARFARE ON A GLOBAL SCALE

To a degree far greater than even the war in Europe and the Mediterranean, the Pacific theatre was a theatre characterised by air power. More specifically, it was a war characterised by the projection of three-dimensional power - the power of the submarine and the power of the airplane against the Japanese navy and Japanese shipping. As the United States Strategic Bombing Survey concluded, 'The war against shipping was perhaps the most decisive single factor in the collapse of the Japanese

³⁸ Statistics are computed on the basis of data from Roskill, *The War at Sea, 1939-1945*, Volume 3, Appendix YY, Table II and Table III, pp 474, 476.

³⁹ *ibid.*, Appendix ZZ, p 479.

⁴⁰ Schofield, *The Russian Convoys*, Appendix I, p 229.

economy and the logistic support of Japanese military and naval power'.⁴¹ Both the submarine and the airplane thus played dominant roles in the destruction of Japan's imperial ambitions; as elsewhere, the operations of submarines and airplanes exhibited strong synergistic effects and benefits. So dominant had air power become that one American naval planner plaintively wrote in the midst of the war: 'The danger is obvious of our amphibious campaign being turned into one that is auxiliary support to permit the AAF to get into a position to win the war'.⁴² That air power came to dominate the Pacific theatre is no longer as controversial a view as it once might have been; one recent essayist noted that:⁴³

By the spring of 1945, American army and naval aviators had demolished Japan's civilian and military industries, sunk most of the Japanese fleet, and established a virtual blockade of the Japanese islands (with the aid of American submarines). Ground and purely naval forces had served mainly to seize and hold forward bases for the projection of air power.

EARLY EXPERIENCES IN PACIFIC COMBAT

The Pacific conflict is commonly thought to have begun with the attack upon Pearl Harbor on December 7, 1941. In fact, of course, Asia had been in an on-and-off war with Japan since 1931 and, particularly, since 1937. In operations against China, Japanese airmen had flown from carriers operating off the China coast in much the same fashion that American and Commonwealth forces operated against North Korea, or in the way in which Americans fought against North Vietnam and, more recently, in the Mediterranean against Libya and in the Gulf against Iran and Iraq. Here the carrier was not a sinker of fleets but, rather, a mobile airfield operating in relatively close proximity to hostile shores. Its time as a sacker of fleets, however, was about to come, beginning on December 7, 1941 at Pearl Harbor.

There is great irony in the Pearl Harbor attack, for it represented at once both the apogee of Japanese naval aviation capabilities (no less than six carriers struck in well-planned simultaneous attacks) and the perigee of Japanese strategic thought. The attack was inspired in great measure by the British raid on Taranto, and directed at the perceived naval 'centre of gravity' (the American battle fleet, which was put out of action if not totally destroyed), but the real 'centre' were the American aircraft carriers that were providentially at sea. In short, the planners who planned the Pearl Harbor attack thus targeted an outdated weapon system (the battleship) using the normative naval weapon system of the future (the carrier-based airplane) while, at the same time, deliberately ignoring the grave threat posed to their own futures by the instrument of their own victory (the aircraft carrier).⁴⁴

⁴¹ Transportation Division, *The War Against Japanese Transportation, 1941-1945*, USSBS, Washington DC, May 1947, p 6; microfilm copy in the archives of the Air Force History Support Office, Bolling AFB, Washington, DC Hereafter USSBS.

⁴² Quoted in Spector, Ronald H., *Eagle Against the Sun: The American War With Japan*, The Free Press, New York, 1985, p 485.

⁴³ Cohen, Eliot A., 'The Unsheltering Sky', *New Republic*, 204, No. 6, 11 February 1991, p 24.

⁴⁴ This argument has been made, though in not quite the same way, by Robert O'Connell in his previously cited *Sacred Vessels*, p 315. The most thorough overall account of the Pearl Harbor strike is Prange, Gordon W. , (in collaboration with Goldstein, Donald M., and Dillon, Katherine V.,) *At Dawn*

As shocking as Pearl Harbor had been, worse followed, with the sinking of large numbers of allied vessels - but most notably HMS *Prince of Wales*, *Repulse*, and *Hermes* - by air attack at sea. The former two - heavily armed battleships, one new and one old - fell before land-based twin-engine torpedo bombers, mixed formations of Japanese Nells and Betties operating from Indochinese bases.⁴⁵ These two ships had intemperately sortied from Singapore to attack Japanese invasion forces then coming ashore in northern Malaya. Astonishingly, continuing a pattern displayed earlier in this misguided mission of failing to inform friendly air forces of their intentions, even while under attack, the force commander, Admiral Sir Tom Phillips, did not request air support.⁴⁶ Lost with them were 840 crewmen, including Phillips who, in tragic irony, had once confided to a junior officer that the man should not join Britain's Fleet Air Arm because aviation was 'poppycock' and he would 'ruin his career'.⁴⁷

So, within days, Japanese airmen had emulated the success of their European contemporaries, though on a much grander scale. They had amply if tragically demonstrated the woeful vulnerability of unprotected ships both in harbour and at sea to both carrier-based and land-based air attackers using bombs and torpedoes. Within months, these lessons would be revisited manyfold upon the Japanese themselves with a remorselessness that would characterise the remainder of the Pacific war. First, highlighting the aerial holocaust that would engulf Japan within three years, came the Doolittle raid in April 1942: a surprisingly effective joint operation whereby 16 US Army Air Forces B-25's embarked on the carrier USS *Hornet* and then raided Tokyo and other Japanese targets on a one-way mission to China. Second, in May, was the Battle of Coral Sea, the first naval engagement in history in which the participants duelled by air attack alone. Third, in June, was the dramatic Battle of Midway, which shattered Japanese naval aviation, resulting in the sinking of four of the six Japanese carriers that had raided Pearl Harbor as well as a cruiser, and the loss of an American carrier and a destroyer. It would be over two years before the Japanese Navy would again openly contest the US Navy for control of the seas, and when it did so, American fighter pilots would utterly destroy the painstakingly rebuilt naval aviation forces Japan had husbanded for the attack in an action known to history as the 'Marianas Turkey Shoot'.⁴⁸

We Slept: The Untold Story of Pearl Harbor, McGraw-Hill Book Co, New York, 1981. I recall with special pleasure my graduate school association with the late Professor Prange at the University of Maryland in 1970-1972.

⁴⁵ The best account of the sinking of these two ships is Middlebrook, Martin, and Mahoney, Patrick, *Battleship: The Loss of the Prince of Wales and the Repulse*, Penguin Books, Harmondsworth, England, 1979.

⁴⁶ Gillison, Douglas, *Royal Australian Air Force, 1939-1942*, Australian War Memorial, Canberra, 1962, pp 250-254.

⁴⁷ Till, *Air Power and the Royal Navy, 1914-1945*, p 47.

⁴⁸ Many detailed accounts of these actions exist. The most useful include the following: Dull, Paul S., *A Battle History of the Imperial Japanese Navy, 1941-1945*, Naval Institute Press, Annapolis, 1978; Glines, Carroll V., (ed), *Doolittle's Tokyo Raiders*, Van Nostrand Reinhold Co, New York, 1981; Lundstrom, John B., *The First Team: Pacific Naval Air Combat From Pearl Harbor to Midway*, Naval Institute Press, Annapolis, 1984); Morison, Samuel Eliot, 'Coral Sea, Midway and Submarine Actions, May 1942-August 1942', Vol. 4 of the *History of United States Naval Operations in World War II*, Little, Brown, and Co, Boston, 1949); Lord, Walter, (ed), *Incredible Victory*, Pocket Books, New York, 1968; a superb narrative of the Battle of Midway; Fuchida, Mitsuo, and Okumiya, Masatake, *Midway: The Battle that Doomed Japan*, United States Naval Institute, Annapolis, 1955; an excellent assessment of Midway from the Japanese perspective; and the previously cited Reynolds.

With the conclusion of major fleet actions by mid-summer 1942, not to resume until the Battle of the Philippine Sea, the naval war in the Pacific settled into a series of actions accompanying the tenacious struggle to liberate islands and territories that Japan had seized, or which it had acquired after the First World War. The island campaign began in earnest with the opening of the Guadalcanal operation in August 1942, which triggered a wider struggle for the Solomons that would last into 1944. Here, imaginative joint and combined control arrangements developed in the face of intensive and bitter Japanese attacks set a pattern for subsequent Pacific operations.⁴⁹ Here, too, a generalised pattern emerged of land-based aircraft attempting to destroy enemy shipping as well as their land-based opponents. In the case of the Japanese (now largely bereft of carriers), this often involved air operations against Allied carrier forces around the Solomons. For the Allies, it involved both carrier operations against land and sea targets, and operations by land-based dive bombers, torpedo aircraft, low-level attack bombers, and long-range landplanes and seaplanes against naval vessels and shipping at sea, as well as against harbour facilities.

So ingrained was fear of air attack against naval vessels by the beginning of the Solomons campaign that the US Navy actually withdrew its fleet out of range of Japanese land-based bombers only two days into the Guadalcanal operation, to the discomfiture of the Marines deployed ashore. Air support was furnished from the New Hebrides for the better part of two weeks, until, later in August, operations could begin from Henderson Field on Guadalcanal itself.⁵⁰

Such fears were well-founded, as were fears of the vulnerability of ships to submarines. At Coral Sea, the United States had lost the carrier *Lexington* to air attack, and at Midway, *Yorktown* had followed from both air and submarine assault. *Saratoga* had been torpedoed by a submarine and removed from combat, repaired, sent to Guadalcanal, and promptly torpedoed and damaged again. And *Hornet* succumbed to air attack in fighting around the Solomons. The Japanese would learn to their dismay the vulnerability of their own naval combatants and transports as they attempted to supply and reinforce their beleaguered Guadalcanal garrison. By late summer 1942, then, one significant lesson of Pacific combat was already clear to all combatants: ships required powerful defensive forces to remain as viable weapons themselves. This need resulted in a transformation of the battleship; no longer the means whereby a nation would secure its victory upon the ocean, it now served as a mobile anti-aircraft gun platform to help protect the vessel that would secure that victory: the aircraft carrier. Thus, throughout the Second World War, the most valuable weapons on American battleships were not their imposing 14 inch and 16 inch cannon; rather it was their massed batteries of 5 inch, 40mm, and 20mm cannon.⁵¹

⁴⁹ These are thoroughly covered in Winnefield, James A., and Johnson, Dana J., *Joint Air Operations: Pursuit of Unity in Command and Control, 1942-1991: A Rand Research Study*, Naval Institute Press, Annapolis, 1993, pp 23-38. Miller, Thomas G., *The Cactus Air Force*, Harper and Row, New York, 1969 is an excellent historical account of Guadalcanal air operations.

⁵⁰ Winnefield and Johnson, *Joint Air Operations*, p 26.

⁵¹ Morison, Samuel Eliot, 'The Struggle for Guadalcanal, August 1942-February 1943', Volume 5 of *History of United States Naval Operations in World War II*, Little, Brown and Co, Boston, 1949, details many of the naval actions around Guadalcanal.

SPECIALISED ATTACKERS FOR SPECIALISED ROLES

Three categories of aerial attackers participated in the Pacific sea war. First were naval aircraft operated from aircraft carriers or (by the Japanese, the US Marine Corps, and, occasionally, the US Navy) from shore bases: fighters, dive bombers, and torpedo bombers. Fighters such as the American Grumman F4F Wildcat and F6F Hellcat, the Vought F4U Corsair, and the Japanese Mitsubishi A6M (Zeke) fought to secure local air superiority so that other, more vulnerable aircraft such as dive bombers and torpedo bombers could survive. Dive bombers such as the American Douglas SBD Dauntless (and the later Curtiss SB2C Helldiver) and the Japanese Aichi D3A (Val) and the Aichi D4Y2 (Judy) constituted, in the pre-precision weapon era, an imperfect but nevertheless occasionally spectacular means of achieving accurate and devastating results by pin-point bombing in diving attacks. Torpedo bombers such as the Grumman/General Motors TBF/TBM Avenger and the Japanese Nakajima B5N (Kate) and B6N (Jill) undertook horizontal attacks at almost wavetop height to emulate the deadliness of the submarine.

Second were naval seaplanes, operated from harbours and anchorages, or from seaplane tenders, such as the American Consolidated-Vultee PBY Catalina and the later Martin PBM Mariner, and the Japanese Kawanishi H6K (Mavis) and H8K (Emily). These flew long maritime patrols and, occasionally, night attack missions against surface vessels, as well as daytime anti-submarine patrols.

Third were land-based aircraft not originally intended to operate from ships at sea, for example fighters such as the American Lockheed P-38 Lightning and Republic P-47 Thunderbolt, and the Japanese Nakajima Ki-43 (Oscar) and Kawasaki Ki-61 (Tony); long-range patrol bombers (of which the United States had a virtually unique monopoly) exemplified by the Consolidated-Vultee B-24 Liberator (and its naval variant, the PB4Y Privateer); medium bombers such as the American North American B-25 Mitchell (the Marine PBJ), and the Japanese G4M (Betty); and specialised light attack aircraft such as the American Douglas A-20 Havoc and Lockheed PV Harpoon, and the Australian Bristol Beaufighter.

RELIABLE, TIMELY INTELLIGENCE: THE VITAL NEXUS

As with the war in Europe, the actions of these aircraft and the men who flew them must be understood within the context of a strong nexus between intelligence and operations. The allied dominance of Axis communications in Europe was matched by the allied dominance of Japanese communications in the Pacific; MAGIC had targeted Japanese diplomatic codes, while ULTRA, a code word for euphemistically named 'special intelligence', gave the allied leadership transcribed copies of Japanese military communications. As a result, for virtually the entire Pacific War, Japanese intentions were known to the Allies, permitting comprehensive understanding of the Japanese order of battle, military resources available to the Empire, and strategic and tactical planning. (Indeed, so complete was signals intelligence on Japanese air forces that the intelligence staff of the USAAF's Fifth Air Force actually maintained and updated a 4,000 card index file on Japanese aircraft in the New Guinea-East Indies-

New Britain region). As in Europe, the importance of this intelligence to the Allies' winning of the war can hardly be overestimated.⁵²

Just a sampling of examples indicates the impact that Pacific ULTRA had upon the maritime air war; it:

- a. gave insight into Japanese intentions at the Coral Sea;
- b. set the stage for the Allies to confront the Japanese fleet at Midway;
- c. gave warning of the sailing of the Bismarck Sea convoy that Australian-American air attacks subsequently devastated;
- d. alerted the Allies to the inspection trip of Admiral Isoroku Yamamoto, leading to the aerial ambushing of his Betty bomber-transport by a squadron of P-38's over Bougainville, and his subsequent death;
- e. set the stage for other successful aerial ambushes, including that of Admiral Seigo Yamagata, over China nearly two years later;
- f. furnished intelligence enabling the airmen of General George Kenney and Admiral William Halsey to devastate Japanese naval and air power at Rabaul; and
- g. gave continuous information regarding Japanese shipping so that the United States could better manage both its submarine and maritime air campaign.

JAPAN'S FAILURE FROM WITHIN

The Pacific maritime air war likewise must be evaluated in light of Japan's serious misuse of its air power and aviation industrial base, so that, by the end of 1942, it found itself everywhere on the defensive, and in 1944-45, destroyed. First, Japanese industry was incapable of meeting the demands of a far-flung Pacific air war. In 1941, Japan produced only 5,088 aircraft, while the United States produced 19,433; in 1944, Japan produced 28,180 aircraft, while the United States that year produced 100,752.

⁵² Generally speaking, by 1945, all Pacific special intelligence was generically termed 'ULTRA.' After years of neglect, there is, at last, a reasonably comprehensive body of literature on the Pacific intelligence war. See Van Der Rhoer, Edward, *Deadly MAGIC: Communications Intelligence in World War II in the Pacific*, Robert Hale, London, 1978; Drea, Edward J.'s superb *MacArthur's ULTRA: Codebreaking and the War Against Japan, 1942-1945*, University Press of Kansas, Lawrence, KS, 1992; Winton, John, *ULTRA in the Pacific: How Breaking Japanese Codes & Cyphers Affected Naval Operations Against Japan, 1941-1945*, Naval Institute Press, Annapolis, 1993; and Prados, John's brilliant *Combined Fleet Decoded: The Secret History of American Intelligence and the Japanese Navy in World War II*, Random House, New York, 1995. The card file anecdote is from the forthcoming Kreis, John F., (ed), *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II*, Air Force History and Museums Program, Washington DC, 1995, p 261. The Yamamoto shootdown is examined provocatively in Glines, Carroll V., *Attack on Yamamoto*, Orion Books, New York, 1990; and, more traditionally, in Hall, R. Cargill, (ed), *Lightning over Bougainville: The Yamamoto Mission Reconsidered*, Smithsonian Institution Press, Washington DC, 1991. The claims and counterclaims of who shot the admiral down will, in all likelihood, never be resolved to all parties' satisfaction.

Like Germany, rivalries among design bureaus and companies hindered production, as did labour shortages, and a defensive posture that understandably skewed acquisition towards fighters and away from the many and varied kinds of aircraft needed to win a war.⁵³

Secondly, Japanese military officials made some critically poor choices in the years prior to the Second World War that came back to haunt them. Among these were (in common with all-too-many other naval surface warfare officers worldwide) an overemphasis upon the battleship as the principal means whereby a maritime nation would achieve victory in war; this prejudice continued well after Pearl Harbor, and might best be described as a ‘it takes a battleship to sink a battleship’ philosophy. Hand-in-hand with this was an almost theological belief in the quest for ‘the decisive battle’. As historian John Prados has written:⁵⁴

This fixed idea, which almost had the force of cargo cults in some traditional societies, had adverse effects on aviation, on submarine tactics, and on the use of fleet forces for sea control. ... Decisive Battle meant Yamatos [battleships - ed.] not Shinanos [aircraft carriers - ed.], range finders not radars, small-scale rather than mass aircrew training. Research and development of advanced aircraft, exotic weapons, and the like were affected adversely.

After the war, Japanese military officials acknowledged some of these poor choices, particularly, as Mitsuo Fuchida and Masatake Okumiya noted, the ‘Myth of the Almighty Battleship’, and a mistaken aircrew selection and training process that produced far too few replacements for those lost in the war, particularly in the destruction of Japan’s carrier forces at Midway. (Indeed, at Midway, Japan had to operate with four as opposed to five carriers because it had insufficient pilots to man a fifth carrier - *Zuikaku* - that was otherwise ready to put to sea.⁵⁵ Other errors include:

- a. The failure to pursue radar so that the Japanese military, essentially throughout the war, operated in a largely ‘visual only’ detection mode (as Fuchida and Okumiya dolefully noted, ‘night glasses were no match for radar’);
- b. The failure to develop and widely produce successors to the Zeke and Betty with which Japan started the war, and which were outclassed by the Allies by 1943 (a failure Japan shared with the Luftwaffe);
- c. A strategic philosophy - Richard Pelvin has rightly termed it a ‘strategic obduracy’ - that stressed defending all territory seized from the Allies, at the risk of destroying forces that could have been better husbanded for the defence of the Home Islands;
- d. A lack of foresight so that the Japanese were, in the words of the United States Strategic Bombing Survey ‘peculiarly and astonishingly unprepared to convoy

⁵³ Pelvin, Richard, *Japanese Air Power 1919-1945: A Case Study in Military Dysfunction*, Paper Number 31, Royal Australian Air Force Air Power Studies Centre, Canberra, April 1995.

⁵⁴ Prados, *Combined Fleet Decoded*, p 734. Its modern equivalent is the notion that ‘it takes a tank to destroy a tank,’ a notion heard loudly before the Gulf War, not at all immediately afterwards, and now beginning to be heard again.

⁵⁵ Fuchida and Okumiya, *Midway*, p 208.

and protect their merchant marine against attack whether by sea or air'; and, finally,

- e. A military culture that accepted, as a given, that Japanese forces would win under virtually all circumstances, and which 'cooked the books' in military exercises that implied (correctly in the case of Midway) the opposite.⁵⁶

THE ACCOMPLISHMENTS OF ALLIED MARITIME AIR POWER

In the air war against Japanese naval vessels and shipping, allied attackers developed a deserved reputation for creative use of tactics and weapons to inflict the maximum amount of destruction on the ships they hit. This was particularly evident in:

- a. USAAF-RAAF operations around New Guinea in 1943;
- b. Naval long-range land-based operations against Japanese shipping;
- c. USAAF operations against Japanese convoys in the South China Sea in 1944-45; and
- d. The mining campaign against the Home Islands in 1944-45.

The New Guinea air campaign is a classic of joint and combined operations that has, unfortunately, been too long neglected. In August 1942, the Japanese attempted to seize Milne Bay, a strategic hold on the New Guinea coast. Tenacious resistance by a combined Australian-American force repulsed this assault, with Australian and American air attacks proving critical to the success of the defenders. In particular, Australian Curtiss Kittyhawks (the P-40 Warhawk in American service) strafed Japanese landing barges, inflicting heavy losses, and prevented Japanese surface vessels from rescuing trapped troops from outlying islands. Unsupported, Japanese forces ashore withered, in one of the few cases where air attack has been directly responsible for preventing a seaborne assault. Had air attack not succeeded in this case, New Guinea likely would have eventually been lost to the Japanese.⁵⁷

But it is justifiably the Battle of the Bismarck Sea in March 1943 that has come to symbolise the maritime air war around New Guinea. Here, combined American and Australian air attacks devastated a Japanese supply convoy, sinking all eight

⁵⁶ *ibid.*, pp 210-212; Pelvin, *Japanese Air Power 1919-1945*, pp 17-24; USSBS, p 2. Prados is less accepting of the 'arrogance' notion than others; see p 735.

⁵⁷ Assistant Chief of Air Staff Intelligence - Historical Division, 'Army Air Forces in the War Against Japan, 1941-1942', No. 34 of the *Army Air Force Historical Studies* series, HQ USAAF, Washington DC, June 1945), pp 151-153. I have also drawn from Gary Null's 'Weapon of Denial: Air Power and the Battle for New Guinea', a study in *The U.S. Army Air Forces in World War II* series, Air Force History and Museums Program, Washington DC, 1995. At least two other examples of air attack defeating amphibious forces exist: the abortive attempt in August 1936 by Loyalists to seize Majorca from the Nationalists during the Spanish Civil War, where Italian bombing of the landing forces precipitated their hasty withdrawal; and the far better known defeat of anti-Castro exile forces by Cuban air force attacks during the Bay of Pigs invasion.

transports and four of eight escorting destroyers. One Japanese naval officer, Tameichi Hara, termed the battle 'shocking,' adding 'Japan's defeat there was unbelievable. Never was there such a debacle'.⁵⁸ The Bismarck Sea victory stemmed from several factors: Ultra special intelligence; a strong and aggressive air commander (the charismatic Major General George C. Kenney, commander of the Fifth Air Force and General Douglas MacArthur's air component commander); two superb operational planners (Australia's Group Captain William 'Bull' Garing--a veteran of the Battle of the Atlantic and the commander of Australian air forces at Milne Bay - and Kenney's deputy Brigadier General Ennis C. Whitehead); hard and realistic training; and appropriate attack aircraft and tactics. This latter point is a significant one, for Kenney's creative engineering and maintenance chief, Major Paul I. 'Pappy' Gunn, had modified B-25 bombers into powerful commerce destroyers by giving them up to ten forward-firing .50 calibre machine guns, complementing the heavily armed Bristol Beaufighters of the RAAF. Further, at Kenney's instigation, another officer, Major William Benn, had pioneered the development of so-called 'skip-bombing' tactics (first used by B-17's raiding Rabaul harbour at night) whereby a low-flying bomber could drop a bomb which would then skip like a stone across a pond, hitting a ship at or just below the waterline. All of these came together at the Bismarck Sea, which was to the Japanese even worse than what Convoy PQ-17 had been to the Allies. Essentially, after Bismarck Sea, New Guinea was effectively under an allied air blockade that remorselessly cut off Japanese forces from any hope of meaningful resupply.⁵⁹

Long-range maritime patrol missions by naval airmen using PBY Catalina and PBM Mariner seaplanes and landplanes such as the PB4Y Privateer, the PV Harpoon, and the PBJ Mitchell (the latter a B-25 for the USMC) were very productive, as were equivalent 'Snooper' operations by radar-equipped B-24's of the Thirteenth, and later the Fifth and Fourteenth, Air Forces. Particularly useful were the Catalina seaplane (which, in its PBY-5A amphibious variant, could operate from both land or sea), and the four-engine Privateer. The somewhat ungainly PBY, truly a 'maid-of-all-work', flew maritime reconnaissance, anti-submarine, search-and-rescue, electronic warfare, and night surface strike missions. Catalina night attacks around the Solomons and the Philippines, undertaken by torpedo and bomb-armed PBY's dubbed 'Black Cats', were very productive. One Navy patrol bombing squadron, VPB-33, destroyed 43 ships totaling 103,500 tons and damaged a further 20 totaling another 53,500 tons in just one month. In the first four nights of operations, they sank four ships; on another

⁵⁸ Null, *Weapon of Denial*, p 30.

⁵⁹ There are a number of sources that discuss these matters, including the previously cited Null; *Weapon of Denial*, Lex McAulay, *Battle of the Bismarck Sea*, St. Martin's Press, New York, 1991; Murphy, James T., with Feuer, A.B., *Skip Bombing*, Praeger, Westport, Conn, 1993; and Cortesi, Lawrence, *Operation Bismarck Sea*, Major Books, Canoga Park, Ca, 1977; see also Birdsall, Steve, *Flying Buccaneers: The Illustrated Story of Kenney's Fifth Air Force*, Doubleday & Co Inc., Garden City NY, 1977, which has an excellent account of the battle from the airmen's perspective. Finally, the command perspective is well-covered in Kenney, George C., *General Kenney Reports*, Office of Air Force History, Washington DC, 1987. For a thorough assessment of Kenney as an air leader, see Wolk, Herman S., 'George C. Kenney: MacArthur's Premier Airman', in Leary, William M., (ed), *We Shall Return! MacArthur's Commanders and the Defeat of Japan, 1942-1945*, The University Press of Kentucky, Lexington, 1988, pp 88-114.

occasion, a single PBY sank two destroyer escorts and capsized a seaplane tender, all in a single sortie.⁶⁰

The Privateers, adopting the skip-bombing tactic of Kenney's airmen, had their own notable successes. During one patrol mission off Truk, a single Privateer sank four ships, possibly a fifth, and damaged a sixth, at the cost of losing an engine to anti-aircraft fire. Another, on a single sortie, sank a small freighter, shot down a Japanese floatplane, and then, acting on ULTRA intelligence, ambushed Admiral Seigo Yamagata's H8K Emily - the real purpose of the mission - sending him to his death. In the summer of 1945, an advanced Privateer model, the PB4Y-2, distinguished by a large single vertical fin, revised turret layout, and numerous radar antennae, entered service. This model could also carry the Navy's Bat glide bomb. While troublesome, this primitive air-to-surface radar-guided missile did score some successes against Japanese shipping (including sinking a destroyer and several freighters) and bridges, marking the first American use of guided anti-shiping weapons, and one of the first attempts to deploy a genuine precision-guided munition against land targets.⁶¹

As with the German experience off Norway or the allied experience in the Mediterranean, the symbiotic partnership between carrier planes, landplanes and submarines was a significant one. In February 1944, for example, submarine attack had bottled up Japanese shipping in Truk harbour, permitting two days of carrier raids to sink 186,000 tons of shipping. Navy Privateers reconnoitred Singapore harbour, monitoring the progress of repairs on damaged Japanese ships; when the moment was right and the ships left port, submarines promptly sank them. Off the China coast, subs and aircraft worked well together. Marauding submarines forced convoys to sail closer to the China coast; then, cued by ULTRA, and radar-equipped Liberators, Privateers, and Catalinas, air attacks by ship-busters took a heavy toll. On March 29, 1945, for example, 31 B-25's of the Fifth Air Force's famed Air Apaches claimed eight ships and a patrol craft.⁶²

Operations such as these dramatically curtailed the attempts that Japan made to run convoys throughout the beleaguered empire, and it was clearly air attack that Japan's transportation leaders feared most. Of Japan's 47 separate convoy routes, only 9 (19 per cent) were functioning at the end of the war. The rest had been shut down from a variety of causes, such as fear of losing or the actual seizure of territory by the Allies, the threat of air attack, and the threat of submarines. Of the 38 routes shut down, 13 (28 per cent) were closed due to air threats; interestingly, only 4 (9 per cent) were closed due to submarine threat.⁶³

⁶⁰ For an excellent survey of PBY operations, see Knott, Richard C., *Black Cat Raiders of World War II*, Nautical and Aviation Publishing Co, Baltimore, MD, 1981. Information on the Snoopers is drawn from USSBS, p 37.

⁶¹ The Privateer story is well-told in Birdsall, Steve, *Log of the Liberators: An Illustrated History of the B-24*, Doubleday and Co Inc, Garden City, N.Y, 1973, pp 126-160; the Bat is also discussed in Trimble, William F., *Wings for the Navy: A History of the Naval Aircraft Factory, 1917-1956*, Naval Institute Press, Annapolis, 1990, p 298. The Navy had a number of specialised glide bomb and missile programs underway, as did the Army Air Forces, which experimented in both the European and Asiatic theatres with early guided bombs.

⁶² USSBS, p 2; Birdsall, *Log of the Liberators*, p 159; Birdsall, *Flying Buccaneers*, pp 277.

⁶³ USSBS, p 50.

Perhaps no combat action of the Pacific war so exemplifies the synergistic partnership of intelligence and air power, the dominance of air attack at sea, and the futility of Japanese actions near the war's end than the strange last sortie of the battleship *Yamato*. In early April 1945, together with some consorts (a light cruiser and eight destroyers), the monstrous *Yamato*, ostensibly the world's most formidable battleship, left Tokuyama in a vain attempt to destroy American fleet elements off Okinawa. Long before they left port, Ultra revealed Japanese intentions. With Ultra forewarning, the Navy sent out search aircraft. Because of the USAAF's Boeing B-29 Superfortress aerial mining campaign, the *Yamato* force was limited to using the Bungo straits, further simplifying the search problem. First, the Japanese were sighted by a plane from the carrier USS *Essex*. Next, two long-range PBM Mariner patrol bombers took up the watch; somewhat pathetically, the band of ships 'made frequent radical changes of course and evasive maneuvering [sic]', but to no avail.⁶⁴ With dismal predictability, a number of strike aircraft from Navy carriers arrived on the scene and, in short order, sent *Yamato*, together with the light cruiser and four of the eight destroyers, to a watery grave amid a furious assault of bombs and torpedoes. In the words of historian Paul S. Dull, 'With the sinking of the great battleship *Yamato*, the once-formidable Imperial Japanese Navy had ceased to exist'. And with it, it might have been added, died 2,500 years of surface warfare ship supremacy.⁶⁵

THE KAMIKAZE: JAPAN'S DESPERATE ATTEMPT AT NATIONAL SALVATION

Japan's response to the growing threat posed by the allied coalition was to launch the infamous Kamikaze anti-shipping campaign. Though virtually all types of Japanese aircraft were employed at one time or another on Kamikaze missions, the Kamikaze was most often a manned fighter, dive bomber, or torpedo plane. Further, though Japanese Army Air Force pilots occasionally flew on such one-way suicide missions, the overwhelming majority of Kamikazes were Japanese naval attackers. In today's parlance, the Kamikaze was in effect a cruise missile with a sophisticated adaptive flight control system - the pilot - able to provide precise terminal guidance in the end-game encounter.

The threat of the Kamikaze was the greatest aerial anti-shipping threat faced by allied surface warfare forces in the war. Despite cuing of attacks by Ultra signals intelligence intercepts, radar tracking, and airborne interception, approximately 2,800 Kamikaze attackers sunk 34 Navy ships, damaged 368 others, killed 4,900 sailors, and wounded over 4,800. While most Kamikazes were single-engine aircraft flown with a bomb or torpedo, a few were multi-engine, and a far smaller number were special-purpose rocket-boosted Ohka ('Cherry Blossom') flying bombs air-launched from twin-engine motherships. Despite radar detection and cuing, airborne interception and attrition, and massive anti-aircraft barrages of proximity-fused 5 inch and 40mm

⁶⁴ Quote from Morison, Samuel Eliot, 'Victory in the Pacific', Volume 14 of *History of United States Naval Operations in World War II*, Little, Brown and Co, Boston, 1968, p 204. See also Prados, pp 711-712.

⁶⁵ Dull, *A Battle History of the Imperial Japanese Navy, 1941-1945*, p 347; Morison, *The Struggle for Guadalcanal, August 1942-February 1943*, Volume 5, pp 205-209; and Prados, *Combined Fleet Decoded*, pp 712-715.

cannon fire, a distressing 14 per cent of Kamikazes survived to score a hit on a ship; nearly 8.5 per cent of all ships hit by Kamikazes sank.

Kamikazes first appeared off the Philippines in the fall of 1944, at a time when Admiral Thomas C. Kinkaid, commander of the Seventh Fleet, and his amphibious assault planners were already concerned that Japanese land-based airplanes could launch potentially devastating air attacks against landing forces during the anticipated invasion of Mindanao, scheduled for early December. Then, on 25 November, Kamikaze attackers damaged four of nine fleet carriers in Leyte Gulf; alarmed, Admiral William F. Halsey ordered the bulk of his Task Force 38 back to Ulithi atoll, echoing the withdrawal of naval forces from Guadalcanal in the face of Japanese land-based air attacks in 1942. In the face of naval estimates that further Kamikaze attacks could, at the least, damage approximately 25 per cent of Kinkaid's transports and landing craft, Kinkaid pressed for a delay in the planned Mindanao landing. After a series of protracted and sharp meetings between Kinkaid and Southwest Pacific commander General Douglas MacArthur, the feisty admiral won his point. The planned invasion of Mindanao was slipped ten days, until friendly air power, both naval and land-based, was strengthened to confront the Kamikaze menace.⁶⁶

As soon as they appeared, then, the Kamikazes revealed their power to force significant changes in allied naval planning and operations, despite their relatively small numbers compared to their adversaries. Later in the year, the threat of Kamikaze attackers based on Formosa and Luzon forced routing changes for American convoys steaming to Lingayan Gulf. Nevertheless, despite such changes, Kamikazes took a heavy toll of ships and sailors. Admiral Jesse Oldendorf's amphibious support group underwent sustained attacks between January 4 and January 6, resulting in one small escort carrier and a destroyer-minesweeper sunk, and multiple hits to other ships, including another carrier, two battleships, five cruisers, and twelve lighters, resulting in urgent calls for greater friendly air cover. Despite prompt response by American naval and land-based fighters, attacks continued over the next several days, claiming two more minesweepers; on January 8, Japanese attackers heavily damaged six ships, including two on an Australian cruiser (already hit previously by three Kamikazes), and one each on two escort carriers. Clearly, like the anti-shipping cruise missile of a later era, the Kamikaze had the potential to influence events all out of proportion to its actual strength.⁶⁷

With some justification, the Okinawa campaign is considered the apogee of Kamikaze operations against the American fleet. In particular, Kamikazes took a terrible toll of radar picket destroyers and other small craft off Okinawa, but larger ships were not invulnerable to attack. Overall, no less than 36 hits were recorded by Kamikazes on aircraft carriers, and three small carriers were sunk (including the unfortunately named USS *Bismarck Sea*). Larger ones - such as the USS *Enterprise* and *Bunker*

⁶⁶ This is discussed in detail in Wheeler, Gerald E., *Kinkaid of the Seventh Fleet: A Biography of Admiral Thomas C. Kinkaid, U.S. Navy*, Naval Historical Center, Washington DC, 1995, pp 409-414. Of Halsey's prudent withdrawal, Wheeler tellingly writes, 'Like most naval aviators, he considered his fast carrier task force too important to jeopardise them through continuous operations within striking range of shore-based Japanese air fleets and special attack squadrons.' p. 410. For further discussion of the escort carriers in Leyte Gulf, see Y'Blood, William T., *The Little Giants: U.S. Escort Carriers Against Japan*, Naval Institute Press, Annapolis, MD, 1987.

⁶⁷ Wheeler, *Kinkaid of the Seventh Fleet*, pp 418-420.

Hill, while not sunk, were often so badly damaged as to be knocked out of the war. (And of course there is the USS *Franklin*, which, while not a victim of a Kamikaze, was nevertheless lost to the war effort by a conventional dive bombing attack). The threat of the Kamikaze was thus considerable, and the most that can be said is that the combination of intelligence, shipboard early warning radars, aerial interception, and close-in defences enabled the Allies to endure the threat, not triumph over it. Had an invasion of Japan been attempted, the Japanese were confident they could inflict at least 50,000 casualties by Kamikaze attack alone. Since they had, at war's end, 6,374 operational fighters and bombers, with several thousand other aircraft available for attack as well, such an estimate is completely acceptable, and yet another reason why servicemen in the Pacific theatre have reason to be thankful for the dropping of the atomic bomb.⁶⁸

AERIAL MINING BOTTLES UP THE HOME ISLANDS

As aerial mining by long-range land-based aircraft played a leading role in the defeat of Nazi Germany's naval ambitions, so, too, did it play a leading role in the defeat of Japan. By the end of 1944, air power (both by land-based and sea-based aircraft) was dominant. In the words of one submariner skipper, 'we had passed the high-water mark of submarine activity. It had become an aviator's, not a submariner's war.'⁶⁹ In the summer of 1945, air attacks dominated Japanese ship sinkings; in July 1945, US submarines accounted for 14 ships. But that same month, aircraft attacks accounted for 129 ships.⁷⁰

Mines were a deadly attacker, and seriously constrained the Japanese.⁷¹ Mine attacks took place in an 'Outer Zone' (consisting of the South Pacific, Southwest Pacific, Central Pacific, and the China-Burma-India theatre), and an 'Inner Zone' which consisted of Japan's home waters. A grand total of 24,876 mines were laid in Japanese waters by allied aircraft, ships, and submarines. Of this total, aircraft accounted for 21,389 mines, representing 86 per cent of all mines deployed against

⁶⁸ Japanese air order of battle, from archives of USAF Historical Research Agency, Maxwell AFB, AL, Document 704.6311-1 (15 Aug. 1945), Plate 24. Japanese estimates of 50,000 casualties came from a lecture by Dr. Edward Drea of the U.S. Army Center for Military History, based on his analysis of wartime Ultra intelligence intercepts. Rikihei Inoguchi, Tadashi Nakajima, and Roger Pineau, *The Divine Wind: Japan's Kamikaze Force in World War II*, Naval Institute Press, Annapolis, 1958 is still the best single history of the Kamikaze story. Statistics on carrier hits were drawn from the appendices of this book.

⁶⁹ Galantin, I.J., *Take Her Deep! A Submarine Against Japan in World War II*, Pocket Books, New York, 1988, p 256.

⁷⁰ *ibid.*, pp 292-293.

⁷¹ Data in the following discussion is drawn from Johnson, Ellis A., and Katcher, David A., *Mines Against Japan*, Naval Ordnance Laboratory, Silver Spring, MD, 1973, *passim*. This is an excellent survey, first prepared in 1947 as a classified document. A caution to readers: the mine data in this document is far more favourable to mining as a weapon of war than the JANAC study cited subsequently. On the other hand, the JANAC study has such a questionable interpretation of mining - crediting only two ships sunk to Navy-dropped mines, for example - that I believe it is not reliable on the mine issue. The Johnson and Katcher study is so detailed and so internally consistent that I have accepted it as authoritative on the mining question. JANAC, on the other hand, is more reliable and more detailed on other forms of attack, notably by ships, aircraft and - especially - submarines. I have chosen therefore to rely on Johnson and Katcher on mining, and JANAC for general submarine and aircraft data. I also wish to acknowledge the assistance of Mr. William T. Y'Blood for information on submarine warfare that I have also incorporated in this discussion.

Japan, dropped in the course of 4,323 allied sorties. (Ships accounted for 11 per cent - 2,829 mines deployed - and submarines for 3 per cent - 658 mines deployed). Overall, the allied air forces flew 4,323 mining sorties against Japan, 67 per cent of these seeding 108 fields in the Outer Zone, and 57 per cent seeding 26 fields in the Inner Zone. Land-based aircraft of the USAAF were responsible for dropping 14,969 mines, representing 70 per cent of the total of 21,389 mines dropped against Japan. Of the total mines air-dropped against Japan, 9,254 (43 per cent) were mines deployed in Outer Zone attacks, and 12,135 (57 per cent) were mines dropped in the Inner Zone. The density differences of Outer and Inner fields are clearly evident; Outer Zone fields averaged 86 mines each, while Inner Zone fields averaged 467 mines each.⁷²

Of these Outer and Inner Zone aerial mine seedings, the USAAF flew 2,078 sorties (48 per cent), the RAAF 1,128 sorties (26 per cent), the RAF 631 sorties (15 per cent), and the US Navy 486 sorties (11 per cent). Of the 2,078 USAAF sorties, 1,424 were Inner Zone seedings by long-range Boeing B-29 Superfortress bombers carrying between 7 and 12 mines. B-29's accounted for 69 per cent of all AAF sorties, 33 per cent of all allied mining sorties against Japan, and (in part because of their high capacity) dropped all 12,135 mines deployed in Inner Zone attacks.⁷³ B-29's were thus responsible for laying 57 per cent of the total of 21,389 mines air-dropped against Japan in both Inner and Outer Zone attacks. While it might have been expected that B-29 commanders - particularly General Curtis E. LeMay - would have resented the 'distraction' that mining offered away from attacks against the Japanese mainland, Dr. Ellis Johnson, a Navy mine expert who played a major role in the campaign, concluded that 'It was the firm belief in and support of the mining effort by General LeMay himself that made the successful campaign possible at all'.⁷⁴

Overall, based on a postwar Naval Ordnance Laboratory assessment of Japanese records, allied mining accounted for a total of 961 ships sunk or damaged, representing 2,027,516 tons. Of these, mines sunk 484 ships (representing 649,736 tons), damaged 139 others so severely as to be lost to the war effort (378,827 tons), damaged 338 ships less seriously (998,953 tons).⁷⁵ Of 606 ships mined in the so-called 'Inner Zone' attacks undertaken by the B-29's of the XXI Bomber Command, 283 ships (representing 396,371 tons) were sunk, 137 (376,004 tons) were damaged too severely to return to service, and 186 (478,881 tons) were less seriously damaged. B-29 mining of the Shimonoseki straits, for example, effectively closed it to large warships as well as other craft; 18 sunken ships and four sunken destroyers attested to futile Japanese attempts to run the Shimonoseki aerial mine blockade.⁷⁶ Ship passage through the Shimonoseki strait decreased from 70,000 tons per day in March, to

⁷² Johnson and Katcher, *Mines Against Japan*, pp 21-29, esp. Table 3-1 and Table 3-3.

⁷³ Two points for purists: (1) Johnson and Katcher state that B-29 sorties constituted 34 per cent of the total. In fact, dividing 1424 by 4323 indicates that they constituted .3294 of the total, which I have rounded to 33 per cent. (2) They also state that the 12,135 mines dropped by B-29's constituted 63 per cent of the mines laid. But since 21,389 were dropped, the B-29 percentage can be calculated as .5673 of the total, which makes it 57 per cent, not 63 per cent.

⁷⁴ Johnson and Katcher, *Mines Against Japan*, p ix.

⁷⁵ *ibid.*, pp 31-32, Table 3-4, 'Summary of Japanese Ship Casualties to allied Mines (Based on Japanese Records).'

⁷⁶ Craven, Wesley Frank and Cate, James Lea, (eds), *The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945*, Vol. 5 of *The Army Air Forces in World War II*, Office of Air Force History, Washington DC, 1983, p 669.

35,000 tons in April, plunged to 7,500 tons in May, to 1,750 tons in June, staggered up to 8,000 tons in July, and dropped to 1,500 tons in August. In their study of the Pacific mine campaign, naval analysts Ellis Johnson and David Katcher concluded that B-29 mining sorties caused fully 60 per cent of Japanese shipping losses between March and August 1945. Further, 19 of 22 repair yards - fully 86 per cent - were rendered useless by mine blockade, inhibiting the ability of the Japanese to repair their damaged vessels.⁷⁷

Indeed, B-29 attacks were approximately twice as effective per unit of time as submarine attacks in strangling Japan. Only counting sinkings, B-29 Inner Zone mining cost Japan 283 vessels lost over 4 1/2 months, a monthly average of 63 ships. By comparison, submarine attacks cost Japan 1,314 vessels over 44 1/2 months, a monthly average of 30 ships.⁷⁸ The force that did this, in terms of national investment, was remarkably small. The postwar Joint Army-Navy Assessment Committee credits 190 American submarines with sinking 1,314 ships, thus averaging 6.92 ships sunk per submarine. But the B-29 mining force deployed against Japan was only approximately 40 aircraft, producing an average of 7.08 ships sunk per B-29.⁷⁹

Thus, a US\$639,188 B-29 with a crew of 11 men achieved slightly better results than an approximately US\$3.6 million submarine with a crew of 85 men. Further, it cost the United States government only US\$90,281 in B-29 aircraft costs per Japanese ship sunk versus US\$520,231 in submarine costs per Japanese ship sunk. The overall force economic costs - just looking at the costs of the aircraft and submarines involved - makes for its own interesting comparison: US\$25,567,520 for the B-29 mining force vs. US\$684,000,000 for the submarine force. The cost differential in human lives is even more sobering. For every airman lost on the Inner Zone mining campaign (a total of 103 men), Japan lost 2.75 ships; for every sailor lost in the submarine campaign (approximately 3,300), Japan only lost 0.40 ships. Additionally, the aircraft dropped a relatively 'stupid' and reasonably cheap weapon - the mine. The submarine fired a far more expensive miniature submersible, the self-propelled torpedo. Although fewer torpedoes were expended per sunken Japanese ship than mines (11.22 torpedoes vs. 42.88 mines), mines clearly were a cheaper alternative and, more importantly, did not require the characteristically close and dangerous approach to enemy shipping and heavily armed escort vessels necessitated by the torpedo.⁸⁰

In sum, then, aerial mining risked fewer lives, used fewer resources, and, proportionally, achieved far more with less than the much-heralded submarine campaign. Further, it is likely that submarine pickings of Japanese shipping over the spring and summer of 1945 were as lean as they were not because so many ships had already been sunk (as submarine adherents have traditionally claimed), but, rather,

⁷⁷ Johnson and Katcher, *Mines Against Japan*, p 133. See Figure 7-16, p 132, for Shimonoseki strait traffic data.

⁷⁸ The Joint Army-Navy Assessment Committee, *Japanese Naval and Merchant Shipping Losses During World War II by All Causes*, GPO, Washington, DC, Feb. 1947, Table II, p vii. Hereafter JANAC

⁷⁹ I have accepted this figure from Johnson and Katcher, *Mines Against Japan*, p 17; however, data on p 129 suggests a more accurate figure is 35. I have used the larger number because it is less favourable to air power, not more favourable.

⁸⁰ In the mining campaign, the B-29's dropped 12,135 mines. In the submarine campaign, the Navy fired 14,748 torpedoes. (Torpedo figure from Blair Jr., Clay, *Silent Victory: The U.S. Submarine War Against Japan*, Volume 2, J. B. Lippincott Co, Philadelphia, 1975, p 853.

because so many were bottled up in port by the aerial mining campaign. And, finally, it must be remembered that, in the case of the B-29's, mining was incidental to the fundamental purpose of the airplanes - strategic bombing - whereas, for submarines, torpedo attacks on shipping were their *raison d'être*. Indeed, one can understand the conclusion of the analysts of the postwar United States Strategic Bombing Survey when they wrote, after examining the mining campaign against Japan, that:⁸¹

It is believed that this campaign, begun earlier and laid on with greater weight, would have reduced effective shipping nearly to the vanishing point. It would have produced a condition of crisis in Japan sooner than actually occurred.

MARITIME AIR ATTACK'S RECORD IN THE PACIFIC WAR

What judgments can one reach about the efficacy of maritime air operations in the Pacific? For a start, both the Japanese and the Allies had notable successes. But as in European waters, once the Allies had secured air superiority, the Japanese were unable to pursue the kind of maritime air war that they needed to win the war; their reconnaissance aircraft were shot down, and their strike aircraft mauled on the way to their targets. The Kamikaze experience, while dreadful, could not bring victory - only delay.

For the allies, the value of air power against Japan's maritime forces was profound. The postwar JANAC study by a joint US Army and US Navy assessment committee of the maritime war against Japan offers a remarkable look at what air power did in the naval war context, even allowing for its conservative approach to mine casualties.⁸²

What is not so readily apparent, but which can be extracted from the data in the JANAC study, is the following: By JANAC's figures, while submarines were responsible for sinking 48 per cent (1,314) of the total ships lost by Japan, aircraft were responsible for sinking by direct attack or with mines 45 per cent (1,232). Further, in concert with other attackers, they sank an additional 2 per cent (46 ships). Therefore, air power forces, directly, indirectly, or partnered with other attackers, was responsible for sinking 47 per cent of Japan's maritime losses, a tonnage value of 4,066,380 tons (see Table 1).

⁸¹ USSBS, p 8. Mines, of course, played a significant role in conflicts after the Second World War as well - for example, the Wonsan mine campaign off Korea, the Gulf Wars of the 1980s, and the Persian Gulf war of 1991, where the Navy experienced two minings of a AEGIS-class cruiser and an assault helicopter ship that essentially drove surface forces away from the Kuwaiti coast.

⁸² JANAC, Table II, p vii. While some - notably submarine commanders whose wartime tallies were significantly revised downwards - have quibbled over numbers in the JANAC study, it is generally more favourable to the submarine than to other attackers; its multiple categories of data tend to fragment sea-and-land-based air power's contributions, and its first bar chart (p. v) is visually misleading. Additionally, as mentioned earlier, its mine statistics are so much at variance with other sources as to indicate that mining from all forms of minelayers has not been adequately treated. I wish to thank Mr. Jacob Neufeld of the Air Force History Support Office for making a copy of the JANAC report available to me.

Table 1 – Japanese Ships Sunk by Number and Tonnage

Japanese Ships Sunk	Number of Ships	Tonnage
Sunk by Submarines	1,314	5,320,094
Sunk by Surface Craft	123	321,166
Sunk by direct & indirect air attack	1,232	3,816,653
Sunk by combined air-sea/other attack	46	249,727
Sunk by mines laid by ships or subs	7	22,353
Sunk by shore batteries	2	2,770
Sunk by unknown causes	4	3,305
Total	2,728	9,736,068

JANAC indicates that of the 1,232 ships (3,816,653 tons) sunk by air attack:

- a. 259 (21 per cent) (587,302 tons) were sunk by aerial mines;
- b. 973 (79 per cent) (3,229,351 tons) were sunk by direct USAAF, USN, or USMC attack;
- c. Of this total:
 - i. 688 (56 per cent) (1,592,482 tons) were sunk by land-based aviation forces in direct attack or by air-dropped mines.
 - ii. 520 (42 per cent) (2,101,477 tons) were sunk by carrier-based aircraft.

Note: combinations of land-and-sea-based air power forces account for the 2 per cent ‘missing’ ships.

Perhaps most surprisingly, JANAC data indicates that of the ships sunk by air attack, land-based Army Air Forces aircraft sank fully 46 per cent - 567 ships representing 1,282,192 tons. This is a powerful commentary on the role that land-based air forces played in maritime warfare even in an era of non-precision munitions, and an indication of the even greater abilities land-based air has to challenge a maritime attacker or nation in the present day era of precision weapons.⁸³

MARITIME AIR POWER AFTER THE SECOND WORLD WAR

The Second World War was the last great war at sea. During the long years of the Cold War, which witnessed the rise (if for only a brief period) of the Soviet Union as a global naval power, both the Western and Soviet alliance systems devoted considerable attention to the anticipated problems of maritime air warfare. Both the Soviet Union and Western blocs produced large numbers of maritime patrol aircraft derived from long-range bombers (such as the Soviet Myasischev Bison, Tupolev Bear, Tupolev Badger, and Tupolev Backfire), airliners (notably the American Lockheed Electra - P-3 Orion, the British Bristol Britannia - Canadian Argus and the De Havilland Comet - British Aerospace Nimrod, and Soviet Ilyushin Il-18 Coot - Il-

⁸³ As was certainly seen in the Falklands, and in the Gulf wars of the 1980s and 1991.

38 May), or, in some cases as special ‘designed to task’ maritime patrol airplanes (as with the American Martin P5M Marlin and Lockheed P2V Neptune, the French Breguet Atlantic, the Soviet Berezin Be-6 Madge and Be-12 Mail, and the British Avro Shackleton).

As the threat of the new generations of sophisticated submarines carrying advanced weapons including homing torpedoes and missiles gradually emerged, more and more of these systems were designed for the anti-submarine role as opposed to attack of surface ships. The clear danger submarines posed to aircraft carriers spurred creation of specialised ship-based anti-submarine aircraft such as the French Breguet Alize and American Grumman S2F Tracker, leading eventually to a turbojet-powered successor, the contemporary Lockheed S-3 Viking, as well as a proliferation of anti-submarine helicopters. In the case of the Soviet Union, the large numbers of American aircraft carriers (and, to a far lesser extent, British, French, and other carrier forces) created its own difficulties resulting in Soviet naval aviation forces emphasising missile attack against carrier task forces using increasingly sophisticated missiles launched from long-range bombers. In turn, with the Kamikaze experience clearly in mind, carrier nations, particularly the United States, emphasised long-range fleet air defence with increasingly sophisticated interceptors, command and control, and airborne warning, eventually culminating in the Phoenix-armed Grumman F-14 Tomcat of the 1970s and beyond.

The size of American aircraft carriers dramatically rose after the early-1950s (with the first of the ‘super’ carriers, the USS *Forrestal*, constituting a departure point), reflecting the demands of the jet age. (Nations with smaller financial resources, such as Great Britain and France, continued with smaller vessels; after two decades of operating smaller helicopter carriers with V/STOL fighters - first pioneered by Great Britain - the Soviet Union finally embarked on large carrier development in the 1980s, but the breakup of the Soviet Union into a federation of independent republics put such plans on hold). Together with size came three significant innovations (adapted from British experience) that transformed American naval aviation and dramatically improved its efficiency and safety: the introduction of the angled flight deck, installation of the mirror landing system, and the introduction of the steam catapult. Ironically, as these changes improved efficiencies and safety, and as the size of aircraft carriers and their crews increased dramatically (as did the need for specialised surface escort forces guarding the carrier) the actual size of deployed carrier air forces aboard ship declined. First termed Carrier Air Groups in World War II and Korea, and then Carrier Air Wings afterwards, these forces decreased from approximately 100 aircraft (virtually all of which were ‘shooters’) per large carrier in the Second World War to approximately 75 airplanes per carrier by the time of the Gulf War, the majority of which were support or purely fleet air defence airplanes.

With the size limitations imposed on naval aircraft (no matter how large the carrier), this meant that, by the late 1980s, American naval carrier forces were increasingly dependent upon long-range land-based air forces in order to prosecute their mission - particularly in their need for aerial tanking -but also for reconnaissance, airborne warning and control, electronic warfare, global deployment and sustainability, and suppression of enemy air defences as well. Without Air Force tanker support in the

Gulf War, for example, two-thirds of the US Navy's strike sorties in the Gulf War would have had to be cancelled.⁸⁴

Ominously, the long-range and precision weapon revolutions were rendering land-based aircraft, submarines, and missile-armed small combatants increasingly dominant and effective in the maritime warfare role, as various conflicts would soon prove. The danger of these weapons increasingly forced carrier battle groups to operate further and further away from shore, degrading their traditional value as a means of projecting global presence (for presence unseen is presence unheeded) and, worse, exacerbating the already serious range problem increasingly afflicting naval aircraft operations against deep inland targets. By the mid-1990s, in response to such changes, as well as the end of the Cold War, maritime strategic thinking increasingly emphasised littoral, insular, and coastal warfare over deep strike power projection.

Fortunately, the United States and its allies never had to confront the Soviet bloc in a 'hot' maritime war. But in the many conflicts and crises that have occurred since the Second World War - and particularly in the Korean, Southeast Asian, Falklands, and Gulf conflicts - maritime air warfare has played a significant role. In Korea, the last major war in which air refuelling was not an option for military planners, the early and continuous presence of American and British Commonwealth carriers greatly assisted in the air campaign against Communist forces. But aside from maritime patrol operations against small coastal craft and for counter-mining operations, there was little in the way of an anti-shipping war.⁸⁵

During the Cuban Missile Crisis of 1962, maritime air power played a significant role in ensuring the success of the blockade the Kennedy administration placed around Castro's Cuba. Naval P-2 and P-3 patrol planes located and photographed Soviet-bloc vessels heading towards Cuba so that intelligence analysts could assess what they were carrying (a science known to intelligence analysts as 'crateology') and, where appropriate, direct naval vessels to intercept them. Less well-known is the role played by the US Air Force's Strategic Air Command which, at US Navy request, located and identified Soviet ships in mid-Atlantic. At first SAC employed KC-97 and KC-135 tankers, together with B-52 strategic bombers, in the sea surveillance role, before standardising on the excellent Boeing RB-47 Stratojet reconnaissance aircraft for the Cuban missions. The six-engine radar-equipped RB-47's eventually made a total of 374 sightings and, in one specific case recollecting the *Rex* mission of the late 1930s, successfully responded to an urgent request by the Navy to locate and photograph the Soviet tanker *Grozny*, subsequently circling this ship until a destroyer could intercept it. Altogether, SAC flew over 5,000 sea surveillance sorties during the month-long Cuban Missile Crisis, demonstrating the enduring value of strategic bombers employed in maritime roles.⁸⁶

⁸⁴ Mixon, Riley D., 'What We Must Do Better', *U.S. Naval Institute Proceedings*, 118/8/1, 1,062 (August 1991). Admiral Mixon commanded Carrier Battle Group Two in the Red Sea during the Gulf War.

⁸⁵ Cagle, Malcolm, and Manson, Frank, *The Sea War in Korea*, U.S. Naval Institute Press, Annapolis, 1957; and Richard P. Hallion, *The Naval Air War in Korea*, Nautical and Aviation Publishing Co, Baltimore, 1986.

⁸⁶ Miller, Maurice A., *The Collateral Maritime Mission of the Strategic Air Command*, SAC History Office, Offutt AFB, Nebraska, 31 December 1980, pp 35-36. This is a SAC study classified at the SECRET level; the data used above reflects declassified information downgraded by a SAF/AA declassification team assigned to the Air Force History Support Office, Bolling AFB, DC. SAC's

The Vietnam experience largely mirrored that of Korea, and witnessed a lengthy sea patrol activity, Operation Market Time, involving both shore and ship-based aircraft (typically P-2, P-3, and P-5 patrol planes, and, briefly, carrier-based A-1 Skyraiders) operating in concert with surface patrol craft. Thousands of sorties helped minimise Communist use of the sea to supply their forces. Of far more significance, however, was the growing importance and relative ease of using the so-called Ho Chi Minh trail running inland from North Vietnam through Laos and Cambodia into the South. For the most part, anti-shipping operations were but a much smaller portion of a naval air war concerned largely with air strikes against land targets. However, in May 1972, the United States resorted to mining seven North Vietnamese ports as one aspect of the air pressure campaign, forcing North Vietnam to the peace table. Mines dropped by carrier-based Grumman A-6E Intruder attack aircraft brought all maritime commerce to a halt, and stranded 27 ships in Haiphong harbour; the US Navy's Seventh Fleet commander, Vice Admiral William P. Mack, subsequently recollected that 'The North Vietnamese ran out of ammunition, just as we always said they would'.⁸⁷

Maritime air operations did not play prominently in any of the Arab-Israeli wars, or in the India-Pakistani ones, though there were some attention-getting attacks. Most notably, in the 1967 Arab-Israeli conflict, Israeli aircraft and small combatants launched a series of air and sea attacks on the intelligence vessel USS *Liberty* (then cruising off the Egyptian coast) that nearly sank the ship and, tragically, killed or wounded 205 of the crew.⁸⁸ After the war, the Israeli destroyer *Eilat*, patrolling off Suez, was sunk by a Soviet-made Styx anti-shipping missile fired from an anchored Egyptian missile boat, a harbinger of how modern rocket and jet-propelled surface and air-launched anti-shipping missiles would increasingly hold surface craft hostage. Likewise, the two India-Pakistani wars featured some maritime air operations (including anti-submarine sorties and carrier air strikes by Indian Breguet Alize and Hawker Seahawk aircraft), though these were but a sideshow to the larger conflicts being waged ashore.

THE FALKLANDS WAR

The Falklands war of 1982, however, was a notable exception. Here maritime air power had a profound effect upon surface vessel operations. Land-based Argentinean strike aircraft sank six ships (two destroyers, two frigates, a container ship functioning as an aircraft carrier, and a fleet auxiliary) and damaged a further 13 (four destroyers,

involvement in the Cuban Missile Crisis is also briefly mentioned in Bruce M. Bailey's *'We See All': A History of the 55th Strategic Reconnaissance Wing, 1947-1967*, Privately printed, 55th ELINT Association, 1982, p 111, copy in the library of the Air Force History Support Office, Bolling AFB, DC.

⁸⁷ There is a voluminous literature on the Vietnam air war. The most relevant to the naval issue are: Mersky, Peter B., and Polmar, Norman, excellent *The Naval Air War in Vietnam*, Nautical and Aviation Publishing Co, Baltimore, 1986; Nichols, John B., and Tillman, Barrett, *On Yankee Station: The Naval Air War Over Vietnam*, Naval Institute Press, Annapolis, 1987, an excellent study of the air war over North Vietnam; Uhlig Jr., Frank, *Vietnam: The Naval Story*, Naval Institute Press, Annapolis, 1986; and Marolda, Edward J., *By Sea, Air, and Land: An Illustrated History of the U.S. Navy and the War in Southeast Asia*, Naval Historical Center, Washington, DC, 1994. The Mack quote is from Mersky and Polmar, p 199.

⁸⁸ See Ennes Jr., James M., *Assault on the Liberty: The True Story of the Israeli Attack on an American Intelligence Ship*, Random House, New York, 1979.

six frigates, and three fleet auxiliaries); British carrier-ship-based aircraft and helicopters sank or forced the abandonment of six vessels (a submarine, two patrol boats, a trawler, and two freighters), and damaged another patrol boat. British maritime air superiority, gained by carrier-launched V/STOL strike fighters, enabled all other British naval and amphibious operations to occur. Air-launched missiles (the French-made Exocet used by Argentina and the British Sea Skua), fired from aircraft and helicopters, proved deadly, but so, too, did conventional bombs.

The Falklands campaign was notable for dramatically highlighting the value of anti-shiping missiles such as the Exocet and the Sea Skua, shipboard surface-to-air missiles, and (for the British) the leverage offered by the British Aerospace Sea Harrier armed with advanced air-to-air missiles (the American AIM-9L). It likewise recalled the continued vulnerability of large capital ships to submarine attack, the latter shockingly highlighted by the sinking of the Argentinean cruiser *Belgrano* by the nuclear submarine HMS *Conqueror*, with disturbingly high casualties. In particular, however, it illuminated the increasing threat to ships by maritime air attack and, especially, to the vulnerabilities of many newer vessels (less well armoured than their predecessors of the Second World War, in part because of their having heavier topsides for carrying extensive electronic equipment) to even unsophisticated and, indeed, obsolescent attackers dropping conventional non-precision 'iron' bombs. These newer ships were heavily damaged or sunk even when weapons did not explode; for example, the British destroyer HMS *Sheffield*, hit by an Exocet that failed to explode, succumbed to a fire triggered by the missile's unspent fuel. (This ominous event 'demonstrated the powerful sea denial capabilities still possessed by Argentine maritime air forces'.)⁸⁹ Likewise, the British destroyer HMS *Glamorgan* was seriously damaged by a shore-launched Exocet that hit the ship, though without detonating.

Indeed, what is often missed is that the British victory owed as much to the operational inexperience of Argentinean airmen and bomb fusing problems as it did to the skill and technological advantages of its own force. For example, of the approximately 22 bombs which struck British ships, 12 failed to detonate and one detonated late. Only nine were released high enough to arm and then detonate upon impacting a ship: but those nine were responsible for sinking two frigates, a destroyer (hit by three of the nine) and a fleet auxiliary. Thus, fully 55 per cent of Argentinean bombs failed to explode even though they hit their targets. Had they done so, it is likely at least six of the other 13 vessels damaged would have been lost - particularly two frigates hit by a total of six 1,000 lb bombs. Such destruction and damage would inevitably have so weakened the task force that it is doubtful the British task force could have continued to operate in the waters around the islands, a necessary precondition to retaking them. And that, of course, would have spelled disaster for the entire expedition.⁹⁰

⁸⁹ Royal Navy Directorate of Naval Staff Duties, *The Fundamentals of British Maritime Doctrine*, BR 1806, HMSO, London, 1995, p 193. Additionally, Annex B, 'The Falklands War 1982 from the Viewpoint of Doctrine', pp 189-195 is a useful summary of the campaign. I wish to thank Capt. Chris Page, RN, for making this work available to me.

⁹⁰ Statistics are computed on the basis of information in Ethell, Jeffrey, and Price, Alfred, *Air War South Atlantic*, Jove Books, New York, 1987, Appendixes 9 and 10, pp 252-254, and elaborated discussion from within the text. For an excellent memoir of the Falklands campaign by the commander of British forces, see Woodward, Sandy, *One Hundred Days: The Memoirs of the Falklands Battle Group Commander*, Fontana, London, 1992.

It is intriguing to speculate what such a defeat in the Falklands might have had on the subsequent history of the 1980s, particularly as the European governments confronted a Soviet Union seeking to compromise the North Atlantic Treaty Organization and the Western Alliance. Concern over the success the Argentineans were having in attacking British fleet units is clearly evident in the memoirs of key British decision makers.⁹¹ The Thatcher government likely would have fallen, perhaps fatally weakening the characteristically strong alliance of the United States and Great Britain that did much to bolster European resistance as NATO faced the Soviet Union in the latter - and most serious - years of the Cold War. The loss of a sea war thousands of miles from Europe might thus have resulted in a dramatically different end - if indeed it *did* end - to the Cold War. (Such potentially profound outcomes continue to be possible risks of far-flung regional contingencies should naval forces lacking robust friendly air power come under modern air attack.)

SINCE THE FALKLANDS

The lessons of the Falklands war were not lost on the world's navies, particularly as the conflict demonstrated the leverage that newer weapons could offer even a small opponent confronting a naval power. Accordingly, naval planners increasingly emphasised reliance upon a diverse means of defensive measures, including the application of stealthy 'low observable' technologies in shaping and materials to reduce the radar signature return of surface vessel; long-range early warning coupled with (if possible) long-range engagement of air and missile threats; and, finally, close-in gun and rapidly blooming chaff deployment defences to defeat aircraft and missiles in terminal 'end-game' engagements.

Despite such efforts, subsequent encounters in the Mediterranean, the Persian Gulf, and, finally, the Gulf War of 1991 itself, have reaffirmed the continued vulnerability of surface forces to precision air and missile attack. As the modern day main battle tank offers little protection against the sophisticated aerial attacker armed with a precision munition, so, too, is the ship likewise held hostage. In March 1986, in the Gulf of Sidra, Navy carrier-based attack aircraft firing Harpoon air-to-surface missiles and dropping cluster bomb munitions, sank three Libyan missile boats that threatened an on-going Sixth Fleet exercise.⁹² The next year, two Exocet missiles fired by an Iraqi Dassault Mirage F-1 fighter hit the frigate USS *Stark*, on patrol in the Persian Gulf, killing 37 American seamen and so damaging the ship that only the heroism and extraordinary professionalism of its crew prevented its sinking. A year later, following a series of Iranian escalations, including vicious air and sea attacks against civilian tankers in the Persian Gulf, and the near-sinking of the frigate USS *Samuel B. Roberts* by an Iranian mine, US naval aviation and surface forces attacked Iranian oil platforms and ships. In a single day they sank over half the Iranian navy, thanks, in

⁹¹ For example, the previously cited Woodward, *One Hundred Days*, and, particularly, Thatcher, Margaret, *The Downing Street Years*, Harper Collins Publishers, London, 1995, particularly pp 216-217, 225-235.

⁹² For an excellent memoir of these operations across the so-called 'Line of Death', see Stumpf, Robert E., 'Air War With Libya', *U.S. Naval Institute Proceedings*, 112/8/1002, Aug 1986, pp 42-48.

large measure, to the leverage offered by naval aviation forces armed with laser-guided bombs and anti-shipping missiles.⁹³

The Gulf War of 1991 left memorable images of bombs flying through doors and elevator shafts, and cruise missiles literally cruising down streets; while, to most observers, the war consisted of the air campaign against Iraqi leadership targets and Iraq's fielded military forces, there was a strong maritime warfare component to the Gulf crisis and subsequent war as well. From the onset of the crisis, long-range maritime patrol aircraft worked with surface vessels to impose a tight blockade over Iraqi merchant traffic attempting to transit the Straits of Hormuz. Then, during the war itself, there were sporadic actions by coalition attackers against Iraqi fleet elements.

During the Battle of Khafji, a coastal town in Saudi Arabia where Saddam Hussein attempted a premature triggering of the ground war in hopes of inflicting heavy Coalition losses, British land-based Jaguar strike fighters sunk or damaged 15 small Iraqi boats by unguided air-to-ground CVR-7 rocket fire. On January 29, 1991, U.S. naval aircraft detected four Iraqi missile boats and other combatants fleeing to Iran. A Grumman A-6E Intruder sank two of the boats with laser-guided bombs, and then 'buddy lased' for a McDonnell-Douglas F/A-18 Hornet which sank a third; the fourth was strafed and damaged by a Canadian CF-18 Hornet, though it made an Iranian port. On January 30, during over 20 separate encounters subsequently dubbed the 'Bubiyah Turkey Shoot', naval aircraft and helicopters from the coalition nations savaged the Iraqi navy, destroying or damaging 19 Iraqi vessels, including seven missile boats, three amphibious ships, and a minesweeper. Thanks to this air action, the Iraqi navy played no further useful role in the war.⁹⁴

Iraq nevertheless had one possible trump card remaining: shore-launched Chinese-built Silkworm anti-shipping missiles. Fears of these weapons - which previously Iran had used against Persian Gulf shipping during the Iran-Iraq war - compelled a lengthy anti-Silkworm strike effort reminiscent, in some respects, to the 'Great Scud Hunt' ashore. The concerns over the Silkworm, coupled with lingering fears that the Iraqi air force might possibly attempt to emulate its earlier success against the USS *Stark*, resulted in the diversion of considerable coalition air effort simply to ensure the security of coalition naval forces. This was, of course, effort thus diverted away from more significant Iraqi target sets.

⁹³ Palmer, Michael A., *On Course to Desert Storm: The United States Navy and the Persian Gulf*, Naval Historical Center, Washington, DC, 1992, pp 114, 133, 142-144; and Lehman John., *Command of the Seas*, Charles Scribner's Sons, New York, 1989, pp 392-395.

⁹⁴ de la Billière, Peter, *Storm Command: A Personal Account of the Gulf War*, Collins Publishers, London, 1992, p 255; Vallance, Andrew, 'Air Power in the Gulf War: The RAF Contribution', *Air Clues: The Royal Air Force Magazine*, 45, No. 7, July 1991, pp 251-254; Rondot, Mike, 'Jaguar Sorties' and 'UK in the Gulf,' *Aircraft Illustrated*, 24, No. 4, April 1991, pp 177-179, 184-185; additionally, I have consulted Marolda, Edward J., and Schneller, Robert J., *Shield and Sword: The United States Navy and the Persian Gulf War*, an unpublished manuscript by the Naval Historical Center, August 1995, pp 241-243

MARITIME CONTROL: THE ENDURING NEED FOR JOINT SOLUTIONS

Because of the twin revolutions of the submarine and the airplane, it is impossible for surface naval forces today to operate with the assurance and the confidence that they are masters of their own fate as was true in previous centuries. Such has been particularly true since the advent of maritime aviation. Contemporary post-Falklands British maritime doctrine, for example, frankly states that:

The minimal requirement for a successful [maritime] operation is a *favourable air situation*. *Air superiority* will be a requirement for sea control where a robust challenge from the air is possible. *Air supremacy* is a necessary precondition of command of the sea.⁹⁵

On the eve of the next millennium, it is worth noting that as the first millennium of the common era was one of predominant land power (typified by Rome), and the second one of predominant sea power (typified by Great Britain), the third millennium is increasingly one characterised by the dominance of air and space warfare.⁹⁶ Indeed, it has already come to pass: the dominant form of power projection for not only air forces but for those of armies and navies is already the air weapon, for example the ship-launched cruise missile, helicopter, or strike airplane, or the army battlefield missile system or attack helicopter (the latter which has essentially supplanted the tank as arbiter of the modern battlefield), or the submarine with a long-range strategic ballistic missile or shorter-range cruise missile. All services thus necessarily have a piece of the air power equation, though only a genuine air force has the combination of doctrine, technology, and undivided focus to use air power broadly and to its greatest effect.⁹⁷

Air power at sea has made its mark on naval warfare since the time of the First World War. While currently the United States is the only truly global naval power - as it is the only truly global air power - the proliferation of increasingly sophisticated weapons among smaller nations in unstable regions offers no confidence to those who would blithely assume that American maritime supremacy - and that of friendly nations - will remain unchallenged, particularly in far-flung regional contingency operations. As the Second World War clearly showed the vulnerability of surface ships to attackers armed with 'dumb' weapons, the wars since the mid-1960s have increasingly highlighted how even more vulnerable surface vessels are to attack by precision missiles and bombs. In the case of the Falklands, for example, only the narrowest of margins separated victory from defeat for Great Britain. In fighting in the Gulf before and during the Gulf War of 1991, hostile action severely damaged four US Navy ships: two frigates, a small aircraft carrier, and a sophisticated AEGIS-class cruiser, all of which required lengthy and costly repairs. The weapons that accomplished this were two Exocet missiles and three mines. For the present, concern over such weapons and their more advanced successors threatens to constrain both the

⁹⁵ RN, *The Fundamentals of British Maritime Doctrine*, p 68. [emphasis in original text]

⁹⁶ This notion of 'millennial' warfare is from Air Chief Marshal Sir Patrick Hine, RAF (ret.) and Group Captain Andrew Lambert, RAF. I wish to acknowledge their contributions to my thinking on this topic.

⁹⁷ For an elaboration of this argument, see Hallion, Richard P., 'The Future of Air Power', *The Royal United Services Institute Journal*, 139, Number 5, October 1994, pp 23-29.

traditional freedom of manoeuvre of surface naval forces and options regarding their use. For the future, maintaining maritime supremacy, particularly on the regional level, without being compromised by such cheap and readily available means obviously constitutes a major challenge to defence planners.⁹⁸

Fully appreciating the lessons of eight decades of maritime air warfare inevitably reaffirms the recognition that maritime supremacy requires a joint-service approach to maritime warfare, an approach more appreciative of the role of land-based air power. Historically, the partnership between sea-based air and submarine forces, and land-based aviation has been the most productive means of thwarting an enemy's attempts to seize local control of the sea. Indeed, virtually all significant naval actions of this century have taken place within reach - and with the involvement - of land-based aviation forces.⁹⁹ Today, in a post-Cold War cost-conscious environment, the advantages of having land-based aviation forces assume a greater role in maritime control operations is increasingly attractive to defence planners, particularly as the acquisition and operating costs of naval aviation are correspondingly increasingly expensive.

A number of circumstances have led to this. First, operating costs for carrier-based aircraft, as a rule of thumb, run three to four times as much as a land-based aircraft. Then, there are the lag times between deployment to a crisis region of naval aviation forces (which traditionally deploy at the speed of their surface vessels) and land-based air: in the Gulf war, for example, aircraft carriers took up to a month to reach the theatre from the United States, while Air Force airplanes deployed in nonstop 15 hour, air-refuelled journeys. Also, on-station times of naval task forces on 'presence' operations are at best sporadic, as they are driven by the need to replenish and resupply vessels; in contrast, as operations in the Persian Gulf region since the Gulf War and in the Adriatic during the Bosnian crisis have clearly indicated, land-based air power offers virtually 100 per cent presence. (Sortie rates for American forces in Operation Southern Watch (Southern Iraq) and Operation Deny Flight (Bosnia) reflect the persistency of land-based air power; in each operation, approximately 70 per cent of all sorties have been by the Air Force, with naval forces - the USN and USMC - responsible for the remaining 30 per cent.) Finally, there are the relatively large 'tooth to tail' ratios for naval forces, wherein a large number of ships and personnel are required to maintain a relatively small number of deployable strike aircraft.¹⁰⁰

Fortunately, land-based air power projection forces can be readily employed in most crisis and regional contingency situations, off-setting such traditional problems and, indeed, acting as effective substitutes for the traditional carrier on missions of presence. In October 1995, the Air Force established an important precedent when it deployed an Air Expeditionary Force (AEF) to the Persian Gulf to fill a void left when an aircraft carrier had to depart from the Gulf; its replacement was not scheduled to

⁹⁸ For example, see Weiner, Tim, 'Cruise Missile is Test-Fired From a Ship by Iran's Navy', *New York Times*, 31 January 1996, p 5. See also Keegan, *The Price of Admiralty*, p 327.

⁹⁹ Or, as Keegan puts it, 'Almost all naval battles, throughout the history of war at sea, have been fought in close proximity to land', p 325.

¹⁰⁰ See McPeak, General Merrill A., USAF, *Presentation to the Commission on Roles and Missions of the Armed Forces*, HQUSAF, Washington DC, 14 September 1994, pp 79-85, for a provocative discussion of these issues.

arrive for over two months. Eighteen Lockheed-Martin F-16 jet fighters deployed from the continental United States with live munitions, and were flying sorties 12 hours after landing in Bahrain, in concert with other Air Force aircraft already in theatre. Twelve of these 18 mounted sophisticated LANTIRN targeting and navigation pods enabling them to use precision munitions, while the other six were configured for firing HARM anti-radiation missiles for air defence suppression. The subsequent experience of this AEF validated the concept of using land-based aircraft as a quick, flexible, responsive, and effective means to project global presence and influence.¹⁰¹

As experience has shown, it is vitally important that air forces and navies work together in partnership (particularly for the United States) for the teaming of land-based aviation forces and traditional naval forces can synergistically and dramatically improve the operating efficiencies of both. Land-based aviation can work to help defeat two of the greatest threats confronting modern surface forces: the mine and the submarine. The view and awareness available from Air Force-operated space-based systems and from long-range land-based intelligence and command and control aircraft offer tremendous leverage to naval forces. Further, explicit capabilities inherent in the modern Air Force - long-range air surveillance and control, high-volume aerial tanking, and long-range maritime patrol by strategic bombers (such as B-52's carrying mines and Harpoon anti-shipping missiles) are particularly well suited for supporting sea control and access denial missions. (Many of these attributes are found in smaller air forces as well, exemplified by the Norwegians employing Penguin anti-shipping missiles on their F-16 strike aircraft, or the Australians who have successfully married the Harpoon anti-shipping missile to the F-111C). The tremendous investment in low observable 'stealth' technology, manifested in the Lockheed F-117, Northrop-Grumman B-2, and the upcoming Lockheed-Martin F-22 can both ensure greater survivability of friendly naval forces and can hold hostile naval forces hostage. This is particularly true for air superiority operations in constrained waters where an exclusively naval force may be unable to operate freely, or where an enemy's anticipated air defences may pose grave dangers to conventional (ie: non stealthy) naval attackers, necessitating stealth strikes to clear the way. Greater interoperability of traditionally land-based systems from naval platforms offers yet another potential synergistic benefit of joint activity.

In sum, then, the pace and impact of aviation in the twentieth century has been extraordinary, and nowhere more so than in military affairs. Less than forty years after the Wright brothers flew at Kitty Hawk, the airplane - both land - and sea-based - had evolved from threatening to dominating the ship. That dominance has been extended even more forcefully into the modern era in spite of intensive and creative efforts to improve shipboard defences. In today's world, the threat posed to the ship by the airplane or the aircraft-deployed missile or mine is at its greatest. If for no other reason than this, strengthening the traditional partnership of air forces and navies

¹⁰¹ Discussed in Fogleman, Gen. Ronald R., 'Air Power and the American Way of War,' a speech before the Air Force Association Air Warfare Symposium, Orlando, Florida, 15 Feb. 1996. See also Graham, Bradley, 'In Carrier's Absence, U.S. Sending 18 Jet Fighters to Bahrain', *The Washington Post*, 24 October 1995, p 13. I wish to acknowledge additional information received from Capt. Bruce Roehm, CSAF Operations Group, AF/CCX, regarding this deployment.

working together to ensure the defeat of their common enemies is no less important today than at any time earlier in this century.