REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
30-04-2016	Master's Thesis	Oct 2015 - Mar 2016

4. TITLE AND SUBTITLE
The Evolution and Employment of Twentieth Century Auxiliary Cruisers: A Successful Example of Asymmetric Warfare

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Mason, Tyler L.

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
United States Marine Corps Command and Staff College
2076 South Street
Quantico, VA 22134-5068

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
United States Marine Corps Command and Staff College
Marine Corps University
Marine Corps Combat Development Command
2076 South Street
Quantico, VA 22134-5068

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release; Distribution is Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

During both World Wars, Germany sought to disrupt the network of Allied overseas resources by atacking its opponents' seaborne commerce through the use of submarine and surface raiders. The freighters that Germany transformed into auxiliary cruisers, though less impressive than regular warships, usually survived longer at sea due to their disguised exteriors, and thus had more opportunities to disrupt Allied trade than other surface raiders. Auxiliary cruisers also had greater fuel storage capacity than many other vessels, particularly U-boats, which permitted them to operate indepdendently for extended periods in areas such as the South Atlantic, Indian, and Pacific Oceans. The destruction they wrought on merchantmen in these waters forced the Allies to divert valuable military assets and resort to convoys. Their activities, including mine laying, also caused Allied shipping rates and insurance costs to increase. This paper explains the impact of auxiliary cruiser warfare through case studies of two raiders. The first vessel patrolled the Indian Ocean from 1916 to 1918, and the second from 1940 to 1941.

15. SUBJECT TERMS
Auxiliary Cruisers, Surface Raiders, Asymmetric Warfare, Word War One, World War Two

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER *(Include area code)*
Unclassified	Unclassified	Unclassified	UU	33	

United States Marine Corps
Command and Staff College
Marine Corps University
2076 South Street
Marine Corps Combat Development Command
Quantico, Virginia 22134-5068

MASTER OF MILITARY STUDIES

The Evolution and Employment of Twentieth Century Auxiliary Cruisers: A Successful Example of Asymmetric Warfare

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

Tyler L. Mason

AY 15-16

Mentor and Oral Defense Committee Member: Dr. Douglas E. Streusand
Approved: [signature]
Date: 31 March 2016

Oral Defense Committee Member: Dr. Paul D. Gregor
Approved: [signature]
Date: 31 March 2016

Executive Summary

Title: The Evolution and Employment of Twentieth Century Auxiliary Cruisers: A Successful Example of Asymmetric Warfare.

Author: Tyler L. Mason, U.S. Department of State

Thesis: Germany's investment in auxiliary cruisers as commerce raiders during both World Wars constitutes a successful example of asymmetric warfare because the Allies devoted far greater resources to eradicating them than the Germans did in operating them, and they caused significant disruption to Allied commerce.

Discussion: During both World Wars, Germany sought to disrupt the network of Allied overseas resources by attacking its opponents' seaborne commerce through the use of submarine and surface raiders. The freighters that Germany transformed into auxiliary cruisers, though less impressive than regular warships, usually survived longer at sea due to their disguised exteriors, and thus had more opportunities to disrupt Allied trade than other surface raiders. Auxiliary cruisers also had greater fuel storage capacity than many other vessels, particularly U-boats, which permitted them to operate independently for extended periods in areas such as the South Atlantic, Indian, and Pacific Oceans. The havoc they wrought on merchantmen in these waters forced the Allies to divert valuable military assets and resort to convoys. Their activities, including mine laying, also caused Allied shipping rates and insurance costs to increase. This paper explains the impact of auxiliary cruiser warfare through case studies of two raiders that patrolled the Indian Ocean, the SMS *Wolf*, active from 1916 to 1918, and HSK-8 *Kormoran*, active from 1940 to 1941.

Conclusion: Although the age of the auxiliary cruiser may have ended, they are a successful example of asymmetric warfare and their tactics, e.g. using subterfuge to increase survivability and overcome enemies, are worth studying today. A review of auxiliary cruiser operations might also provide insight into the means by which nations with smaller, less powerful navies attempt to engage the United States (U.S.) in future conflicts, particularly in the event that modern, automatic ship identification systems are compromised.

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

Table of Contents

Page

Preface

During an assignment at the U.S. Consulate General in Chennai (formerly known as Madras) almost a decade ago, I was surprised to learn that an oil storage facility in the city's harbor had been bombarded by the German light cruiser SMS *Emden* in 1914. This led to an interest in the history of commerce raiders, particularly the armed freighters that disrupted trade during the First and Second World Wars. At the time I never imagined I would have the opportunity to write about them, or that they might have something to offer to modern military strategists as well as aficionados of naval history. Although terrorists firing shoulder-launched rockets from a dhow are now more likely to sink a U.S.-flagged vessel than the 15-centimeter (cm) shells of an auxiliary cruiser, the tactics are similar, e.g. using subterfuge to approach within range. Moreover, seaborne mines, which auxiliary cruisers deployed to good effect, remain viable weapons to the present day.

I would like to take this opportunity to thank my research advisor, Dr. Douglas Streusand, whose guidance and encouragement have been instrumental in completing this paper. I am also grateful to my wife, Mercedes, who has supported me in this and many other endeavors throughout our marriage.

INTRODUCTION

Germany attacked Allied commercial shipping with varying degrees of success in both World Wars. Scholars and historians have written volumes about German attempts to strangle trade through the use of submarine warfare. However, they have devoted less study to the impact of surface raiders, particularly the merchant vessels that the German Navy armed and sent abroad to disrupt Allied shipping, known as auxiliary cruisers (*Hilfskreuzer*).[1] The auxiliary cruisers that Germany appropriated during the latter half of World War I (WWI) as well as World War II (WWII) had great range and endurance, permitting them to sink shipping in Indian and Australian waters—areas the Allies once considered safe from danger. Auxiliary cruiser predations forced the Allies to divert naval assets from the main theatres of war for trade protection duties, and influenced their decision to adopt a convoy and routing system that delayed deliveries during both World Wars, causing commercial shipping rates and insurance costs to increase. Although the Allies eventually drove German auxiliary cruisers from the seas, they represent a successful example of asymmetric warfare because of the vast amount of naval and intelligence resources the Allies devoted to eradicating them, and the disproportionate impact they exerted on Allied commerce.

Although the ideas of Alfred Thayer Mahan shaped German naval strategy prior to WWI, German commerce raiding during both World Wars followed the doctrine of the French naval strategists of the Jeune École of the 1880s.[2] The French theorists contended that commerce raiding—*guerre de course*—would drive up insurance costs, immobilize the British merchant fleet, and force Britain to sue for peace. According to Theodore Ropp, the Jeune École's ideas stemmed from observations of the wars of 1854 to 1871:

> Much of the damage suffered by American shipping during the Civil War was due to an owners' panic; a similar panic might disrupt the whole of British economic life. The first proposals for national insurance against war shipping losses were supposed to give the

> government far too much power over business and many shipowners felt that their only salvation would be mass transfer to neutral flags. The economic disorganization attending such a panic was one of the *Jeune Ecole's* [sic] main strategic purposes.[3]

The Germans initially believed the most important aspect of an auxiliary cruiser to be speed with which to break through an enemy blockading fleet and hunt down quarry. Hence, the first generation of German auxiliary cruisers consisted of large, fast passenger liners. These vessels could maintain speeds of over 20 knots, but consumed fuel rapidly and had not been equipped with extra coalbunkers so their range and endurance were limited. Moreover, they were easily identifiable due to their distinctive, undisguised profiles. These factors shortened the careers of first generation auxiliary cruisers; the raiders that were not sunk ended up interned in neutral ports as their supplies ran out.

This experience taught the Germany Navy that endurance and stealth trumped speed for commerce raiding. In August 1915, a young naval reserve officer named Theodor Wolff submitted a memorandum contending that cargo vessels would make the best commerce raiders. Although slower than warships or passenger liners, freighters consumed less fuel and had greater storage capacity for food, fuel, and ammunition. Moreover, unlike a submarine, such a ship could be sent on a long-range trade disruption mission and operate within the Hague rules of sea warfare.[4] The next generation of German WWI auxiliary cruisers, which included the SMS *Wolf*, relied on endurance and subterfuge to accomplish their missions.

CAREERS OF SHIPS

The raider SMS *Wolf* began her career as the freighter *Wachtfels* in 1913. She was one of seven cargo vessels built by the Flensburg shipbuilding company (Flensburger Schiffbau-Gesellschaft) between 1913 and 1915 for the German steamship company Hansa. She was 135 meters in length, with a displacement of 11,200 tons, driven by a coal-fueled steam engine that could generate a maximum speed of 10.5 knots.[5] The conversion process took six months, and

involved the installation of camouflaged torpedo launchers, primary and secondary guns, and mine laying equipment. Her masts and funnel were modified so their dimensions could be changed at sea, her decks were compartmentalized to secure supplies or prisoners, and her fuel capacity was increased. Carrying her maximum load of 6,300 tons of coal, *Wolf* could range up to 42,000 nautical miles at a speed of 9 knots without refueling.[6] With expanded coalbunkers, the *Wolf* was expected to have enough fuel for a six-month voyage. However, she would remain at sea far longer by refueling from prize ships.

The *Wolf's* captain, Karl August Nerger, was a career officer who had joined the navy in 1893 at age nineteen. Nerger was one of the few men in the German Imperial Navy with combat experience before the outbreak of WWI. As a lieutenant aboard the SMS *Iltis*, his gunboat exchanged fire with the Dagu forts during the Chinese Boxer Rebellion in 1900. Additional action as commander of the light cruiser SMS *Stettin* during the Battle of Heligoland Bight in 1914 solidified his reputation as efficient, calm under fire, and exceedingly lucky. The German Admiralty (Admiralstab) considered all of these traits in selecting Nerger to command the *Wolf*, particularly his apparent good luck.[7] However, another trait contributed to the *Wolf's* success more than luck, namely Nerger's almost obsessive penchant for secrecy. Nerger's operational security concerns probably stemmed from his knowledge of the fate of another auxiliary cruiser, the SMS *Greif*, intercepted and destroyed by the British several days after leaving port in February 1916.

Nerger received orders to mine the approaches of Britain's most important colonial ports in South Africa and India, and the trade routes between them. He was to begin with Cape Town and then mine five additional ports in whatever sequence he saw fit from a list that included Karachi, Bombay (Mumbai), Colombo, Calcutta (Kolkata), Rangoon (Yangon), and Singapore. His orders continued: "After execution of the mining tasks, war on commerce is to be pursued

until all resources are exhausted. The choice of operation area is left to your own judgment. Main objective for attack is the grain trade from Australia to Europe, which continues throughout the year."[8]

On November 30, 1916, approximately one week ahead of her expected departure date, due to her commander's obsession with operational security, the vessel that would become the *Wolf* steamed forth from Kiel in the guise of an innocent merchantman. Once offshore, the crew painted over the freighter's name, took on a cargo of 465-horned contact mines from a supply ship, and rendezvoused with a Friedrichshafen FF.33E floatplane that had been kept secret from the crew.[9] This aircraft, subsequently known as the Wolf Cub (*Wölfchen*), would perform a valuable reconnaissance role as the mission progressed. After hauling the floatplane aboard, the ship that had become the SMS *Wolf* proceeded into the North Sea. To avoid the British blockade, she steamed 1,300 uneventful kilometers (km) to the northwest, then cruised down the 290 km wide Denmark Strait between Iceland and Greenland into the Atlantic Ocean. December 1916 passed quietly as the *Wolf* progressed toward South African shores.

Offensive action began January 16, 1917, when *Wolf* mined the waters off Cape Town, South Africa, which would cause the destruction of four ships (one neutral and three British) totaling 21,358 tons. *Wolf* then headed for Colombo in what is today the country of Sri Lanka. Along the way, the crew painted the ship's exterior from white to black and altered the funnel's dimensions. *Wolf* approached Colombo on February 15, and laid a string of mines across the harbor entrance during the night. As *Wolf* steamed toward Bombay the next day, her wireless operator picked up a distress call from the 7,175-ton British freighter *Worcestershire*, indicating the vessel had struck a mine and was sinking. From February 15 to 20, 1917, *Wolf* mined the sea-lanes approaching Bombay. These mines would cause the destruction of five more British ships and one Japanese vessel totaling 36,711 tons. By the end of February, *Wolf* had captured

her first prize, the 5,528-ton British tanker *Turritella*. By the time the *Wolf* steamed back into the sanctuary of Kiel flying a lengthy paying-off pennant, she had taken two prizes, sunk twelve vessels through direct action with a combined Gross Registered Tonnage (GRT) of 38,391 tons, and laid mines that claimed thirteen ships totaling 75,888 tons.[10] *Wolf* had spent 451 days at sea—far longer than anticipated by the staff of the German Admiralty—by replenishing coal stocks and reprovisioning from the ships she had intercepted. The SMS *Wolf* arrived in Kiel on February 24, 1918, carrying 467 prisoners of war, along with large quantities of rubber, copper, and other war-related materiel.

Germany ceded the *Wolf* to France at the close of the war, and she served as a commercial vessel until scrapped in 1931. Although promoted and feted as a returning hero, Captain Nerger retired from the German Navy in 1919 to embark on a civilian career with the Siemens conglomerate in Berlin. Nevertheless, Nerger remained involved in naval affairs, and in 1936 he compiled a report at the request of the Sea Warfare Command (Seekriegsleitung) that served as a guide to prepare for WWII surface raiding operations.[11]

HSK-8 *Kormoran*, also known as Raider G to the Allied forces that hunted her, was the largest and heaviest of Germany's WWII auxiliary cruisers. *Kormoran* began life as the cargo vessel *Steiermark*, built for the Hamburg America Line in 1938 at the Germania shipyard in Kiel. Technicians equipped and disguised *Kormoran* in a similar manner to the *Wolf*, based on Captain Nerger's 1936 report. However, she was significantly larger and faster than the *Wolf*, displacing 8,736 tons and capable of a maximum velocity of 18 knots. *Kormoran's* fuel storage capacity was 17.5% less than that of the *Wolf*, but the ship's diesel-powered engines doubled *Kormoran's* operating range.[12] The four 9-cylinder diesel engines permitted *Kormoran* to overtake many of the commercial vessels she encountered, but she was not fast enough to outrun British warships that hunted her, relying on subterfuge and caution for protection instead.

Kormoran's captain, Commander Theodor Detmers, joined the German navy in 1921, also at the age of nineteen. This was a remarkable career choice at the time, considering the limited prospects for advancement in Germany's much smaller post-WWI navy, and Detmers' upbringing in the industrial Ruhr region rather than a coastal area or Hanseatic city with a seafaring tradition. Prior to receiving his first command—a torpedo boat—in 1934, Detmers twice visited the Indian Ocean while serving aboard light cruisers. On one of these voyages, his vessel made a port call in Australia, during which he and fellow German officers attended a reception aboard the HMAS *Canberra*, an Australian heavy cruiser.[13] By 1938, Detmers had advanced to command of a new destroyer, the Z7 *Hermann Schoemann.* His destroyer participated in anti-commerce and mine-laying operations during the first year of WWII. These activities, along with his prior international experience, probably influenced Detmers' selection to command the *Kormoran*. At the time of his selection, Detmers was thirty-eight years old. He proved to be the youngest officer to command a German auxiliary cruiser in WWII. Although Detmers was somewhat ascetic and banned liquor from his vessel, he enjoyed sharing meals with his men, a habit he may have picked up in the close confines of a torpedo boat.

The Sea Warfare Command ordered Detmers to search the Atlantic for targets of opportunity, then to seek and destroy Allied shipping in the Indian Ocean and to mine one or more British ports in India or Australia. *Kormoran* was also expected to resupply U-boats during her journey, and she carried spare parts and torpedoes for this purpose. However, *Kormoran's* primary mission was trade disruption.

After two months of training in the Baltic Sea, *Kormoran* embarked on her war patrol December 3, 1940, in the guise of a Soviet freighter. Like her predecessor, she broke into the Atlantic via the arduous Arctic route through the Denmark Strait. However, *Kormoran* made the journey much faster, slipping past the British Northern Patrol under cover of foul weather.

Rather than heading directly for Cape Town as *Wolf* had done, *Kormoran* initially prowled the western mid-Atlantic outside the Pan-American security zone, then proceeded southeast toward the African coast, taking eight ships over a three-month span before heading into the Indian Ocean. She also rendezvoused several times with U-boats or logistical support vessels to offload or take on fuel and provisions, as well as disembark prisoners. Detmers chose to hunt farther offshore after arriving in the Indian Ocean to reduce the chances of encountering enemy aircraft or warships. During the journey, the crew changed *Kormoran's* disguise to a Japanese and then a Dutch vessel to match local shipping patterns. Although supplied with mines and under orders to mine at least one British colonial port, *Kormoran's* career ended before she did so. Detmers would linger too long in Australian waters after deciding to delay a mining operation off Perth.

Kormoran's voyage culminated in a mutually destructive battle with the Australian light cruiser, HMAS *Sydney*, on November 19, 1941. All 645 hands perished with the *Sydney*, but most of *Kormoran's* crew survived and were taken prisoner when severe engine damage forced them to scuttle several hours after the battle. There are no Australian eyewitness accounts of the engagement, but a detailed investigation of both wrecks, discovered in 2008, corroborated the German version of events.[14] *Sydney* had approached too close while attempting to verify *Kormoran's* identity, which allowed the Germans to bring their primary and secondary guns to bear in the opening moments of the engagement. A combination of rapid, accurate gunnery destroyed *Sydney's* bridge, director control tower (range finding system), and wireless room during the opening moments of the battle. Considering the almost immediate loss of command and control, the continuing high volume of German fire, and the subsequent torpedo impact near *Sydney's* bow, it is a tribute to her gun crews—particularly the crew of X turret—that *Sydney* managed to return fire and critically damage *Kormoran's* engine room. Several days after scuttling their vessel, 317 *Kormoran* survivors were rescued and became prisoners of war in

Australia, including Commander Detmers.[15] Detmers was repatriated in 1947, and medically retired from the German Navy at the rank of Captain due to a stroke he suffered while in captivity.

Kormoran sank ten merchant ships prior to her duel with the *Sydney*, and captured one additional vessel, the tanker *Canadolite* that was sent home as a prize. *Kormoran* had sunk or captured a total of 68,274 GRT of Allied shipping during her 351 days at sea.[16] It is interesting to note that the WWI auxiliary cruiser SMS *Greif*, mentioned earlier, dispatched the HMS *Alcantara* in a similar, mutually destructive manner when the British vessel approached to less than 1,800 meters in an attempt to confirm *Greif's* true colors.[17] However, in this instance, the German ship sank first and sustained more casualties.

CONTINUITY AND CHANGE

Although some differences are apparent in how the captains chose to pursue their missions, the purpose of auxiliary cruisers—trade disruption—remained the same during both conflicts. Other examples of continuity include auxiliary cruiser operational areas, use of subterfuge as an offensive and defensive tactic, camouflaging techniques, and, in some instances, armament. The ships' main guns and range finding equipment would remain the same during both wars, but German communications technology—already superior to the British in WWI—and auxiliary cruiser communications security would be more advanced in WWII. The German naval logistics system would also evolve. Arguably the most important changes and greatest advancements pertained to fuel sources and engine capacities. As noted earlier, the SMS *Wolf* was coal-fueled and her maximum speed was several knots slower than any of the diesel-powered auxiliary cruisers of WWII.[18] Switching to diesel oil extended the cruising endurance of Germany's WWII vessels. It also facilitated at-sea refueling operations, as oil can be more

easily transferred at sea than coal.[19] The Appendix contains a table listing the range, endurance, armament, and other statistics for both vessels.

Auxiliary cruiser camouflage during both wars included hinged, drop-down hull plating, false bulkheads, and spring or counterweight systems that covered guns with fireboxes or cable drums. In *Wolf's* case, a special hatch was fitted on the starboard side of the hull under the poop deck to drop mines overboard in a stealthy manner. *Kormoran's* mines were transported on wheeled trolleys that ran on small tracks from their storage area below deck to the stern, where they could be dropped overboard through hidden openings. In both instances, the mine laying equipment was concealed. *Wolf's* funnel was encased in a faux outer shell that would allow the crew to alter its height or width, and telescopic masts were installed to further mask the ship's profile. *Kormoran* and other WWII auxiliary cruisers were similarly camouflaged, and all of them carried copious amounts of paint, canvas, and carpentry supplies to alter their identities at sea.

Wolf's primary armament consisted of seven 15-cm guns, six of which were hydraulically mounted and concealed by the drop-down bulwarks mentioned above. The seventh 15-cm gun, mounted on the stern, was disguised as a derrick. The main armament of WWI and WWII auxiliary cruisers consisted of 15-cm SK L/45 guns that first entered service in 1908 and continued in limited production through the early 1920s.[20] *Kormoran* was equipped with six 15-cm SK L/45 guns, which apparently came from WWI-era warships such as the SMS *Seydlitz*.[21] Although the same caliber, the SK/L 45 guns on *Kormoran* were not as powerful as the 15-cm SK C/25 guns on the German Navy's regular WWII warships, e.g. its Leipzig-class light cruisers.

Wolf represented a great leap forward in technology for WWI auxiliary cruisers, and would set the standard for WWII raiders, because she was equipped with the fire control system

of a regular German warship of the time period, which considerably enhanced the accuracy of her main guns. According to Ryan Noppen, "*Wolf* was equipped with a modern range finder and firing coordinates were relayed to gun batteries, giving the raider the same degree of fire control as a proper warship."[22] Though some improvements in German range-finding technology were made during the inter-war period, WWII auxiliary cruisers would rely on essentially the same system. (The German Navy employed stereoscopic rangefinders during both World Wars.) The gunnery officer determined distance using a three-meter optical rangefinder once the auxiliary cruiser revealed itself as a warship. In the meantime, this large piece of equipment was camouflaged as a water tank or some other item to conceal its true purpose. Robert Forczyk describes the range-finding procedures of WWII auxiliary cruisers below.

> Since the large rangefinder could not be used before a raider dropped its disguise, the gunnery officer covertly employed a hand-held rangefinder during the approach to combat. Once the large rangefinder was unveiled, firing data was transmitted to the gun batteries by means of an elderly model 1910 telegraph system, allowing coordinated salvoes. Using stereoscopic rangefinders required very well-trained gunnery staff, but allowed the *Hilfskreuzer* [auxiliary cruisers] to get off rounds much quicker than the slower British system. Yet the fire-control system on *Hilfskreuzer* was very vulnerable to splinter damage and was not very effective beyond 12,000 yards [10,973 meters].[23]

By centering a mark on the target's mid-ship area, German gunnery officers tended to ascertain range more rapidly than their British counterparts. British range finding equipment produced two pictures of a target, which had to be merged to determine its range. The British coincident system was slower, as Forczyk noted, but more precise at long distance targeting.[24] German 15-cm gunfire was very accurate at distances of 4,000 meters or less, due to the technology employed as well as frequent gunnery practice, but at 8,000 meters gun crews only hit their targets five percent of the time. The probability of scoring a hit dropped to one percent by 13,500 meters.[25]

Wolf's secondary armament consisted of three 5.2-cm SK L/55 guns that could be removed and used to equip prize ships as auxiliary cruisers, four 50-cm deck-mounted single torpedo tubes fore and aft of the bridge on either side of the hull, 465-horned contact mines, and an assortment of small arms for boarding vessels and guarding prisoners. The 50-cm torpedo tubes were concealed by drop-down hull plating in a similar manner to the main guns; they could be swung out and fired only after the hinged hull plating had been dropped. *Kormoran's* secondary armament consisted of two 3.7-cm PaK 36 anti-tank guns scrounged from the German Army, which killed most of the Australian bridge crew during the engagement with HMAS *Sydney*,[26] five 2.0-cm anti-aircraft guns, and an assortment of small arms. *Kormoran* was equipped with two additional torpedo tubes (six total, all 53-cm) and an LS-3 light torpedo boat that was stored in one of her aft holds, as well as 390 mines.

Although *Kormoran* carried fewer mines than *Wolf,* she was outfitted with an additional reconnaissance aircraft. However, *Kormoran's* two Arado floatplanes flew less frequently than their WWI predecessor, the *Wölfchen*, perhaps due to assembly or disassembly difficulties. According to Ryan Noppen, captain Nerger frequently employed his aircraft, and it even took on an air assault role as the voyage progressed:

> The Friedrichshafen FF.33e, named Wölfchen by the raider's crew, would be used to scout for enemy vessels and compel those sighted to heave to under threat of bombardment while the Hilfskreuzer caught up to capture the prizes. Wölfchen made a total of 56 flights during *Wolf's* cruise and assisted in the capture of five enemy vessels. Wölfchen alone captured the 567-ton British schooner *Winslow* on June 16, 1917 when she dropped a bomb ahead of the vessel's bow, brazenly taxied up to the ship after landing, and the pilot, with pistol in hand, ordered the British captain to sail towards the *Wolf*.[27]

Wolf's Friedrichshafen floatplane could remain airborne for up to five hours; however, the assembly, dismantling, and storage process took several hours as well, so the aircraft usually made only one flight per day. The fuselage was stored in a crate, and the wings were kept below

deck.[28] Reconnaissance aircraft and wireless rooms would serve as captains' eyes and ears during their voyages.

The *Wolf* was driven by a vertical triple expansion engine fired by three coal-fueled boilers that turned a single screw up to 10.5 knots.[29] Although her coalbunkers were enlarged, no engine enhancements occurred when she was converted to an auxiliary cruiser. *Kormoran's* four 9-cylinder diesel engines generated 16,000 Horsepower (hp) compared to the 2,800 hp that *Wolf's* coal-fed steam engine produced, and *Kormoran* could achieve 18 knots at full power. Although the WWII-era merchant ships on which auxiliary cruisers preyed had grown faster, too, *Kormoran's* 16,000 hp engine capacity may have been one of the reasons her commander favored hunting over mining operations. (Another reason was probably the increased risk of exposure to enemy warships and aircraft, since mining operations tended to be conducted close to harbors in well-trafficked sea-lanes.) In addition, with a maximum displacement of 19,900 tons and a fuel capacity of 5,200 tons, *Kormoran* could cruise for up to 352 days without resupply compared to a cruising endurance without resupply of only 194 days for *Wolf.* Although *Wolf* had a fuel capacity of 6,300 tons,[30] the shorter cruise endurance was due to the less efficient steam engine. Refilling *Wolf's* coalbunkers also took more time than refilling *Kormoran's* fuel tanks. WWI raider commanders who took on coal in anchorage increased the risk that their vessels would be detected. The oil-powered surface raiders of WWII were less likely to be caught at anchor.

Although switching from passenger ships to freighters undoubtedly extended the endurance of German WWI auxiliary cruisers, resupply would remain an issue as long as commerce raiders were forced to rely on captured vessels for fuel and other resources. Based on the WWI experience of its officers, the German Sea Warfare Command (Seekriegsleitung) realized that future auxiliary cruisers would require logistical support to restore ammunition

stocks and remove prisoners even if they succeeded in capturing sufficient food, water, and fuel to sustain themselves. Relying on good hunting for resupply left too much to chance. The Sea Warfare Command decided to use a combination of blockade runners and civilian vessels supposedly interned in neutral ports to resupply the eleven auxiliary cruisers it unleashed on Allied shipping in WWII. However, to make its logistics system work, the vessels involved in at-sea resupply operations had to communicate with each other and the shore-based Sea Warfare Command.

Wireless technology was barely a decade old at the outset of WWI, and many British vessels used rudimentary crystal receivers and magnetic-wire transmitters with a range of only a few hundred miles. In contrast, *Wolf's* radio room had been enlarged and she was outfitted with the latest German technology, including very powerful receivers. In addition, commander Nerger's crew was augmented with code-breaking specialists that joined the wireless team monitoring the airwaves for enemy activity.[31] These personnel provided tactical intelligence vital to the success of *Wolf's* mission. For example, the wireless team intercepted a British Admiralty alert that caused Commander Nerger to abort the mining of Karachi harbor, because he knew authorities there would most likely halt and search all vessels in the vicinity.[32] By WWII, wireless technology had advanced to the point that jamming was possible, making it an even more useful tool. *Kormoran* succeeded in jamming the wireless transmissions of her targets on several occasions, making her discovery by enemy warships less likely. To confuse the Allies further, WWII auxiliary cruisers often broadcast spurious distress calls using captured British radio equipment.[33]

The Sea Warfare Command was aware that the need to communicate would make auxiliary cruisers and their support ships vulnerable. The German Navy therefore equipped WWII auxiliary cruisers with the most secure communications equipment available at the time.

(The German Navy utilized eight interchangeable cipher wheels with its M3 Enigma machines, while the German Air Force and Army only used five.[34]) The German Navy also developed and employed brevity codes that consisted of five letter groups for surface raider communications in WWII,[35] and instructed auxiliary cruiser wireless operators to limit transmissions to short bursts of no more than a few seconds. As a result, the British were unsuccessful in breaking the code used by the auxiliary cruisers, although they did succeed in breaking the code used by some of their supply vessels.[36]

At the strategic and operational level, British naval intelligence tended to be better than that of the Germans in both wars. However, the Germans—particularly the wireless teams operating onboard auxiliary cruisers—were often successful at the tactical level as noted above. During WWI, the British had an organization, known simply as Room 40 in Whitehall, where a team of mathematicians and academics decoded intercepted German radio messages. Moreover, the Allies had obtained the wireless codes of Germany's navy, merchant fleet, and diplomatic corps during the first year of WWI,[37] and an intercepted radio transmission provided the British with the SMS *Greif's* location. Although many German naval personnel attributed the destruction of the *Greif* after only a few days at sea to the presence of spies in German ports, some members of the German Admiralty must have suspected that their wireless code had been broken, because the German Navy changed its main codebook in May 1917. At the same time the Germans changed all of their call signs and Admiral Reinhard Scheer, commander of the High Seas Fleet (Hochseeflotte), drastically curtailed signaling.[38]

Throughout WWII, the British Royal Navy depended on communication with shore-based staffs for intelligence. Shore stations relayed wireless distress signals from merchant vessels under attack, and British warships steamed to the coordinates that had been rebroadcast in an attempt to intercept the raider. British signals intelligence (the Y-Service) also used

direction-finding techniques on intercepted German communications to provide naval assets with a general idea of where raiders were operating. The Y-Service began to decipher the content of German Navy messages in 1941. Although the British never broke the foreign waters (*Ausserheimisch*) cipher typically used by surface raiders, which Bletchley Park referred to as "Pike," they succeeded in breaking the home waters (*Heimisch*) or "Dolphin" cipher often used by supply vessels, and this sufficed to degrade the German naval logistics network.[39] However, the British did not share their code-breaking intelligence with Australian or New Zealand naval forces, making it more difficult for these Commonwealth nations to defend their commercial shipping.[40]

Even when the British could determine the approximate location of a WWII auxiliary cruiser, intercepting the raider frequently proved difficult. Allied warships had to positively identify the vessel before it could be sunk, and auxiliary cruisers often avoided detection due to the thoroughness of their disguises, which extended to the smallest details, such as the outfits the crews wore, in addition to altering the ship's superstructure to mimic a noncombatant. To counter auxiliary cruiser false-flag tactics, the Admiralty introduced secret call signs for Allied merchant ships in December 1940, and issued Confidential Admiralty Fleet Order 143 the following month on raider identification. Despite these measures, German raiders continued to deceive British warships, e.g. the HSK-2 *Atlantis* passed within 7,500 meters of the battleship HMS *Nelson* on May 18, 1941, in the guise of a Dutch freighter.[41] The identification measures helped, but would not be fully successful in driving auxiliary cruisers from the seas until the British dismantled the German supply network and the Allies committed exorbitant resources to the hunt.

After Germany declared war on the U.S. in December 1941, the U.S. Navy's Convoy and Routing Division assisted in eliminating the commerce raider threat by identifying vessels that

were part of the German naval logistics network. The Office of the Assistant Director of Convoy and Routing maintained a worldwide plot of all independent (non-convoyed) merchant vessel movements, in addition to its other duties, which included diverting independent Allied shipping from danger zones, and maintaining a liaison with Combat Intelligence – Atlantic (F-21). The merchant plotting sub-section tracked Allied, Axis, and neutral shipping. According to chapter two of the WWII convoy and routing history first published by the Headquarters of the Commander in Chief, United States Fleet, in 1945:

> Neutral shipping is required, for the most part, to follow certain prescribed routes agreed upon by both the Allied and Axis powers. Furthermore, daily radio positions reports are required from neutrals in certain areas and a fairly accurate dead reckoning plot can be kept. At the height of enemy submarine activity in the Atlantic area the plot was of use in determining whether or not 'neutral' shipping was aiding the Axis by refueling or supplying submarines and raiders at sea.[42]

Although the Convoy and Routing Division was primarily concerned with the Atlantic, it also maintained charts for vessels operating in the Pacific and Indian Oceans. However, these charts were updated twice a week, while the Atlantic chart was updated daily.

The tide gradually turned against auxiliary cruisers in WWII. The British made it more difficult for German ships to break out of home waters. Allied air superiority made inshore operations increasingly difficult for auxiliary cruiser commanders, and the British stationed warships with radars in the Denmark Strait, closing off this route to the Atlantic. Interrogations of the surviving crew of sunken raiders provided human intelligence about German tactics, and this, along with improved signals intelligence and overlapping identification measures, significantly decreased the raiders' ability to avoid detection.

EXAMPLES OF ASYMMETRIC WARFARE

Auxiliary cruisers were a "cost-effective means to attack British trade in the South Atlantic, Indian Ocean, and Pacific, seas that would otherwise be inaccessible, and thereby deny

Britain the luxury of 'safe areas' beyond German reach."[43] In addition to disrupting commerce by sinking vessels with cargoes bound for Allied shores, auxiliary cruiser activity encouraged Germany's opponents to resort to convoys—a significant economic detriment—and caused the rerouting of independent shipping many miles from established sea-lanes. Moreover, they compelled Britain to deploy far more warships to protect its trade routes than would otherwise have been necessary. The Allies only partially succeeded in countering auxiliary cruiser operations in WWI. Although the last WWII auxiliary cruiser, HSK-9 *Michel*, was sunk by a U.S. submarine in Japanese waters in October 1943, the Allies did not realize the German surface raider threat had been eliminated until early 1944.[44] In the meantime, the Allies continued to devote ships, aircraft, fuel, and time to the hunt. During both conflicts, auxiliary cruisers sank far more tonnage than the Germans lost with their destruction.

During WWI, the Germans converted sixteen vessels to auxiliary cruisers totaling 147,675 GRT.[45] However, four of these ships were prizes captured from the Allies (16,734 GRT), and one was a British-owned vessel detained in Hamburg (1,912 GRT).[46] Although only twelve of the sixteen auxiliary cruisers "were operationally deployed as commerce raiders" during WWI,[47] they sank or captured 124 ships totaling more than 500,000 GRT.[48] A simple GRT comparison indicates the Germans received more than a 3-1 return for their auxiliary cruiser investment in the First World War, and the return would have been even greater had they not equipped large, easily recognizable passenger liners as commerce raiders at the start of the conflict. During WWII, the German Navy deployed eleven auxiliary cruisers totaling 70,083 GRT,[49] and Germany achieved a 12-1 return on its investment. Its WWII auxiliary cruisers sank or captured 142 ships totaling more than 850,000 GRT.[50] According to August Muggenthaler, auxiliary cruisers were responsible for the destruction, damage, or capture of more than 890,000 tons of shipping during the Second World War, which represented more than 7% of the total

tonnage destroyed by U-boats in this conflict.[51] However, the ratio of U-boats to auxiliary cruisers was approximately 100-1. (The German Navy built 1,162 U-boats during WWII.[52])

The auxiliary cruiser threat also forced the Allies to increase their inventory of warships, which imposed additional costs. At the start of WWI, the Royal Navy had 108 regular cruisers of various classes and ages, but no more than a few dozen were equipped for trade protection duties.[53] This led the British to commandeer and convert their own civilian vessels, which they referred to as Armed Merchant Cruisers (AMCs). During both conflicts, the British preferred to use fast passenger liners as AMCs, and fitted them with surplus 4.7-inch (in) and 6-in guns. AMCs were "intended entirely for the commerce protection role, particularly on distant stations far removed from the main theater of war."[54] The inter-war Admiralty estimated that it would require a minimum of seventy cruisers for trade protection if another armed conflict occurred with Germany. However, it had only fifty-eight in service by 1939.[55] As a result, the Admiralty authorized the conversion of fifty-four merchant vessels to AMCs a few days before the outbreak of hostilities. British cruisers often patrolled over 60,000 nautical miles per year in 1940 and 1941,[56] which placed a great deal of stress on engines and boilers, and increased maintenance and fuel expenses.

The convoy and routing history produced by the Headquarters of the Commander in Chief, United States Fleet, succinctly describes the drawbacks of the convoy system.

> Most important among the delays caused by the larger convoys are congestions of port facilities while unloading and loading ships in large groups, reduction in speed of the faster ships to that of the slowest ship in convoy, longer distances which ships may have to sail to reach port of destination, and waiting in port for the next convoy to sail.[57]

Goods piled up on docks in congested harbors. Trains conveying merchandise to ports could not be promptly emptied and sat idle.[58] Freight fees rose due to a shortage of transportation. Fewer

wares were exported to Britain and the cargo that arrived took longer to distribute because of sequential unloading. These delays cost money and hampered the Allied war effort.

British officials were aware of the economic burden that convoying posed, and did not adopt the convoy system during WWI until the U-boat campaign reached its peak in 1917. Although unrestricted U-boat warfare (and the indiscriminate sinking of neutral shipping) compelled the Royal Navy to escort large groups of cargo vessels in the North Atlantic, auxiliary cruisers forced the Admiralty to assign escorts to commercial ships carrying vital resources across other oceans. The British delayed the departure of troop transports from colonial ports due to reports of auxiliary cruiser activity, and then resorted to accompanying them with warships.[59]

The British decision to initiate the convoy system at the start of WWII was probably due, in part, to the success of auxiliary cruisers during previous war. An Admiralty monograph issued to Royal Navy vessels in 1940 credited Germany's WWI auxiliary cruisers with inflicting "very heavy losses on British shipping" and holding up "trade and transport for long periods."[60] According to the Convoy Section of the British Ministry of Shipping, during WWI 16,693 ships participated in a total of 1,134 convoys; this figure would rise to 46,000 ships in WWII.[61]

However, many ships were forced to sail independently due to lack of escorts or insufficient speed, even in WWII. This, too, would prove costly, because of Allied efforts to "to scatter independent shipping throughout any given ocean area, avoiding peacetime steamer tracks and standard turning points which could have been made the focal point for enemy attacks."[62] For example, no convoy route was established between American ports and Cape Town during WWII. When the German Navy discovered this, its raiders began to focus on the South Atlantic "where many slow independent vessels were lost attempting to reach the Persian Gulf and the Red Sea via the Cape of Good Hope" with equipment vital to the Soviet war

effort.[63] To counter the threat to this Allied supply route, the U.S. sent all east coast ships bound for the Indian Ocean through the Panama Canal, down the western shore of South America, around Cape Horn, and thence to South African ports before continuing to the Indian Ocean. During the final four months of 1942, more than 200 ships travelled by this circuitous course,[64] which took significantly more time and consumed far more fuel than using the usual sea-lanes. When German activity in South African waters increased, Allied commercial vessels utilized a circular route from the Panama Canal south around New Zealand to Freemantle, Australia, and thence to the Persian Gulf. Over 500 vessels made this journey.[65]

Scores of merchant ships remained in port during both wars to avoid attack, and the paucity of cargo vessels caused freight fees to increase. Transportation costs for routes that included hostile waters increased as much as 700%.[66] Insurance premiums rose to staggering heights for vessels that chose to transit war zones, and, if not for auxiliary cruisers, the Indian and Pacific Oceans would have been safe zones during the latter half of WWI and the first three years of WWII. Perhaps this is the reason British authorities were reluctant to issue an explicit warning regarding the minefields *Wolf* had laid off of Colombo and Bombay,[67] i.e. insurance rates would increase sharply if the loss of a merchant ship resulted from enemy action rather than the negligence of the vessel's crew or a natural hazard.

CONCLUSION

Accurate intelligence; enhanced recognition methods; and the combined, joint efforts of Allied surface, submarine, and air forces eliminated the auxiliary cruiser threat by the end of 1943, but not before German surface raiders had inflicted a disproportionately large amount of damage. Did WWII represent the end of the era of auxiliary cruisers? Perhaps not. The lessons—and many of the tactics—remain relevant today, even if the ships themselves do not. The examples of the USS *Pueblo* and the USNS *Hughes Glomar Explorer* indicate there may

still be a viable post-WWII role for disguised vessels in clandestine activities.[68] Investing a small amount to achieve a large return is a desirable goal applicable to many current fields of endeavor, including naval warfare. Using subterfuge to avoid enemy strength (warships) and attack weakness (commercial shipping) is as germane now as it was during WWII. Although another conflict of the magnitude of either World War appears unlikely, with a relatively small investment a terrorist organization might attack an oil tanker from the concealment of a coastal trader or fishing trawler. Moreover, seaborne mines have been employed in both high and low intensity conflicts since WWII, e.g. the mining of Nicaraguan waters during the Contra insurgency in 1984.[69] With several nations willing to sell ordnance to the highest bidder, most notably North Korea, an extremist group could acquire mines and use a disguised vessel to surreptitiously place them in a strategic sea-lane.

APPENDIX

	SMS *Wolf*	HSK-8 *Kormoran*
Former Name	*Wachtfels*	*Steiermark*
Former Owner	Hansa	HAPAG
Dates of Naval Service	1916 - 1918	1940 - 1941
GRT	5,809 t	8,736 t
Displacement	14,200 t	19,900 t
Length	135 m	164 m
Breadth	17.1 m	20.2 m
Draught	7.9 m	8.5 m
Number of Decks	5	3
Number of Holds	2	6
Number of Compartments	7	6
Propulsion System	One 3-cyl-III Expansion Steam Engine with three boilers	Four 9-cyl-Diesel Engines with two Electric Motors
Max. Horsepower	2,800 hp	16,000 hp
Fuel Type	Coal	Oil
Fuel Capacity	6,300 t	5,200 t
Range without Resupply	42,000 nm at 9 kn	84,500 nm at 10 kn
Cruising Endurance without Resupply	194 days	352 days
Maximum Speed	10.5 kn (19.4 km/hr)	18 kn (33.3 km/hr)
Complement	347 personnel	401 personnel
Main Guns	7 x 15-cm SK L/40	6 x 15-cm SK L/45 C
Secondary Guns	3 x 5.2-cm SKL/55	2 x 3.7-cm PaK 36 anti-tank guns, and 5 x 2-cm FlaK 30 anti-aircraft guns
Torpedo Tubes	4 x 50-cm deck-mounted single tubes	2 x 53-cm deck-mounted twin tubes, and 2 x 53-cm underwater tubes
Torpedoes	16	Unconfirmed
Mines	465	360 EMC mines, and 30 TMB mines for motor boat
Aircraft	1 x Friedrichshafen FF.33E	2 x Arado Ar 196A-1

END NOTES

[1] In this paper, the term auxiliary cruiser applies exclusively to commercial vessels that the German Navy appropriated, armed, and sent abroad to attack Allied trade. However, in general usage, the term auxiliary cruiser also applies to Allied commercial vessels equipped with weapons to defend shipping. Although the Royal Navy referred to these ships as Armed Merchant Cruisers, the U.S. Navy called them auxiliary cruisers.

[2] Norman Friedman, *Fighting the Great War at Sea: Strategy, Tactics and Technology* (Barnsley, UK: Seaforth Publishing, 2014), 51.

[3] Theodore Ropp, "Continental Doctrines of Sea Power," in *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler*, ed. Edward Mead Earle with Gordon A. Craig and Felix Gilbert (Princeton, NJ: Princeton University Press, 1952), 449.

[4] Richard Guilliatt and Peter Hohnen, *The Wolf: How one German Raider Terrorized the Allies in the Most Epic Voyage of WWI* (New York: Free Press, 2010), 26.

[5] Ryan K. Noppen, *German Commerce Raiders 1914-18* (Oxford, UK: Osprey Publishing Ltd., 2015), 39.

[6] Noppen, 39.

[7] Guilliatt and Hohnen, 30.

[8] Great Britain Admiralty Publication, *Review of German Cruiser Warfare 1914-1918*, O.U. 6337 (40), 1940, 17, https://archive.org/details/ReviewOfGermanCruiserWarfare19141918.

[9] Guilliatt and Hohnen, 36.

[10] Schmalenbach, 140.

[11] Robert Forczyk, *German Commerce Raider vs. British Cruiser: The Atlantic & The Pacific 1941* (Oxford, UK: Osprey Publishing Ltd., 2010), 20.

[12] Schmalenbach, 48.

[13] Forczyk, 44.

[14] Ted Graham, Bob King, and Kim Kirsner, ed., *The Search for HMAS Sydney: An Australian Story* (Sydney, UNSW Press, 2014), 214.

[15] Forczyk, 68.

[16] Schmalenbach, 140.

[17] Forczyk, 7.

[18] Schmalenbach, 48.

[19] Great Britain Admiralty Publication, 2.

[20] Forczyk, 21.

[21] Thomas R. Frame, *HMAS Sydney: Australia's Greatest Naval Tragedy* (Sydney, AU: Hachette Livre Australia, 2008) 60.

[22] Noppen, 39.

[23] Forczyk, 30.

[24] Forczyk, 16.

[25] Forczyk, 29.

[26] Forczyk, 65.

[27] Noppen, 40.

[28] Guilliatt and Hohnen, 36.

[29] Noppen, 39.

[30] Schmalenbach, 47.

[31] Guilliatt and Hohnen, 32.

[32] Guilliatt and Hohnen, 47.

[33] Forczyk, 32.

[34] "Enigma M3," Crypto Museum, accessed March 20, 2016, http://cryptomuseum.com/crypto/enigma/m3/index.htm.

[35] Forczyk, 32.

[36] Forczyk, 38.

[37] Guilliatt and Hohnen, 37.

[38] Friedman, 95.

[39] Ralph Erskine, "Breaking German Naval Enigma on Both Sides of the Atlantic," in *The Bletchley Park Codebreakers: How Ultra Shortened the War and Led to the Birth of the Computer*, ed. Ralph Erskine and Michael Smith, 165-183 (London: Biteback Publishing, 2011), 167; Forczyk, 38.

[40] Forczyk, 38.

[41] Forczyk, 32.

[42] Naval History and Heritage Command, *United States Naval Administration in World War II: History of Convoy and Routing* (Washington, DC: Washington Navy Yard, May 2015), Chapter Two, 14, http://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/h/history-convoy-routing-1945.html.

[43] Forczyk, 34.

[44] August Karl Muggenthaler, *German Raiders of World War II* (London: Pan Books, 1980), 294.

[45] Schmalenbach, 48.

[46] Schmalenbach, 46-47.

[47] Forczyk, 7.

[48] Schmalenbach, 141.

[49] Schmalenbach, 48.

[50] Schmalenbach, 141.

[51] Muggenthaler, 295.

[52] Encyclopedia Britannica Online, s.v. "U-boat," accessed April 23, 2016, http://www.britannica.com/technology/U-boat.

[53] Forczyk, 6.

[54] Forczyk, 19.

[55] Forczyk, 9.

[56] Forczyk, 25.

[57] Naval History and Heritage Command, Chapter One, 1.

[58] Andrew Gibson and Arthur Donovan, *The Abandoned Ocean: A History of United States Maritime Policy* (Columbia, SC: University of South Carolina Press, 2000) 104.

[59] Great Britain Admiralty Publication, 3.

[60] Great Britain Admiralty Publication, 2.

[61] Naval History and Heritage Command, Chapter One, 5.

[62] Naval History and Heritage Command, Chapter Two, 20.

[63] Naval History and Heritage Command, Chapter Two, 20.

[64] Naval History and Heritage Command, Chapter Two, 20.

[65] Naval History and Heritage Command, Chapter Two, 20.

[66] Gibson and Donovan, 104.

[67] Guilliatt and Hohnen, 47.

[68] Muggenthaler, 296.

[69] Sabrina R. Edlow, *U.S. Employment of Naval Mines: A Chronology*, CNA Report Approved for Public Release CIM 506 (Alexandria, VA: Center for Naval Analyses, April 1997) 9, http://www.dtic.mil/docs/citations/ADA362483.

BIBLIOGRAPHY

Detmers, Theodor. *The Raider Kormoran: The exploits of a German 'mystery ship' in World War II*. Translated by Edward Fitzgerald. London: Tandem Publishing, 1975.

Edlow, Sabrina R. *U.S. Employment of Naval Mines: A Chronology*. CNA Report Approved for Public Release CIM 506. Alexandria, VA: Center for Naval Analyses, April 1997. http://www.dtic.mil/docs/citations/ADA362483.

Erskine, Ralph. "Breaking German Naval Enigma on Both Sides of the Atlantic." In *The Bletchley Park Codebreakers: How Ultra Shortened the War and Led to the Birth of the Computer*, edited by Ralph Erskine and Michael Smith, 165-183. London: Biteback Publishing, 2011.

Forczyk, Robert. *German Commerce Raider vs. British Cruiser: The Atlantic & The Pacific 1941*. Oxford, UK: Osprey Publishing Ltd., 2010.

Frame, Thomas R. *HMAS Sydney: Australia's Greatest Naval Tragedy*. Sydney, AU: Hachette Livre Australia, 2008.

Friedman, Norman. *Fighting the Great War at Sea: Strategy, Tactics and Technology*. Barnsley, UK: Seaforth Publishing, 2014.

Gibson, Andrew, and Arthur Donovan. *The Abandoned Ocean: A History of United States Maritime Policy*. Columbia, SC: University of South Carolina Press, 2000.

Graham, Ted, Bob King, Bob Trotter, and Kim Kirsner, ed. *The Search for HMAS Sydney: An Australian Story*. Sydney: UNSW Press, 2014.

Great Britain. Admiralty. *Review of German Cruiser Warfare 1914-1918*. O.U. 6337 (40), 1940. https://archive.org/details/ReviewOfGermanCruiserWarfare19141918.

Guilliatt, Richard, and Peter Hohnen. *The Wolf: How one German Raider Terrorized the Allies in the Most Epic Voyage of WWI*. New York: Free Press, 2010.

Mallmann Showell, Jak P. *Deutsche Kriegsschiffe: Hilfskreuzer, Schnellboote, Minensucher und Begleitschiffe 1933-1945*. Stuttgart: Motorbuch Publishing Company, 2010.

Muggenthaler, August Karl. *German Raiders of World War II*. London: Pan Books, 1980.

Naval History and Heritage Command. *United States Naval Administration in World War II: History of Convoy and Routing*. Washington, DC: Washington Navy Yard, May 2015. http://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/h/history-convoy-routing-1945.html.

Noppen, Ryan K. *German Commerce Raiders 1914-18*. Oxford, UK: Osprey Publishing Ltd., 2015.

Ropp, Theodore. “Continental Doctrines of Sea Power.” In *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler*, edited by Edward Mead Earle with Gordon A. Craig and Felix Gilbert, 446-456. Princeton, NJ: Princeton University Press, 1952.

Rosentreter, Robert. *Deutsche Kriegsschiffe: Hilfskreuzer und Handelsstörer 1914-1918*. Stuttgart: Motorbuch Publishing Company, 2015.

Schmalenbach, Paul. *German Raiders: A history of auxiliary cruisers of the German Navy 1895-1945*. Translated by Keith Lewis. Annapolis, MD: Naval Institute Press, 1979.

Williamson, Gordon. *Kriegsmarine Auxiliary Cruisers*. Oxford, UK: Osprey Publishing Ltd., 2009.

Winton, John. *Convoy: The Defence of Sea Trade 1890-1990*. London: Michael Joseph Ltd., 1983.