

HISTORICAL REVIEW OF CRUISER CHARACTERISTICS, ROLES AND MISSIONS

Photo # 80-G-470115 SOC's on a light cruiser's catapults, Jan. 1943



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**A HISTORICAL REVIEW OF CRUISER
CHARACTERISTICS, ROLES AND MISSIONS**
SFAC Report Number 9030-04-C1

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EXECUTIVE SUMMARY

"What is a cruiser?" With the VLS versions of the CG 47 class in routine service, it would seem the answer is self-evident. However, the CG 47 class is a recent specialized cruiser variant which is optimized as a large aircraft carrier AAW/ASW escort. That role drove the designers towards a high speed, lightly or unarmored ship that is expected to receive supplies (hence, have limited endurance) as component of a deployed carrier battle group. The Navy needs to examine the assumption that a one-for-one replacement for those ships (focused on the carrier escort role) is needed. Due to large number of DDG 51 class ships, which are also carrier escort capable, it may be desirable to focus a future cruiser on different missions. This study surveys the historical roles of ships called "cruisers" to develop a list of possible missions for a future cruiser. If a future cruiser takes on some of the many other roles performed by cruisers in the past, it might be a much different design than the CG 47.

The historical survey shows that ships with the name "cruiser" have covered these missions:

- Foreign station ships, independently deployed, looked out for national interests around the world. In addition to an extensive gun armament, the station ship had self-repair capability, long range, and "first-responder-to-disorder" equipment such as small arms for the crew and an extensive boat outfit. The disorder could be a revolutionary situation or a natural disaster.
- Sea denial ships, using their pre-deployed location, attacked other nations' trade routes. Counter-raider merchant ship escorts would, in turn, try to stop enemy sea denial ships.
- The Washington Battleship construction limitation treaties made large cruisers into substitutes for battleships in an alternative battle line (especially for night time combat). The attempt to forge a homogenous cruiser battle line ended up making US and Japanese "light" cruisers the same size and weight as "heavy" cruisers. The French and Italian navies specialized in "interceptor" cruisers –

sacrificing many other ship features, such as range, for speed and armament. The Soviet Union's first cruisers were based on Italian designs which explains their heavy armament on smaller displacements.

- Cruisers have served as command ships at many levels, from small group leader to provisions for carrying the national command authority.
- Cruisers have served as reconnaissance platforms (either directly as fast scout cruisers or via launching and retrieving smaller vehicles such as float planes).
- The "C" in CV reflects the fact some of the first aircraft carriers were armed with cruiser caliber guns for self-protection and thus thought of as part of the cruiser family. The CVs lost their gun armament in favor of more aircraft but depended on gun cruiser protection (prior to all weather/day/night aircraft) when night/fog/bad weather left a carrier helpless against enemy surface combatants.
- Smaller cruisers (CLAA) took on the role of gun armed AAW specialists able to keep up with the carriers regardless of sea conditions.
- There have been several proposals for cruiser-aircraft carrier hybrids and one Japanese cruiser class was constructed to a float plane version of that concept.
- There have been a few highly specialized variants such as cruiser minelayers and dedicated training cruisers.
- Cruisers served as anti-battleship (UK WWII) and anti-carrier (USSR 1950-60s) deep ocean barrier picket ships and, once a target had been identified, as high-speed long-distance tattletales.
- Cruisers supplied amphibious gunfire support to land forces at the start of wars until the more operationally expensive battleships could be reactivated.
- Currently USN CGs and CGNs serve as aircraft carrier escorts providing AAW and ASW.
- Independent land strike capability became a cruiser feature with the fitting of Tomahawk to the CG 52 onward.

A summary of the changing mission assigned to ship designated as cruisers follows.

Traditional Cruiser Roles	1890s to WWI	1920 to 1938	WWII	1945 to 1960s	1960s to 1980s	Current CG	Future CG?	Future Equivalent Cruiser Roles
Offensive								Offensive
Ship barrier patrol	X	X					X	Missile Barrier Patrol
Commerce raider	X	X					X	WMD Interception
Station ship	X	X					X	Sea Swap ship
Deep Land strike						X	X	Deep Land strike
Gunboat Diplomacy	X	X					X	Gunboat Diplomacy
Amphibious cover			X	X				Amphibious cover
Minelayer		X	X					Minelayer
Defensive								
CV SUW defense			X	X				CV SUW defense
CV AAW defense			X	X	X	X		CV AAW defense
CV ASW defense					X	X		CV ASW defense
Counter sea denial	X	X	X	X			X	Counter sea denial
Other								
Fleet Command				X	X			Fleet Command
Local Command	X	X	X			X	X	Local Command
Scouting	X	X						Scouting
Float Plane Carrier		X	X				X	RPV Carrier

It appears that the consistent theme of all the traditional missions was a ship with long endurance and the potential for independent operations. Sometimes this theme was strongly emphasized as in ships for the foreign station, commerce raider and commerce defender roles. Sometime those characteristics dwindled in ship customized for specialist roles such as the battle fleet scout cruiser of WWI, the cruiser minelayers and the highly optimized big carrier escorts of the US of the last half of the 20th century.

If a future cruiser is not a dedicated AAW/ASW carrier escort (intended to surge with the carrier battle groups), it may pick up modern versions of some of the historical roles:

- A forward deployed “Sea Swap” unit, with the carrier battle groups based in the United States instead on constant patrol, would return the cruiser to the independent station ship role.
- Future cruisers will not serve as sea denial raiders in declared wars because submarines are so much better at it. However, a modern sea denial role is intercepting and searching merchant ships in remote ocean locations to see if they are transporting terrorists or serving as Trojan horses for destructive weapons to be delivered to a US port.
- Future cruisers will not conduct anti-surface raider barrier patrols, but could provide a ballistic missile defense barrier, the modern equivalent. This role requires a ship with the traditional cruiser virtues of endless boring patrolling (reliability, seakeeping, crew comfort) with the possibility of sudden unanticipated action (100% availability, time critical response, independent action).
- Future cruisers will not carry float planes, but they may be a launch/recovery platform for the modern analog of unmanned vehicles (air, surface or underwater).

A return to other missions will, in turn, cause ship designers to put modern versions of other hull features, found in the previous cruisers types, into a new ship:

- Increased survivability, especially against ambush attacks, including a return to structural armor,
- Increased stores and fuel loads for independent operations,
- Increased self repair stores and shops to allow staying on station for extended period while remaining fully capable,
- First responder capabilities (such as limited medical facilities, small arms for the crew and an extensive boat/helo outfit), and
- Crew sized not only to operate the ship but to put small detachments ashore or on seized merchant ships.

- Provisions for carrying a small command staff and a senior officer (if assigned a role in the command structure).

The hull features listed above noticeably increase ship size (dimension and weight) compared to the current generation of lightly-protected aluminum superstructure ships bearing the cruiser name. However, most of those features have relatively low construction costs and a relatively small life cycle cost impact. Note that the associated higher manning level for self-repair, first responder role and detachment operations would carry a noticeable life cycle penalty. A combined nuclear cruiser with gas turbine boost (CONAG) plant would increase initial cost and crew cost but, at the fleet level, might pay off by reducing the logistic train required to support a ship assigned to a remote station for long periods of time or eliminate the vulnerability caused by using regional port facilities.



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LIST OF ACRONYMS

AAW	Anti Air Warfare
AoA	Analysis of Alternatives
ASROC	Anti-Submarine Rocket
ASW	Anti Submarine Warfare
CA	Heavy Cruiser
CAG	Guided Missile Light Cruiser
CB	Large Cruiser
CC	Command Ship
CG	Guided Missile Cruiser
CIC	Combat Information Center
CIWS	Close-In Weapon System
CL	Light Cruiser
CL(AA)	Light Cruiser (Anti-Aircraft)
CLC	Command Light Cruiser
CLG	Guided Missile Light Cruiser
CLK	Hunter-Killer Cruiser
CM	Minelayer
CNO	Chief of Naval Operations
CSGN	Nuclear Strike Cruiser
CVA	Attack Aircraft Carrier
CVL	Light Aircraft Carrier
DASH	Drone Anti-Submarine Helicopter
DD	Destroyer
DDG	Guided Missile Destroyer
DE	Ocean Escort
DL	Frigate
DLG	Guided Missile Frigate
ESG	Expeditionary Strike Group
FF	Frigate
HTS	High Tensile Steel
LAMPS	Light Airborne Multi-Purpose System
LCC	Amphibious Command Ship
NRL	Naval Research Laboratory
NTDS	Naval Tactical Data System
NTU	New Threat Upgrade
PIRAZ	Positive Identification Radar Advisory Zone
RN	Royal Navy
SAM	Surface to Air Missile
SRBOC	Super Rapid Blooming Offboard Chaff
TFCC	Tactical Flag Communications Center
USN	United States Navy
VLS	Vertical Launching System

1. INTRODUCTION

Ships called “cruisers” have been part of world navies for over 150 years. Because of their long history everyone involved with the United States Navy (USN) has at least a general understanding of the ship type. However, while there is widespread agreement among naval planners that the USN should have a new cruiser (CG(X)) to replace the existing *Ticonderoga* class (CG 47) when they go out of service in 15-20 years, it is not clear exactly what they have in mind. Is it the independent operations cruiser of the first half of the 20th century? Is it a specialized large carrier escort characteristic of most USN cruisers of the last half of the 20th century? Is it a sea-denial-to-the-enemy asset or a distant lanes-of-communications guardian? Is it a “Sea Swap” first responder to a crisis which serves to contain it while awaiting the deployment of the major “Surge” battle groups?

Even the basic cruiser nomenclature is confusing. What is a ‘protected’ vice ‘armored’ vice ‘scout’ vice ‘battle’ cruiser? Why is a 1930’s ‘light cruiser’ the same size and displacement as a ‘heavy’ cruiser? Why were some cruisers as large as, or even larger than, the equivalent era battleships? Why did ships that USN had long classified as big destroyers (DLs, DLGNs, DDG 47s) become cruisers overnight?

The purpose of this paper is to explore the history of the cruisers, looking at their performance characteristics, the roles they were formally assigned in force planning, and the actual missions that they were pressed into during wars and other emergencies. From this will be derived a checklist of potential cruiser roles to serve as a means of surveying naval planners “is this what you mean when you say ‘cruiser’?”. If there is agreement that any future CG is a direct continuation of the CG 52-73 carrier escort (plus land attack missile role) product line, that will greatly simplify the amount of work in an Analysis of Alternatives (AoA). However, if use of the checklist shows a wide divergence in thought about other cruiser roles, then the AoA work will greatly expand and possibly result in recommending not just one CG but a family of ships to take on the various, sometimes incompatible, cruiser roles.

2. THE WOODEN SAILING SHIPS

The word “cruiser” was first used in English in 1651. It was derived from related terms in Dutch, Portuguese, and French, all of which had the meaning of “crossing”, as in crossing back and forth across the entrance to a harbor to enforce a blockade, or crossing an ocean. In 1694, British Parliament documents indicate that 5th and 6th rate ships were detached from main fleets to “cruise” to protect merchant shipping. Documents of this period also mention independent “cruising” in search of enemy vessels.

The suitability of a wooden sailing frigate to fill this role stemmed from its speed, one continuous gun deck, plus berth deck design features, and increased stores capacity [Appendix A]. It was suitable for long range operations in remote areas where crew comfort, self-reliance, seaworthiness, and endurance were important. The frigate’s speed advantage made it useful for scouting and reconnaissance, as well as facilitating the long voyages for which its increased stores capacity per man also made it suitable.

Sailing frigates also had a role in fleet operations. While their lighter scantlings made them too vulnerable to take a position in the column of capital ships, they could maneuver on the disengaged side of the line to transmit signals, or on the engaged side at a safe distance from the enemy to report his movements. Because they had nearly the same sail power as a ship of the line, they could take a crippled capital ship under tow to disengage it from the battle, or rescue the crew of a sinking ship. As a result of the loss of the French flagship at the Battle of the Saintes (1782), it became common for admirals to choose frigates as flagships so that, not being a primary target of the enemy’s ships of the line, they could still maintain control of the battle.

The commanding officer of a frigate was always a full Captain in the British Navy, a “post Captain”, since during independent operations or as senior-officer-on-station in remote areas, important decisions about employing force would have to be made without directions from the Admiralty.

3. CRUISER DEVELOPMENT 1890'S TO WWI ERA

3.1 Early Developments

The cruiser as a named ship type evolved when the world's navies phased out sail propulsion and wooden hulls, creating the armored, steel battleship to replace the sailing ship of the line as the means of enforcing or seizing command of the sea in a fleet action. Early battleships were big - the largest warships in history when introduced - rather slow, and had relatively short endurance even when aided by auxiliary sail. These characteristics opened up a niche for various types of smaller warships. The cruiser was created to fill several of these niches.

Very small ships were created at the same time for the sea denial mission. Using newly developed underwater weapons such as mines and torpedoes, these ships could sink the largest ships and prevent a dominant power from taking advantage of control of the sea even after it had been achieved. These very small ships, torpedo boats and submarines, had extremely limited range and even less seaworthiness. Therefore, they were only helpful in what would today be called littoral warfare – breaking a blockade or countering a shore bombardment operation. They were not capable of intercepting an enemy's merchant ships or fleet on the high seas.

With the emergence of a naval strategy using large battleships and small torpedo boats and submarines, the need arose for the functions of a middle-sized combatant, later to be called the cruiser. One of these functions was that of a commerce raider, which had to have global range, and enough speed to outrun the fastest merchant ship or battleship. The commerce raider must also have enough capacity to house the crews of the captured or sunk merchant ships; in those days it would be considered unacceptable to leave them in their lifeboats. Prize crews might also be required for ships carrying exceptionally valuable cargoes.

Another cruiser mission was to “show the flag” on a foreign station. While this would seem to be a mainly ceremonial function, in those days the “station ship” might also be required to take action to protect the interests of its nationals when their rights

or property were infringed upon by irate locals in what would now be called the Third World, with or without approval from the local government. This “gunboat” mission would not be suitable for a ship as big and expensive as a battleship, and required somewhat different naval architecture than the commerce raider mission (speed had almost no value, for instance). Nevertheless a mid-size vessel was still required to carry the naval representative (often a flag officer) and his staff, a Marine detachment, and sufficient personnel and equipment to do most of their own maintenance in remote, primitive areas not equipped to service mechanized hardware. An elegantly fitted-out wardroom and well-equipped galley was another requirement, since the gunboat was required to do substantial entertaining, of ambassadors and local dignitaries. A full complement of boats was often needed to ferry the guests ashore if the ship had to anchor out for security or other operational reasons. Depending on the level of threat on the foreign station or on how badly the diplomats handled foreign relations, the “gunboat” mission could escalate into a power projection operation, where the station ship would have to perform battleship-like functions of shore bombardment and sea control. Evidently, this could quickly lead to a much more capable ship being called for, and actually sending a battleship might not be possible due to considerations of maintaining the “fleet in being.”

The sea-denial functions of both cruisers and the small warships mentioned earlier called for a “counter-sea denial” function. A mid-size warship was needed to escort merchant ships to drive off commerce-raiding cruisers and pirates, as well as to escort battleships to guard them against torpedo boats and submarines (and later destroyers). These missions, like the commerce raider mission, called for substantial speed and seaworthiness so that the cruiser could keep station on the ship being escorted in all weathers, even if it could not necessarily match the speed of the sea denial vessel. A cruiser need not overhaul such a craft in a stern chase; it just had to force it away from the ship being escorted without the cruiser itself being too easy a target.

Finally, in an age before spy satellites or airborne reconnaissance, cruisers had a scouting function. The “scout cruiser” was a smaller vessel of extreme speed whose other main attribute was tall masts to hold up the spotters’ tops and later the radio antennas with which the ship could report what it had seen. It needed to be able to defend itself against lesser ships long enough that its report could get through to the force commander, so if we imagine this function as integrated with the fleet or helping the battleships to find their targets, a scout cruiser might not necessarily be small. On the other hand, scouting could also be more like espionage, and for that function a small and less belligerent-looking ship would be more suitable. “Strategic scouting”, providing advance warning of the departure of an enemy fleet from its base, might also call for a large number of units to provide sufficient coverage to shadow the enemy. This would again lead to many smaller, less expensive units, which still needed high speed capability.

Accordingly, ship designers developed cruisers as mid-size combatants to do these principal missions. Different navies stressed some missions more than others, and most navies built cruisers in different sizes and configurations to suit the mission their doctrine put at the top of their priority list. For example, British designers stressed the counter-sea denial and station ship/gunboat mission, while French and German designers preferred sea denial. This was a natural consequence of the dominant position of the British Navy in the Victorian period and the second-rate character of the smaller European navies.

The United States entered the cruiser market late, without extensive experience of iron and steel ship construction. But, our designers seem to have studied the activity of the foreign navies, especially the British, and even our earliest cruisers, dating to around 1890, showed the influence of European experience.

From the beginning of steel navies, it was recognized that simply scaling down all functions uniformly from a capital ship would not produce a satisfactory cruiser. Such a ship would have guns that couldn’t penetrate battleship armor and armor that couldn’t protect against battleship gunfire; she would be slower than a battleship

because of the disadvantage of a shorter waterline, and would still lack an advantage in range. Therefore, such a ship would be hopelessly outclassed by hostile battleships and unable to keep in range of commerce raiding cruisers long enough to damage them. Such a ship would be more heavily armed than required for the station ship or scouting roles and more heavily armored than required against guns less potent than those mounted on battleships or shore batteries.

However, in the power projection or high threat gunboat role, it was apparent that the cruiser was a cheaper and less capable stand-in for a battleship. This was the origin of the first class or “armored cruiser,” a larger ship with substantial armor over most of its vital areas that was thinner than battleship armor, a scaled-down battleship-type armament, but an extra dose of speed and endurance so that it could theoretically run away from an encounter with a battleship. From this description, it is implicit that the armored cruiser would not necessarily be smaller than a contemporary battleship, since speed and fuel capacity lead to increased ship size. Armored cruisers varied substantially in size; our largest, the “Big Ten” of 1905-6, were over 15,000 tons and longer than contemporary battleships, which generally displaced less than 18,000. They were named after states in a further demonstration of their near-capital ship status. The *Maine*, whose destruction in Havana Harbor triggered the Spanish-American War, was designed as an armored cruiser (to a modified British design) but later redesignated a second class battleship; she was both smaller and slower than the contemporary armored cruiser *New York*, but carried heavier main armament.

Moving down the size scale, a “second class” or “protected cruiser” had less armor and was generally smaller than an armored cruiser. In most sources protected cruisers are described as having an armored protective deck but no waterline belt; US protected cruisers mostly followed this scheme, but one class had a 4-inch belt and all had additional armor around weapons and conning tower. Protected cruisers were usually faster than armored cruisers but at least in the US, did not have more endurance. They were more suitable for the sea denial and counter-sea denial missions

that required high speed and long range gunfire, where a protective deck might help more than a waterline belt.

Smaller yet is the “third class cruiser” or “peace cruiser.” This was designed to be the station ship in areas of low threat. These ships could be as small as 3,000 tons full load or even less, and they generally had light deck and localized gun armor, occasionally an armored conning tower, and sometimes even no armor at all. In the 1890’s many of these had quite modest top speeds, being unable to reach even 20 knots. While in their peacetime roles this was not a handicap, it could certainly be a danger if war broke out, because against many possible opponents these ships could neither fight nor run.

The “scout cruiser” was about the size of a protected cruiser; its main unique feature was a higher speed. Scout cruisers introduced the tradition of quadruple screws for US cruisers. Dividing the propulsion thrust up among 4 propellers reduced propeller loading and the tendency to cavitate at extreme speeds. Therefore, quadruple-screw cruisers could have higher speeds without excessive draft, and continued to be produced through World War II. The most outstanding US scout cruiser was certainly the *Omaha* class, discussed in a later section. Once naval aviation began to provide float planes for use on cruisers and battleships, the scout cruiser’s role declined in importance so that none were built after about 1925.

3.2 Shift from armored to unarmored

Cruisers did not, of course, evolve in a vacuum; they were affected by the development of other warship types. By 1890, the transition to steam and steel was complete in most navies. “Classical” solutions to most of the ship types had been arrived at by experimentation and analysis, aided by war game experience in the absence of actual combat. But the sea denial craft were still evolving rapidly, with surface torpedo boat speeds and seaworthiness increasing to the point that the British Royal Navy began to see these craft as a threat to the battle fleet. (While submarines had been successfully deployed by the Confederacy in the American Civil War, they

were still experimental in the 1890's and did not become a serious threat until around 1900).

The British sought an antidote, a “torpedo boat destroyer,” and in 1893 the first group of 250-ton boats was commissioned. These craft (later to be known as destroyers), had a designed top speed of 27 knots – faster than contemporary torpedo boats – and were also much larger and better armed. Now destroyers became in their turn a threat to (as well as a defense for) the battle fleet. Because the new craft were still relatively small and short range, they could not generally accompany the battle fleet on the high seas. Their existence became a factor driving cruiser designers to increase the speed of cruisers that might act as escorts to the battle fleet. This additional speed was generally achieved at the expense of armor protection and tended to drive designers towards lighter types of cruiser.

In 1906, the British Navy upset the status quo by introducing the battleship *Dreadnought*, which gave its name to the modern type of battleship with a uniform main armament of the largest caliber, assisted by a secondary, anti-torpedo boat battery of much smaller guns and later by anti-aircraft guns. *Dreadnoughts* were also capable of higher speeds than previous battleships, using the newer technology of steam turbines and the advantage of larger size.

At about the same time as the *Dreadnought* battleship was introduced, the British Lord John Fisher also pushed the concept of the battle cruiser, a ship of higher speed but similar armament to the *Dreadnought*. Battle cruisers were the same size or somewhat larger than battleships, but with much reduced armor. In most navies that built them, they had 4 screws in a time period when battleships generally had 3 or 2. It is likely that Fisher intended the battle cruisers to serve similar functions to the scout cruiser, but by being essentially invulnerable to cruiser gunfire, to be able to do so even when opposed by enemy cruisers and destroyers. In addition, he probably recognized that a small unit of battle cruisers could perform maneuvers such as crossing the T of an enemy battle fleet while battleships prevented the enemy from concentrating fire on the battle cruisers. It was never intended that battle cruisers were, in classical terms, “fit to

lie in the line”, i.e. to trade broadsides with an enemy capital ship. But, perhaps because of their armament and styling – they carried battleship-sized guns, looked like battleships, and were at least as large – commanders did just that with them in World War I. But, they were not designed to survive battleship gunfire, and several of them blew up at Jutland (May 31, 1916).

The US did not complete a battle cruiser until much later; while several designs were developed during World War I, and one was approved in 1916, the Navy’s bureaus absorbed the lessons of Jutland and the British *Hood* as the prototype of the fast battleship.ⁱ

However, the advent of battle cruisers changed the tactical environment for cruisers radically. The battle cruiser’s battleship-size guns could hit at ranges no conventional cruiser could reach, and penetrate any armor short of a battleship’s even at long range. Battle cruisers were faster than all but the fastest protected cruisers and of course the scout cruisers. If there was any possibility of meeting a battle cruiser, an armored cruiser was at severe risk.

This reality was exposed starkly by the First Battle of the Falklands, in December 1914, where a German squadron under Admiral von Spee, centered around armored cruisers *Scharnhorst* and *Gneisenau*, was practically annihilated by two British battlecruisers, *Invincible* and *Inflexible*.ⁱⁱ If cruisers in general were to be kept relatively small to maintain naval presence over huge areas, speed, rather than more armor and/or guns, was needed so that they could retreat when presented with an overwhelming threat like a battlecruiser. Accordingly, shortly before and during World War I, the armoring of cruisers decreased in favor of higher speeds. Some cruisers were produced with no armor at all; in many navies these were called “light cruisers.”

However, armor of limited thickness still had a place in cruiser design. Performing the gunboat function, a ship might be exposed to small-arms fire or light artillery that could disable a ship far away from dockyards and supplies before much defensive action could be taken. Also, a cruiser must not be disabled by a single hit from destroyer-size guns.

3.3 Communications

Communications for cruisers and other naval vessels are of two fundamental types, short range for exchanging tactical signals between an embarked commander and other ships in the squadron and long range for receiving instructions from or reporting information to higher command.

During the day, tactical signals would usually be accomplished by signal flags, which had existed at least since the 1600's. Initially, colored lanterns or rockets were used at night. Around 1880, electric lights were introduced, using a searchlight-like beam interrupted suitably to transmit the same Morse Code used in the telegraphs, greatly improving night signaling. At this time, however, flag signals were still the primary means of daylight communication between ships.

Long range communications had historically been accomplished through the use of written communications (dispatches) carried by fast ships or later, through the use of telegraphed messages to foreign ports where they could be picked up by the ships (this was the method used to instruct Admiral Dewey that hostilities with Spain had commenced and to proceed to the Philippines). The next development was the evolution of "wireless telegraphy" or WT. A two-way radio could transmit or receive a keyed, Morse code signal from a shore station or another ship. This capability evolved gradually from the first experiments of Guglielmo Marconi in 1895 that required huge land-based towers to hold the antennas, gradually producing marine sets with (at first) very limited range, then gradually increasing performance. Radio started being installed on cruisers routinely around 1900, and was on board most naval ships by the start of World War I.

However, radio communication, while it greatly augmented the value of a scout cruiser, perhaps even making specialized scout cruisers worthwhile,ⁱⁱⁱ also created entirely new problems of command and control. In World War I, central naval commands and heads of state recognized that radio gave them the ability to give orders almost in real time to operational commanders. This put the at-sea commander in a difficult situation, that is, he could be blamed for taking independent action without

consulting London or Washington, but he could also be blamed if he followed radioed instructions and the instructions proved to be ill-advised because central authority didn't understand the situation on the water. Both of those situations developed in World War I, and a number of careers were ruined as a result.

In the maneuvers that led to the Gallipoli campaign, for instance, Vice-Admiral Troubridge decided not to engage the German battle cruiser *Goeben* with a force of cruisers. He was court-martialled, but acquitted based on the radioed orders he had received to avoid combat with “a superior force.” However, he never got another sea command.^{iv}

4. CRUISER DEVELOPMENT 1920-1938

The Washington Naval Treaty of 1922 significantly altered the progression of cruiser design in the United States. The Treaty caused what can roughly be thought of as a 16 year long detour in cruiser design stretching from 1922 to around 1938, when the looming threat of WWII effectively rendered the treaties established during the previous years no longer in effect. While the dissolution of the Treaty restrictions allowed unfettered design development, the cruisers developed post-1938 were largely derived from the Treaty-constrained *Brooklyn* Class rather than the pre-1922 battle cruiser designs scrapped by the Treaty implementation. Consequently the 16 year detour had far reaching implications extending well beyond 1938.

4.1 US Navy leading up to the Washington Naval Treaty

US Navy cruiser design in the years leading up to 1920 was focused on two main types of new cruisers. The first was a class of scout cruisers which would eventually become the *Omaha* Class; the second was a new class of battle cruisers which was started, but never completed.

4.1.1 *Omaha* Class

The US Navy continued the pattern of deliberately designing cruisers with slightly increased performance over comparable foreign designs. Before WWI, the average cruiser in the world's navies displaced less than 5,000 tons and was armed with a few 6-inch guns in open shields. The *Omaha* Class design was greatly superior to such craft in battery, speed, and range. The *Omaha* Class was designed specifically in response to the British *Centaur* Class cruisers. Although from a modern viewpoint a conflict between the US and Great Britain seems implausible, US Navy planners during this time and up to the mid-30's considered Britain to be a formidable rival for power in the Atlantic, and the possibility of armed conflict between the two countries plausible enough to merit appropriate planning measures.

Originally designed with eight 6-inch guns, this number was increased to a total of twelve during construction to counter the seven 6-inch guns aboard the *Centaur*. At a design speed of 35 knots, the *Omaha* was the fastest ship in the world, a full 3 knots faster than its closest British rival.

Launched in 1920, the *Omaha* (designated C4 and later CL 4) had a displacement of just over 7,100 long tons. The cruisers emerged with a distinctly archaic appearance owing to their WWI-type stacked twin casemate-mount cannons and were among the last broadside cruisers designed anywhere.

As a result of the design changes placed on the ship mid-construction, the *Omaha* that entered the water in 1920 was a badly overloaded design that, even at the beginning, had been rather tight.^v The ships were insufficiently insulated, too hot in the tropics and too cold in the north. Sacrifices in weight savings in the name of increased speed led to severe compromise in the habitability of the ship. While described as a good ship in a seaway, the low freeboard led to frequent green water ingestion over the bow and in the torpedo compartments. The lightly built hulls leaked, so that sustained high-speed steaming contaminated the oil tanks with sea water.

These drawbacks notwithstanding, the US Navy took a great deal of pride in the *Omaha* Class. The *Omaha* placed a high emphasis on underwater explosion protection

from the threat of torpedoes. She was designed with improved compartmentation while her magazines were the first to be placed on centerline, below the waterline.

Originally designed to serve as a scout, they served throughout the interwar period as leaders of fleet flotillas, helping them resist enemy destroyer attack. Tactical scouting became the province of cruiser aircraft, and the distant scouting role was taken over by the new heavy cruisers spawned by the Washington Naval Treaty. Thus, the *Omahas* never performed their designed function. They were relegated to the fleet-screening role, where their high speed and great volume of fire were most appreciated.^{vi}

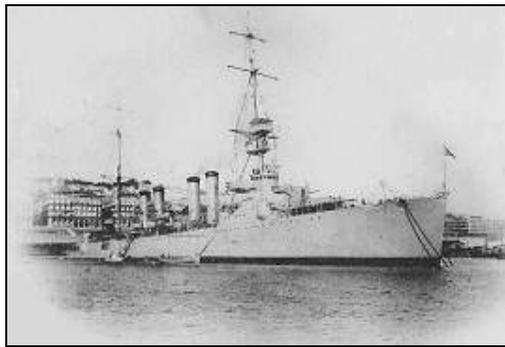


Figure 1 C10 Concord

4.1.2 Pre-1922 Heavy Cruisers

While the successful fielding of the *Omaha* Class cruisers gave the US a slight advantage against the *Centaur* class cruisers, an additional threat to US Navy scout cruiser superiority loomed across the Atlantic which outmatched the *Omaha's* capabilities. The British *Hawkins* Class cruisers (1916) boasted seven 7.5-in/45 guns at a displacement of 9,750 tons at a sprint speed of 30 knots. The *Hawkins* was designed by the British to hunt down German commerce raiders, and had been given an unusually long-range weapon that might enable them to cripple such raiders before they could flee. This counter-raider had the unintended effect of upgrading foreign designs, partly because of its potential as a raider.^{vii}

For the US Navy, the *Hawkins* became the standard for cruisers designed for independent operations, with planners demanding six 8-inch guns and a speed of 32.5 knots to counter the *Hawkins* capabilities. The designs produced by the US Navy which

were formulated in response to the *Hawkins* Class would eventually lead to the USS *Pensacola*, the first of the so called “Treaty cruisers.”

4.1.3 Pre-1922 Battle Cruisers

In 1909, as discussed in a previous section, the British Navy had already fielded another extremely powerful ship. *HMS Invincible*, the first battle cruiser, was designed to be superior to any normal cruiser then in existence. *Invincible* was armed with a battleship’s big guns, while at the same time having a speed superior to both battleships and armored cruisers. Its role was to act as a superior scouting vessel, able to penetrate enemy cruiser screens while at the same time effectively screening her own battle force. She had secondary roles in hunting down and destroying enemy commerce raiders and in helping to reinforce the main battle line in a naval engagement.

In order to achieve the high speed necessary for the battle cruiser while carrying a sizable battery of heavy guns, the hull and machinery had to be bigger, more complicated, and more expensive than any vessel previously built. However, armor protection had to be kept to a minimum to reduce weight. Consequently, critics generally believed such a ship could not be used in a fleet action and was larger and more costly than necessary to carry out its other missions. Chiefly because of these criticisms, the US Navy hesitated for several years before committing itself to building battle cruisers.^{viii}

Apparent validation of the battle cruiser concept came early in WWI. In the First Battle of the Falklands, discussed in an earlier section, the superiority of the battle cruiser over the armored cruiser was clearly demonstrated.^{ix}

Development of a battle cruiser for the US Navy was very turbulent, with Navy planners following the capabilities of the British Navy, while Navy leaders wrestled with the political obstacles impeding the construction of the expensive and complex new class of ships. Originally envisaged with 14-inch main guns, the US battle cruiser designs were modified during the pre-Treaty years to overmatch the *HMS Hood’s* 15-inch guns with 16-inch guns. *HMS Hood* and the US Navy design were really more akin

to fast battleships. The US design had stalked the British battle cruiser designs as they moved from the lightly armored *HMS Invincible*, shown to be particularly vulnerable to an encounter with a battleship, to the heavily armored *HMS Hood*.

Photo # NH 60418 HMS Hood, photographed circa the early 1930s



Figure 2 Battle Cruiser *HMS Hood*

Six keels of the new battle cruiser class were laid during 1920: *Constellation*, *Constitution*, *Saratoga*, *United States*, *Lexington*, and *Ranger*. By the time they were begun it was already becoming clear to some of the more farsighted and politically oriented naval officers that they would probably never be completed. Construction lagged during 1921, and was nearly halted after the Washington Conference began its deliberations in November.

Thus begins the great detour in US cruiser production. It would be another two decades before the *USS Alaska* and *USS Guam*, the US Navy's first battle cruisers, would find their way into the waters of the Pacific Ocean just in time for the conclusion of WWII.

4.2 Washington Naval Treaty

On November 12, 1921, the five principal naval powers of the post World War I world convened in Washington D.C. to discuss naval disarmament. The United States, Great Britain, Italy, France, and Japan controlled the largest naval forces in the world at that time. Each came to the conference seeking an advantageous settlement. This was especially true in the case of the United States government, which wanted a naval disarmament agreement that could curb the capital ship arms race, particularly the increasing trend towards expensive battle cruisers, while also limiting Japanese expansion in the Far East.

The United States saw a potential threat from across both oceans. Britain had long been a dominant naval power, and was still warily regarded by naval planners all the way through the mid-1930's. The British controlled a far reaching network of colonies across the globe, which gave Britain many bases for naval operations. In a conflict against Britain, the US would have to steam considerably longer distances, with stretched supply lines. US planners hoped to curb the number of ships Britain was building, and also to maintain the tradition of having superior ships.

Japan was just becoming a threat. Japan's dramatic defeat of the Russian fleet in 1905 suddenly revealed Japan as a first class naval power. Although an ally during WWI, Japan's influence was steadily growing in the Far East, making US planners nervous about American interests around the Philippines.

To counter the Japanese, American naval strategists began planning for the development of naval bases in the Philippines and on Guam, in addition to the naval construction program authorized by Congress in 1916.

Realizing that their position in the Western Pacific was weak, the American military was forced to adopt a holding strategy. US Navy planners intended to be able to fight in two separate scenarios. The first was a two ocean war, with the US Navy on the offensive in the Atlantic, while on the defensive in the Pacific. The second was a one ocean war with the US Navy on the offensive in the Pacific.

The cornerstone of this strategy was the possession of a superior fleet, meaning a large number of battle cruisers capable of engaging and destroying Japanese cruisers. This was a cost that many American politicians were unwilling to underwrite. In this context, the Washington Naval Treaty can be seen as the lesser of two evils, with diplomatic intrigue replacing military might as the weapon of choice.

An agreement between the five powers was eventually reached, regulating the expansion of each nation's Navy. The most critical factor in allowing the Treaty terms to be agreeable to all of the parties was the genuine desire for arms limitations felt by all.

After specifying some exceptions for ships in current use and under construction, the Treaty limited the total capital ship tonnage of each of the signatories. The United States Navy and the Royal Navy could not exceed 525,000 tons, the French Navy and the Italian Navy were limited to 175,000 tons, and the Japanese Navy to 315,000 tons. No single ship could exceed 35,000 tons, and no ship could carry a gun in excess of 16 inches.

Aircraft carriers were addressed specifically with the total tonnage for carriers of the United States and the British Empire limited to 135,000 tons; for France and Italy 60,000 tons; and for Japan 81,000 tons. Only two carriers per nation could exceed 27,000 tons, and those two were limited to 33,000 tons each. The number of large guns carried by an aircraft carrier was sharply limited, meaning it was not legal to put a small aircraft on a battleship and call it an aircraft carrier.

As to fortifications and naval bases, the United States, the British Empire, and Japan agreed to maintain the status quo at the time of the signing. No new fortifications or naval bases could be established, and existing bases and defenses could not be improved in the territories and possessions specified. In general, the specified areas allowed construction on the main coasts of the countries, but not on smaller island territories.^x

This caused a change in strategy on the US side. Unable to further fortify the Philippines or establish a solid base on Guam, the US effectively gave up a strong

permanent presence in the Western Pacific. This reduced land-based presence would have to be balanced by a greater sea based power projection.

All signatories pledged to maintain a balance in their respective capital fleets under a predetermined ratio:

- Britain 5
- United States 5
- Japan 3
- France 1.67
- Italy 1.67

The United States proposed to extend this ratio beyond just capital ships to apply to auxiliary ships, but was unable to get agreement from the other nations at the negotiating table.

Cruiser designs were capped at a maximum displacement of 10,000 long tons, with armament no larger than an 8-inch gun. (It is notable that these specifications correspond approximately to those of a *Hawkins* class cruiser.) While the aircraft carriers and capital ships were limited to a certain combined tonnage by the terms of the agreement, no such limitation was placed on cruisers.

The Treaty measured the displacement of the ships based on their “standard displacement”, a weight accounting methodology defined within the Treaty. The intent of the standard displacement was to avoid unfairly penalizing Great Britain and the United States for the large steaming distances the two countries required. Standard displacement did not count the weight of the fuel and reserve feed water needed for long range against the Treaty limits.

This had an immediate and dramatic effect on ship design within the United States. For the first time, weight estimation, control, and reduction moved to the forefront of design drivers for new ship designs. The US had not invested resources in investigating weight reduction measures in the years preceding the Treaty implementation. Additionally, US designers were suddenly trying to design a ship that

would be just under the Treaty limits without fuel weight, while meeting speed and range requirements which are naturally tied to the amount of fuel onboard.

The bizarre effects of the Treaty were also evident in all of the US Navy conceptual designs coming after the Treaty's implementation. For each, the potable water, which might be excluded from standard displacement, was carried in the turret overhangs, and thus balance secured without added (Treaty) weight.^{xi}

The limitations on the cruiser displacement and armament were not arbitrarily assigned, rather they were a rationally arrived upon set of restrictions due to the world's intention to maintain parity with rival nations' capabilities. By this time the US Navy had two years of experience designing 10,000 ton, 8-inch cruisers and had convinced itself that nothing smaller was really worth building, considering Pacific distances. The British *Hawkins* class cruisers had already made the 8-inch gun cruiser the standard for long range cruisers in every nation, and agreeing to the 10,000 ton displacement limit and 8-inch armament limitation was naturally amenable to the US. This had the immediate, if unintentional, effect of simultaneously creating both an upper and lower bound of future cruiser designs. While the Treaty did indeed curtail the arms race of building capital ships, it inadvertently supplanted this contest with a new arms race of building "Treaty cruisers."

After the conference, cruisers carrying the 8-inch guns were re-designated as "Heavy Cruisers (CA)" because they carried the heaviest allowable armament under the Treaty limitations. The *Omaha* Class ships, with their 6-inch guns, were re-designated as "Light Cruisers (CL)."

The Treaty was one of the first steps of the United States Navy's conversion from a battleship fleet to an aircraft carrier-based force. The United States was over the limits in capital ships when the Treaty was ratified, and had to decommission or disarm several older ships to comply. The US was under the allowable tonnage for aircraft carriers since the only aircraft carrier in the US fleet before the Treaty was signed was USS *Langley* (CV 1), a converted collier. Not only did carriers have separate limits, but as an experimental vessel, *Langley* did not count against the tonnage restrictions.

Consequently, the US Navy had a free rein to build carriers, subject initially only to budget limitations. The decision was made to halt construction on the current fleet of battle cruisers and convert the *USS Lexington* and *USS Saratoga* to aircraft carriers. The *Constellation*, *United States*, *Constitution*, and *Ranger* were scrapped.

For the US Navy the Treaty did indeed limit the production of capital ships but escalated the production of heavy cruisers and carriers. Thus the Washington Naval Treaty had the fortunate effect of moving the US Navy towards carrier based warfare, though it would be several years before the full potential of this paradigm shift in ocean warfare was realized by the US and other Navies.

4.3 1st Generation Treaty Cruisers

4.3.1 Foreign Activity

The British *Arethusa* class, completed in 1914, introduced a number of new features. This was a small cruiser of only 3530 tons, armed pre-dreadnought style with two 6-inch/45 guns fore and aft and six 4-inch guns in broadside. However, she had high speed turbine machinery and oil fired boilers, plus a novel weight saving feature: an armor belt that was built into the hull so that it contributed to longitudinal strength.^{xii}

Armor is generally bolted to the ship's structure. The reason for this is that armor is generally not homogeneous: the outer surface is case-hardened using various chemical processes so that it has the greatest possible resistance to penetration, while below this hard surface the steel is maintained in a ductile condition to prevent the plate from becoming brittle and shattering if hit by a projectile that cannot be stopped by the surface. This process had different names and slightly different chemistry among the various producers of armor, such as "Harveyed" in Britain or "Krupp Cemented (KC)" in Germany. So as not to weaken the hardened surface, these plates needed to have a threaded rod screwed in from the rear into the ductile part. This rod could later be passed through a corresponding hole in a layer of teak backing and the ship's structural plating, then secured with a washer and nut. It was rarely practical to

secure adjacent plates to each other, so belt armor was generally not watertight, and the backing and fasteners added weight.

But, by 1912, high tensile steel (“HTS”, harder than mild steel through and through, but with substantial toughness as well) had become available. For light armor under 4”, this worked nearly as well as case-hardened plates. The Royal Navy used HTS for *Arethusa*’s belt, riveted firmly into the surrounding plating so that it was part of the watertight envelope of the ship. It therefore contributed to longitudinal strength, although this contribution was not huge since it was close to the neutral axis of the hull. The deck and bottom were the principal members of the “box girder” of the hull, when considered in longitudinal bending. The added stiffness provided by the belt allowed some degree of weight saving in the rest of the structure, but probably more by eliminating fasteners and backing.

The *Arethusa* was also the first British cruiser to be called a “light” cruiser; she later achieved fame as the flagship of Commodore (later Admiral) Sir Reginald Y. Tyrwhitt, CB, RN, commanding the “Harwich Force” of destroyers.

Japan received a visit by HMS *Hawkins* shortly after the war, and she made a huge impression. Accordingly, they adopted the 8-inch gun as the standard cruiser weapon, agreeing with soon-to-be-imposed Treaty limits.

In 1921 (before the Treaty took effect) they started building an innovative, experimental small cruiser, *Yubari*, that with a displacement of only 3309 tons, achieved 34.8 knots on trials and mounted six 5.5-inch guns and twin 24-inch torpedo tubes. Like *Arethusa*, this ship had armor used as a strength member.

In 1922 Japan placed an order for a larger Treaty cruiser, mounting six 20-cm (7.4-inch) guns, 3-inch side armor and 34.5 knot speed, all on 7100 tons standard displacement. Here too, armor was used as a strength member. The name-ship *Kako* came out overweight, barely within Treaty limits at 9540 tonnes standard. However, in spite of the extra weight, the two ships achieved their design speed on trials.

The British built their first class of Treaty cruisers in 1924-5, commissioned in 1928. This was the “County” or *Kent* class. They were 9750 tons standard displacement,

armed with four twin 8"/50's, four 4"/45 AA, two quadruple 2-pdrs, 2 quadruple 21-inch torpedo tubes, and later one seaplane apiece. Armor was extremely light, with a 1-inch belt and additional 1 to 4 inch magazine box protection. The main armor was concentrated in a 1.375-inch protective deck. This lack of armor was a direct result of compromises inherent in the Treaty displacement limit coupled with the desire for high speed (31.5 knots on 80,000 SHP with 4 shafts.) The Admiralty had earlier wanted 33 knots, and the Director of Naval Construction (DNC) had intended to delete the belt armor entirely; the reduced speed and light belt were a compromise. (Why exactly the British chose to build a heavy cruiser so early in light of their later opposition to the type is somewhat mysterious.)

France authorized its *Duguay-Trouin* class of 3 cruisers in 1922 (commissioned 1926-7). They had eight 155-mm (6.1 inch) guns in twin turrets and made 33 knots on trials, but had practically no armor. At 7250 tons standard, 9350 full load, and carrying four 75mm secondary guns and twelve 21-inch torpedo tubes, they were well below Treaty limits and probably their lack of armor was the result of other considerations rather than Treaty compliance. They were heavily powered at 100,000 SHP, 4 shafts, even more than the US *Omaha*. Since they also had an advantage in length and were not much different in displacement, it is surprising they did not turn in a better trials speed. Endurance was only 3,000 miles at 15; *Omaha* claimed more than twice as much, but endurance figures in this period were frequently criticized as inaccurate.

4.3.2 *Pensacola* Class

If the General Board had strongly favored cruisers before 1922, the Washington Treaty greatly increased its interest in them. In effect the Treaty turned the 8-inch gun cruiser into a kind of junior capital ship. The old scouting role was, if anything, more important in the new kind of Pacific war the navy was then planning than it had been in the Atlantic. Perhaps as importantly, the prospect of losing a single capital ship out of the reduced number surviving under the Treaty would deter a commander from releasing single ships for such roles as convoy escort and shore bombardment. In WWI

there had been many obsolete battleships and armored cruisers available for even the riskiest assignments, but they had been wiped out at the conference table. To fill their place, heavy cruisers, their numbers unlimited under the Treaty, would be required.^{xiii}

The General Board had evaluated a number of scout cruiser designs leading up to the Treaty limitations, and continued to evaluate alternatives up to 1924 with the authorization of the *Pensacola*. The General Board concluded that designs split into two categories depending on what function a cruiser would serve: protecting or destroying merchant ships, or operating with the fleet. Ships in the former role required a speed of 32 to 34 knots, in the latter, 27 to 32 knots. Although opinions on guns and protection differed widely, the Board did agree that aircraft were secondary.^{xiv}

By December 1924 there was enough evidence of foreign willingness to begin a cruiser-building race that Congress authorized eight new cruisers, the *Pensacolas* (CA 24-25) and the *Northhamptons* (CA 26-31). The first of the *Pensacola* Class cruisers launched was the USS *Salt Lake City* (CA 25) on January 23, 1929, with a design displacement of 11,568 tons.



Figure 3 CA24 *Pensacola*

4.3.3 Northampton Class

The development of an alternative design to the *Pensacola* Class, which became the *Northampton* Class, began even before the *Salt Lake City* had been laid down. The new ships had two separate origins. First, there was a feeling within C&R that the *Salt Lake City* design sacrificed too much in order to mount the maximum battery, ten 8-inch

guns. No great improvement in protection could be achieved, but it did seem possible to improve the balance between firepower and seagoing characteristics. That is, the earlier design had traded freeboard for extra guns. Reducing the armament to 9 guns had a big effect on weight, armor area, and volume because this battery could be mounted in three triple turrets, rather than requiring four turrets of two different designs. Also, the aircraft arrangements of the *Pensacola* Class were not entirely satisfactory.^{xv}

The other and driving impulse behind a new cruiser came from the General Board. In 1926, with funds for three new cruisers in prospect, it sought improvement over the existing *Salt Lake City* design to increase survivability.^{xvi}

There was considerable interest in habitability for the *Northampton*s. Volume studies showed an increase from the *Salt Lake City* Class of about 15% per man. The *Northampton*s were the first major US warships to be designed for bunks rather than hammocks. Objections were raised: bunks would encroach upon open spaces used for recreation, assembly, and shelter in bad weather, as well as upon mess spaces. Bunks above the second deck would be subject to splinter damage, though this danger was rationalized by Navy planners with a familiar ring to modern ears.^{xvii}

The rationale was that the crew should be at battle stations during action, and therefore the bunk spaces would be lightly, if at all, manned. The fraction of the ship's time spent at war was miniscule compared with the time spent during peacetime. In the event of war, the bunks could easily be removed and the sailors would put up with reduced accommodations as one of the obligatory sacrifices made necessary by war.

Even then, the Navy suffered from a high rate of desertion and poor re-enlistment numbers. The improved habitability was one step in a far reaching effort to improve retention through quality of life that extends to today.

The first of the *Northampton* class cruisers, the USS *Chester* (CA 27), was launched July 3, 1927, with a design displacement of 11,574 tons.



Figure 4 CA 29 *Chicago*

4.3.4 The “Treaty Tinclads”: *Pensacola* and *Northampton* Classes

The great irony was that, after the designs had been largely determined by the need to stay barely within Treaty limits, the ships came out grossly underweight, even after last-minute changes. The full load delivery displacement of 10,666 tons for the *Salt Lake City* was a full 900 tons underweight, the full load delivery displacement of the *Northampton* of 10,965 tons a full 600 tons underweight. This was a result of Preliminary Design’s conservative estimating of the design weight and the concurrent implementation of the *Northampton* class, which was already being built by the time the weight shortage in the *Salt Lake City* was fully realized. As a result, the both classes had an excessive metacentric height. The roll was, therefore, both short and deep which caused a disconcerting motion.^{xviii}

Very heavy snap rolling could even break the topmast, which was essential for long-range radio at this time. This happened to the *Salt Lake City* when she was en route from New York to Guantanamo early in 1931. Anti-rolling tanks were installed experimentally in the *Pensacola* and the *Northampton*. The tanks were not interconnected, rather, the tank on each side was open to the sea, with a vent pipe.^{xix}

There were also complaints of weak sternposts and excessive vibration aft at high speed, presumably due to weight savings in the hull structure and cured by structural stiffening. The ships seemed light, with serious damage inflicted on the hull of the ship when the three guns of a turret were fired together.^{xx} Thus the first two cruiser classes

emerging from the Washington Naval Treaty were informally dubbed “Treaty tinclads.”

The 8-inch gun cruisers brought a new capability to the fleet when they entered the service. They replaced the elderly battleships of the Scouting Force and served not merely as scouts but, perhaps much more importantly, as escorts for the new fast carriers in independent task force operations. Another role these cruisers could fill was that of fleet flagship. The first three *Northampton*s were built as division flagships. The last three were fleet flagships.

4.4 2nd Generation Treaty Cruisers

4.4.1 *Portland* Class

Almost from the first, there was certain dissatisfaction with the very limited protection of the 8-inch gun cruiser. As it became evident that more weight was available than had originally been estimated, protection was improved as much as possible in the ships still under construction.^{xxi} The *Portland* Class, originally slated as CA 32-36, was in effect an upgraded version of the *Northampton* Class cruisers.

The first *Portland* Class cruiser launched was the USS *Indianapolis*, on 7 November, 1931. She had a design full load displacement of 11,574 tons, a speed of 32.5 knots and an endurance range of 10,000 nm at 15 knots. Her main battery consisted of nine 8-in/55 guns and an anti-aircraft battery of eight 5-in/25 guns and eight 0.50 caliber machine guns. She actually came in heavy at a full load delivery displacement of 12,755 tons.



Figure 5 CA 35 *Indianapolis*

4.4.2 *New Orleans* Class

The follow on group to the *Portland* Class cruisers, CA 37-41, exhibited such superior characteristics, that an attempt was made to reorder CA 32-36 to its specifications. However, two ships, the *Portland* and the *Indianapolis* had been awarded to private builders and contract changes would be far too expensive. The remaining three ships were all at Navy yards and could be modified without great expense. Thus the *Portland* Class was relegated to just two ships, while CA 37 became the lead ship for the new *New Orleans* Class cruisers.

The *New Orleans* Class cruisers corrected the weight estimation deficiencies of the previous classes, and formed a much better protected and balanced cruiser design. The *New Orleans* Class was the first US cruisers built without torpedo tubes due to war gaming results from the Naval War College which indicated that the torpedoes were unlikely to be fired from a cruiser, and more a liability than an asset. (These academic results were contradicted a number of times during World War II, when both Japanese and British cruisers used torpedoes rather effectively).

The first ship of the *New Orleans* class launched was the USS *San Francisco*, on March 9, 1933. She had a full load displacement of 11,585 tons, a design speed of 32.7 knots, and a design range of 10,000 nm at 15 knots. She had a main battery of nine 8-

inch/55 guns and an anti-aircraft battery of eight 5-inch/25 guns and eight 0.50 caliber machine guns.



Figure 6 CA 38 *San Francisco*

4.5 Geneva Summit and the London Naval Treaty of 1930

The heavy cruiser race began in earnest in 1922 with Japan's announcement of a major construction program of cruisers, destroyers, and submarines. The British, Americans, French and Italians soon followed suit. The first attempts to curtail the buildup began in 1925 through the League of Nations. These talks and a second series of talks in 1927 in Geneva both failed. The United States and Britain were fundamentally at odds on the issue of heavy cruiser buildup.

The British preference was for smaller cruisers because they were easier to build and maintain across the vast British Empire. The existence of heavy cruisers was an obvious threat to a predominantly light cruiser oriented British fleet. The British did, however, need heavy cruisers for working with the fleet. Therefore, their position was not to eliminate the heavy cruiser, but to limit its numbers.^{xxii}

For the American fleet, trade protection was not a major consideration. The US needed to maintain naval communications out to the Philippines in the Far East. Large cruisers were vital, since American refueling facilities and naval bases in the Pacific were few. The American position was to maintain the current restrictions set forth in the Washington Naval Treaty, but to control escalating costs by restricting the numbers built by the negotiating navies.^{xxiii}

The Japanese had very little use for light cruisers as trade protection was not a major concern. They instead required cruisers which could work with the fleet. The Japanese wanted parity with their American and British counterparts, and to maintain the Washington Naval Treaty restrictions concerning heavy cruisers.^{xxiv}

In the interim between the failed Geneva talks of 1927 and the London Naval Treaty of 1930, several key compromises were worked out between the negotiating parties. The United States agreed to restrict its total number of heavy cruisers to 18, and build the remainder of its tonnage allowance in light cruisers. Japan gained a higher ratio of 10:7 against the American and British light cruisers and destroyers, and maintained the 10:6 ratios in heavy cruisers. The maximum armament allowed for subsequent light cruisers was set at 6-inch guns and maximum displacement 10,000 tons.

4.5.1 Flying-Deck Cruisers

As part of the Washington Naval Treaty, the battle cruisers *Saratoga* and *Lexington* were both converted into aircraft carriers. Unfortunately, these ships together used up nearly half the carrier tonnage quota allowed to the US Navy under the Treaty, so that less tonnage remained for future construction. Furthermore, a frugal Congress kept naval appropriations so small that no new carriers could be built. The result was that the Navy, well aware of the potential of the aircraft carrier for scouting and attack duties, began to consider aircraft carrier/cruiser hybrids. Given that resources were too scarce to have both, the hope was to combine the best features of both ship types into a single cruiser class.^{xxv}

Within a few months of the conclusion of the London Naval Treaty, the Bureau of Construction and Repair was working on plans for what was called a flying-deck cruiser. The design was to incorporate as much carrier capability as possible while sacrificing the least amount of cruiser capability. All of this in a ship whose displacement could not exceed 10,000 tons.^{xxvi}

With the election of Roosevelt and the implementation of the “New Deal”, specifically manifested in the National Industrial Recovery Act of 1933, the US Navy suddenly found itself in the unexpected position of no longer needing to compromise between carriers and cruisers. Given the funds necessary to build both types of ships, the flying-deck cruiser idea was scrapped.

4.5.2 *Erie* Class Gunboats

The *Erie* Class gunboats were an updated version of the old peace cruiser with important additional wartime roles. It is because these gunboats had a role usually filled by a cruiser that they are worth some mention in this report. The roles the new gunboat would fill in a wartime setting were listed by Captain Ingersoll of Fleet Training as antisubmarine and anti-destroyer screening, high-speed minesweeping ahead of the battle fleet, tactical control of fleet submarines, plane guard duty for slow carriers, support of destroyer attacks made from ahead of an enemy fleet, convoy warfare, and fire support of amphibious operations.^{xxvii} Unfortunately the *Erie* Class was too slow to perform most of these functions.

Although the ships were intended to spend most of their service in Asiatic or Caribbean waters, their design was governed by their proposed semi-cruiser employment in wartime.

The *Erie* was designed to embark an aircraft because of the needs of the Asiatic station. The *Erie* Class gunboats could augment the dwindling number of tender-based aircraft. The hull was designed with a wide transom to facilitate minelaying or for carrying depth charges, while the rake and sheer of the bow resisted green water. Diesel propulsion was considered but abandoned in favor of steam turbines because the turbines would fit in a smaller space, and *Erie* was a tight design.

One of the problems the General Board had in choosing a final design for the *Erie* Class concerned armor: did an armored ship violate the letter or the spirit of the Treaty? The board convinced itself that it was allowed by their interpretation and the *Erie* was designed to allow the ready addition of a 3 inch side belt in time of war. While it

appears the belt was not fitted at delivery^{xxviii}, photos from the war years seem to show it.

The *Erie* class was not particularly successful. It consisted of only 2 ships; the name-ship was torpedoed in November 1942 and after being towed to harbor, capsized and became a total loss. Considering how small a ship this was, loss to one torpedo hit does not reflect badly on the design. The sister was decommissioned in 1946 after only 10 years of service.

4.5.3 *Brooklyn* Class Light Cruisers

The London Naval Treaty (1930) had the immediate effect of triggering construction of the first seven *Brooklyn* Class light cruisers. These cruisers and the *Brooklyn* based design for the *Wichita* mark a defining moment in US cruiser design. Previous cruisers had evolved steadily under the limitations of the Washington Naval Treaty while the cruisers to follow would be unfettered by Treaty limitations. The *Brooklyn* Class undoubtedly would never have been built were it not for the influence of the London Treaty of 1930. The US Navy suddenly found itself in the difficult situation of being obligated to build 6-inch gun cruisers regardless of the military value of such ships. Absent the 1930 Treaty, there is little doubt that the US Navy would have preferred improved 8-inch gun cruisers.

The legacy of the London Treaty of 1930 stretched far beyond the *Brooklyn* Class. Both major wartime classes, the *Clevelands* and the *Baltimores*, share a direct lineage with the *Brooklyn* Class cruisers. This influence was principally channeled through the *Wichita*, an 8-inch *Brooklyn* Class variant. Consequently, the unrestricted wartime cruisers were heavily based on the Treaty-restricted *Brooklyn* Class ships.

Following the ratification of the London Naval Treaty, C&R began a study of possible 6-inch gun cruiser designs. They were to have a speed equal to the 8-inch gun cruisers with as near a range to the 8-inch gun cruisers as was possible. Acceptance of the US Navy eighteen ship limit stipulated in the 1930 agreement hinged on C&R estimates that showed a well designed light cruiser could strike an acceptable balance

between guns and protection. C&R believed the ship could be made to stand up to heavy cruiser fire, while retaining adequate armament. This was based on the concept of “Immune Zone” protection, an idea which seems to have originated in the US Navy during or shortly after World War I. It was originally applied to capital ships.

The immune zone was a range band within which a ship's armor was intended to defeat enemy projectiles, as shown in Figure 7. For example, a certain cruiser might have armor designed to protect it against 8-inch shells from 15,000 yards to 22,000 yards. This means that for direct fire closer than 15,000 yards, an 8-inch shell was expected to have enough energy to penetrate the ship's side armor, but beyond 15,000 yards it did not. Beyond 15,000 yards, the shell would not have enough energy to penetrate the armor until the trajectory of the shell became so steep so that, as it plunged out of the sky, it had enough energy to penetrate the armor on the deck. This happens at 22,000 yards in the example. At 21,000 yards, a shell may hit the deck, but the angle of impact and the armor on the armored deck were expected to be sufficient to prevent it from penetrating into the ship's vitals. Also playing into the calculation of required protection was the range at which accuracy of the fire controls made hits so rare that protection at certain ranges was not warranted.

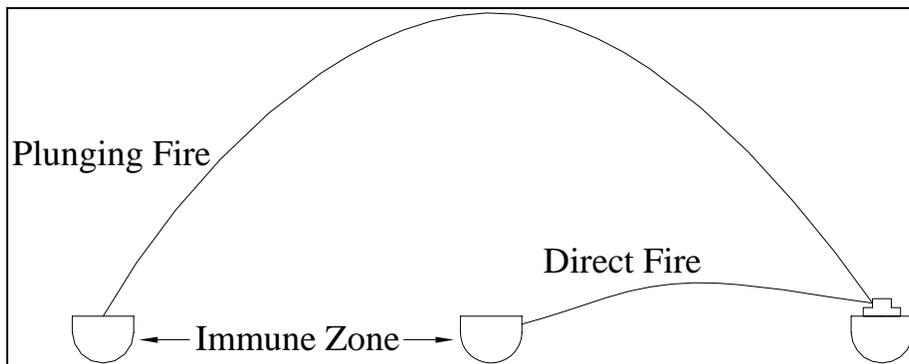


Figure 7 Immune Zone

The General Board desired a new cruiser with overmatched protection, a ship with protection against armament larger than her own. This was essential due to the number of 8-inch gun cruisers already in service with other navies which could handily defeat a 6-inch gun cruiser designed for protection against her own armament. The US

Navy believed a 6-inch gun cruiser could be designed with acceptable armament while remaining protected from 8-inch shells from a heavy cruiser. Indeed, as previously mentioned, this was the catalyst which provided US Navy acceptance of a limit of eighteen heavy cruisers, with all additional restricted to 6-inch gun maximum armament.

A number of candidate designs were developed for the new class of light cruisers. The fundamental dilemma imposed by the naval treaties was determining the right balance between capability (i.e. displacement) and numbers of ships. The US fleet would have widely differing characteristics were all of the Treaty tonnage allowance used on a large number of 6,000 ton ships versus fewer but more capable 10,000 ton ships. Also competing for Treaty tonnage would be the possible flight-deck cruisers, limiting the number of true cruisers. Admiral Pratt, the CNO, wanted experimental flight-deck cruisers and large numbers of smaller cruisers. He believed that cruisers should be used as rangers with the Scouting Fleet or with the Battle Fleet and would be able to retire back to the protection of the main fleet once they had secured the necessary information. Friedman^{xxix} notes that this view seems slightly odd in view of the later concern for using small cruisers as an anti-destroyer screen for the battle line, and in view of Pratt's feeling that aircraft had displaced cruisers as the primary scouts.

The studies that brought about the genesis of the *Brooklyn* Class were prepared in response to the Japanese *Mogami* Class light cruisers. The Japanese announced they would mount fifteen 6.1-inch guns (5 triple turrets) on a new cruiser that would make 37 knots at 8,500 standard tons. To accomplish this feat, Japanese designers resorted to the latest weight saving techniques, including light alloys in the superstructure and electric welding. On trials in 1935, the first two ships of the class had numerous problems. Firing the guns caused the welded seams to open, and the turrets frequently jammed because of deformation in the hull girder. Worse, the ships were dangerously unstable and some of the anti-aircraft guns had to be removed. Later, they were bulged to regain a safe degree of stability, and full load displacement grew to 11,200 standard tons (beyond Treaty limits) with speed dropping to 35 knots.

It never seems to have occurred to anyone at the time what would happen if a ship was over the Treaty limit at delivery; the answer, it soon developed, was nothing. This “loophole” was exploited more or less dramatically by most of the navies of the interwar period. The *Mogami* class “cheated” in another way: their turret mountings were designed to accept 8-inch twin turrets in place of the triple 6.1-inch to get around the Treaty limits on heavy cruisers. This modification was performed before the war.

However incorrect the declared specifications were, the announcement had the immediate effect of galvanizing the US Navy and setting the new design acceptable armament at a minimum of fifteen 6-inch guns. Previous studies had shown a smaller number of guns, around twelve, would result in a better balanced ship. These results were discarded in light of the new threat, and protection was to be sacrificed for increased armament, not speed.

This was a reversal of policy from heavy protection and moderate gun power towards heavy gun power at the expense of protection. The US delegation at the 1930 London Naval Treaty had accepted the Treaty limitations on the assumption that a 6-inch gun cruiser could be made to engage an 8-inch gun cruiser with some prospect of success, under the right conditions.

However, changes since 1930 had led to improved 8-inch gun cruiser designs to a point where guns, machinery, and magazines could be adequately protected within the 10,000 ton limit. Conversely, it was apparent that no fifteen gun light cruiser could be made with protection against attack by existing heavy cruisers. A twelve gun light cruiser design showed a very small, 1,600 yard immunity zone against 8-inch shells, with possible improvement with design refinement.

The designs submitted by Preliminary Design in response to the new direction made concerted steps towards reducing weight as much as possible to be placed back in as increased protection. Preliminary Design estimated that 280 tons could be moved towards protective measures by using longitudinal framing, and more general use of high-grade steels. This foreshadowed the more daring weight control program eventually incorporated during design. Weight reductions, however, were somewhat

counterbalanced by the emergence of a new long 6-inch shell which threatened new designs with increased direct fire penetration power than previously assumed. Speed was held constant at 32.5 knots for all designs with armament and protection traded between various twelve, fifteen and sixteen gun schemes.

The final decision was solidified by a comparison between the twelve and fifteen gun US designs against the *Mogami*. The fifteen gun light cruiser was shown to be superior to the twelve gun light cruiser against the Japanese design, according to Naval War College analysis. Thus, the decision was made that the new *Brooklyn* Class cruisers would mount fifteen 6-inch guns.

The design of the *Brooklyn* cruisers differed sharply from existing US cruisers. They incorporated aft aviation features that were copied on all following heavy and light cruisers, excluding the *Alaska*. They also incorporated longitudinal framing as a weight saving measure. They were the first ships in the fleet to be designed with the new 6-inch gun firing semi-fixed ammunition, a precursor to the automatic dual-purpose weapons introduced in the late WWII *Worcester* and *Des Moines* Classes. Increased protection was evaluated by lowering speed to 30 knots, but this was rejected since the slower ships would be unable to operate in formation with existing cruisers.

The weight saving pessimism seen on the *Portland* and *New Orleans* designs gave way to an undue optimism causing weight saving measures to be compulsory to stay beneath the 10,000 ton limit as the ship was further refined. The forward belt was omitted and the acceptable hull stresses increased to further shave structural weight. The first seven *Brooklyn* cruisers (CL 40 – 43, CL 46 – 49) were built to this design.



Figure 8 CL 43 *Nashville*

The first of the *Brooklyn* Class cruisers launched was the USS *Brooklyn* on November 30th, 1936. She displaced 11,581 long tons full load at a length of 608 feet overall.

The General Board considered next building a new class of cruisers with less displacement and armament, but a repeat of the *Brooklyn* Class was ultimately decided upon. CL 49–50, USS *St Louis* and USS *Helena*, were constructed as the final hulls of the *Brooklyn* Class. Friedman^{xxx} quotes the General Board in explaining their decision to repeat the *Brooklyn* Class rather than a reduced capability ship as follows:

“Since the question of numbers is necessarily regulated by the total tonnage allowed and since that total tonnage after 1936 is largely indefinite owing to the uncertainties of the 1935 Conference, the Board considers that for now the properties of the individual ship are of greater importance than the number of ships.”

This was a fortunate decision given that the 1935 conference would limit new cruisers to 8,000 tons standard, with no concurrent total tonnage limit.

The *St Louis* and *Helena* differed from the *Brooklyn* Class in a few marked ways. They mounted the new 5-in/38 guns, rather than the 5-in/25. They differed in internal machinery arrangement with two separated engine rooms made possible by smaller boilers using higher pressure, higher temperature steam. Because of these modifications, CL 49 & 50 are usually referred to as the *St Louis* Class cruisers. The *St*

Louis was launched April 15th, 1938. She displaced 11,790 long tons full load at a length of 607 feet overall.

The *Brooklyn* class was received favorably by the fleet. The rapid fire 6-inch guns received wide acclaim in the ship reports coming back to Navy Headquarters. Seakeeping was also reported to be excellent. However, it soon became apparent that in the name of weight saving, the structural integrity of the ship had been overly compromised. The *Savannah* ran over her anchor chain in a gale which sliced through her bow, causing severe damage. This led to a weakening of confidence in the survivability of the design among the fleet.

4.5.4 *USS Wichita*

Under the 1930 Treaty, a new heavy cruiser could be laid down in 1935. This was to eventually be the *USS Wichita*, a design based on the *Brooklyn* Class, 600-foot waterline hull, unlike (and longer than) any of the previous US heavy cruisers. She foreshadowed the *Baltimore* Class “production” heavy cruisers of WWII.^{xxxix}

In 1934 a modified *Brooklyn* design was proposed which would mount 3 triple 8-inch turrets, increase steaming radius, upgrade the secondary battery, and incorporate aviation aft. She was expected to have better stability and survivability owing to her smaller main compartments and greater freeboard.^{xxxix} Protection was increased throughout the ship. The advantage of split salvos in minimizing dispersion was also recognized around this time and the *Wichita*'s 8-inch turrets were designed specifically to permit the guns in it to be loaded and fired separately. The *Wichita* was launched November 16th, 1937 at a displacement of 11,581 long tons full load and a length of 608 feet.

The *Wichita* was a one of a kind design, but greatly influenced following heavy cruiser designs starting with the *Baltimores*, which started as improved *Wichitas*.



Figure 9 CA45 Wichita

4.6 The End of the Treaty Limited Cruisers

The 1930 London Naval Treaty had specified that in 1935 another naval conference should be held between the parties. As talks began, a clear delineation became apparent with the Anglo-American parties aligning against Japan's demands for full parity. Japan walked out of the talks in 1936, leaving the United States, Great Britain, and France as the only signatories of the 1936 Treaty.

The failure of Japan to abide by the Treaty's qualitative restrictions in building programs led the signatory powers to invoke the escape clauses in the Treaty. By 1938 the 1936 Treaty was effectively no longer in effect and, since the 1930 Treaty had lapsed in 1936, naval limitations of any kind no longer existed.

By 1938 Hitler and Mussolini were firmly in power and headed on a direct course for war in Europe. In the East, the steadily growing threat of Japanese Imperialism loomed larger with each passing month. It is into this world that the United States emerged from the naval limitations treaties, and began its steady slide into the global conflict soon to erupt across the globe.

4.7 Inter-War U.S. Fleet Organization and Cruiser Employment

After WWI, the United States concentrated its main battle fleet (the United States Fleet) in the Pacific, anticipating that the major future threat was Japan. By the time war broke out, the heavy cruisers were primarily assigned to the Scouting Force and the

light cruisers to the Battle Force. Both were organized into divisions of three to five ships each commanded by a rear admiral. Each of the destroyer flotillas (made up of multiple destroyer squadrons) had a light cruiser assigned as the flotilla flagship.^{xxxiii}

When this organization was adopted, the tactical doctrine was that the heavy cruiser was more versatile and suited by its heavier armament to range ahead in a scouting role and was assigned to the Scouting Force. After the enemy force was found and the fleet was getting ready for battle, the heavy cruiser took its place in the outer screen. The light cruisers stayed closer to the battle line to help defend against torpedo attacks by enemy destroyers. In this role the volume of fire from the six inch guns was more important than the greater weight and range of the eight inch gun.

At the same time, the relatively soft aircraft carriers, also assigned to the Battle Force, were originally planned to stay to the rear of the battle line where they would be safe. However, as a result of fleet exercises and experimentation, it was discovered that the best use of the aircraft carriers was to seek out and destroy the enemy carriers, thereby blinding the enemy commander. To do this, it was necessary for the carriers to operate independently and ahead of the battle line to scout for the enemy. The concern was that the carriers would encounter the enemy's heavy cruisers at night or under some other condition where they could not use their aircraft to protect themselves. The *Lexington* and *Saratoga* were initially armed with eight-inch guns for just this reason.^{xxxiv} The answer ultimately adopted was a task force organization where a division of heavy cruisers was assigned to each carrier group.

A smaller group of ships, the Asiatic Fleet, represented the U.S. interests in the pre-war Far East. Most of its units were based in the Philippines (at the time a U.S. colony) but it also included the Yangtze Patrol and the Fourth Marines, both based in China.

Through the 1930's and until the Asiatic Fleet ceased to exist in 1942, one modern heavy cruiser was the heaviest unit assigned and served as the flagship. The *USS Houston* and *USS Augusta* alternated in this role. Both ships spent a significant amount of time in Chinese waters, showing the flag and on occasion landing Marines and

sailors to protect U.S. interests. They also visited other countries in the region including Japan a number of times. On one of these visits, the *Augusta* represented the United States at the state funeral of Admiral Togo, the hero of the Russo-Japanese War. As war between the Chinese and Japanese erupted in Shanghai, the *Augusta* observed at close range and sent back intelligence reports on Japanese capabilities.^{xxxv} In addition to the heavy cruiser, the Asiatic Fleet had one light cruiser of the *Omaha* class assigned.

Photo # NH 78379 USS *Augusta* off Shanghai during fighting there, 1937



Figure 10 *USS Augusta* Observing Sino-Japanese Fighting

5. CRUISER DEVELOPMENT WWII

5.1 Foreign threats

The major foreign threat concern of the U.S. was Japan. It was assumed that if war came, the U.S. would be fighting Japan in the Pacific without other allied support.

As previously discussed, the treaties agreed upon between World War I and World War II were intended to limit the potential naval arms race between the U.S., Great Britain, Japan, France, and Italy (Germany's navy was limited by the Treaty ending WWI). While the U.S. stayed strictly within the Treaty limits, Japan exceeded the limits by as much as 30 percent.

The British followed their *Kent* and similar *London* classes with a smaller heavy cruiser with only three big gun turrets. This allowed, on a standard displacement of 8390 tons, for a 3 inch armor belt and other improvements. Two ships were built; one, *Exeter*, was later to achieve lasting fame in the Battle of the River Plate. The Royal Navy's need for large numbers of cruisers for commerce protection and Imperial defense led them to create a large class of light cruisers, the *Leanders*, of which nine were built starting in 1933. They had four twin 6-inch/50's as main armament, a top speed of 32.5 knots, and varied between 6985 and 7270 tons standard. Once the total tonnage of cruisers was limited by Treaty, the British reduced the size of this design to create the *Arethusa* class, of which six were built at 5250 tons, using the same technique that had worked with the *County*'s: eliminating one turret. Once the *Mogami*'s capability became known, the British went into panic mode and built two maxed-out, 9100 ton (standard) light cruisers with twelve guns, *Southampton* and *Newcastle*, starting in 1937. More were built after war broke out.

These British cruisers were Mahan's "far distant, storm-beaten ships" in WWII as they had been in WWI, enforcing the blockade and stopping raiders. While the English Channel could be sealed off by light forces and mines, the wide straits to the north of England were covered by cruiser patrols, since only a cruiser size ship could remain on station for long periods in the brutal North Atlantic weather. The cruisers were well armed enough to directly take on armored merchant raiders or German cruisers. They also had enough sea speed to shadow larger units while calling on the main fleet such as when the *Suffolk* and *Norfolk* detected and tracked the *Bismarck*.

Drawing on his personal experience serving on a Royal Navy cruiser in WWII, the novelist Warren Tute (*The Cruiser*, 1955) attempted to define a cruiser to his layman readership with the quote in Table 1.

Table 1 A Description of a Royal Navy cruiser

“Every man-of war is a compromise built for a special purpose – an agreed mixture of speed, armour, offensive and defensive weapons; seaworthiness and living accommodation. A battleship has huge guns, is heavily armoured but is usually slow. A destroyer has no armour, light weapons and is very fast. Midway between the two stands the cruiser – to me almost the ideal ship.

A cruiser is the smallest of the major war vessels. She has all the essentials and none of the frills. She carries a Surgeon, a Chaplain and a detachment of Royal Marines. She is an independent command in the charge of a four-ringed Captain R.N.

Her spick-and-span, spit-and-polish appearance and routine, while lacking the pomposities of a capital ship, are very far removed from the roll-top sweater and oil-stained cap of the sloop or corvette. From one point of view a small maritime township; from another a most effective expression of naval power, a cruiser is comfortable to live in and is perhaps the most versatile warship the world has seen.”

Warren Tute, *The Cruiser*, 1955, Author’s Preface

France had followed the *Duguay-Trouin’s* with a similar heavy cruiser, *Duquesne*. This two ship class, commissioned in 1928, had 8-inch guns in the same arrangement as their predecessor, but with the hull enlarged to 10,000 tons standard, 185m (606.95’) LBP, to support the heavier weapons and more AA guns. Speed was 33.75 knots on 120,000 SHP (exceeded on trials). Like the light cruisers, they had no armor, just a box of 30 mm plate around each magazine. The follow-on *Suffren* class, commissioned starting in 1930, kept the same hull dimensions but traded off engine power for additional protection compared to the earlier class. The French also completed the *Algerie* in 1934 with better protection and an improved eight-inch gun.^{xxxvi}

Italy’s *Fiume* class, commissioned in 1931, was of 11,680 tons standard, but the government simply did not admit they had exceeded the limits. These were probably the first cruisers to cheat outright on the Treaty. They were armed like the French heavy cruisers with four twin 8-inch turrets, but much better protected.

Japan's *Myoko* class (1929) also exceeded Treaty limits at 10,940 standard. With her ten 8-inch guns, eight 5-inch/40 DP guns, and 34-knot top speed, these were formidable warships. The Japanese authorities were so happy with them that they refused to reduce any of their capabilities for the next class, *Takao*, and accordingly it exceeded the limit by even more at 11,350 tons (1932).

Photo # NH 88373 Japanese heavy cruiser Haguro, circa 1931-1932

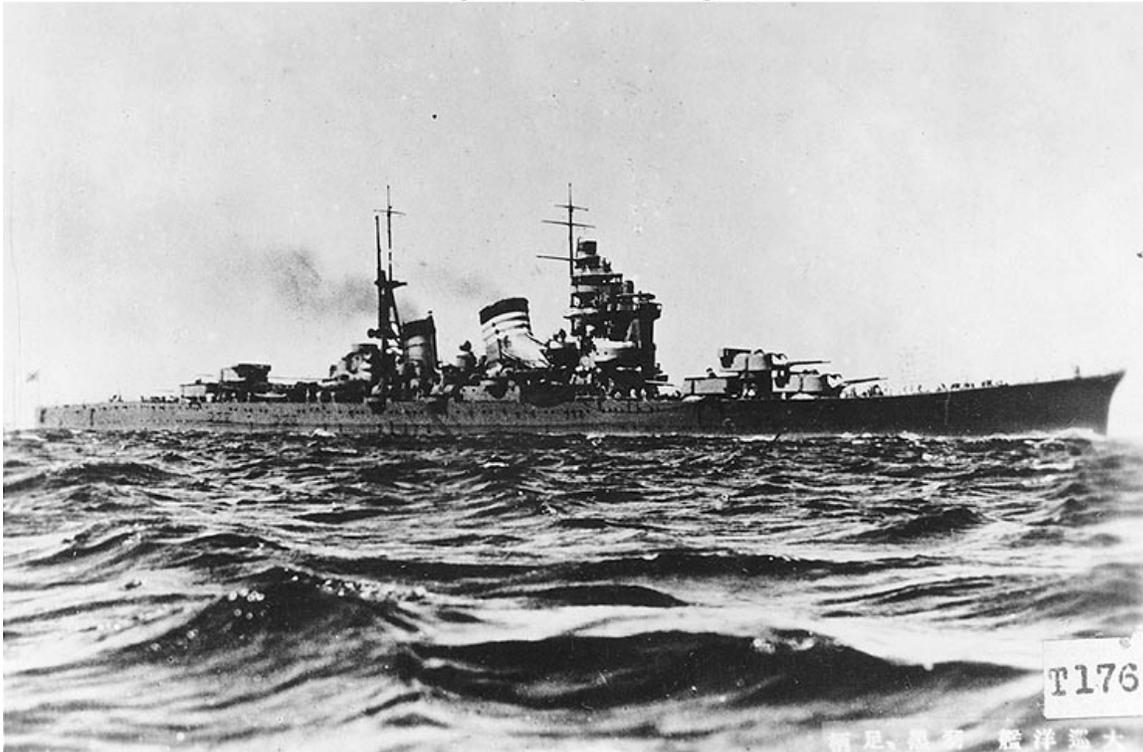


Figure 11 Japanese Heavy Cruiser *Haguro* (*Myoko* Class)

Germany rearmed steadily as it was allowed by the Versailles Treaty ending WWI, commissioning the light cruiser *Emden* in 1925. This was a 5600 standard ton ship with eight 5.9-inch (15cm) guns, some mounted in broadside like a WWI cruiser, and four torpedo tubes, with a top speed of 29 knots and a range of 5300 nm at 18 knots. The next class, *Konigsberg*, was almost 1000 tons larger; the Germans took advantage of the definition of standard displacement from the Washington Treaty to allow them to build bigger ships than the Versailles Treaty intended. These ships also made extensive

use of welding as a weight saving measure.^{xxxvii} But, these ships were overloaded with three triple 5.9's and were not successful. Then in 1929 the Germans started work on the *Deutschland* class, a 10,000 ton ship with 11-inch (28-cm) guns in two triple turrets. The size and armament of this ship was limited by the Versailles Treaty, and Germany was trying to get around these limitations. Therefore, it is hard to say exactly what this ship should be called; armored cruiser seems the closest, since she was too slow at 26 knots to be a battle cruiser. The Germans used the word "*panzerschiffe*" which just means armored ship. The British called them "pocket battleships." Diesel powered, these ships (3 were built, commissioned starting in 1933) had ranges of 10,000 miles, enough to be a formidable commerce raider. The three ships were slightly different in dimensions, the later ones being beamier and even heavier. Then after the Nazis took over Germany in 1933, the *Admiral Hipper* class heavy cruisers were built, conventional units with four twin 8-inch turrets but, at 13,900 tons, far beyond their claimed Treaty displacement.

Photo # NH 98271 World War II recognition drawings of German light cruiser Köln

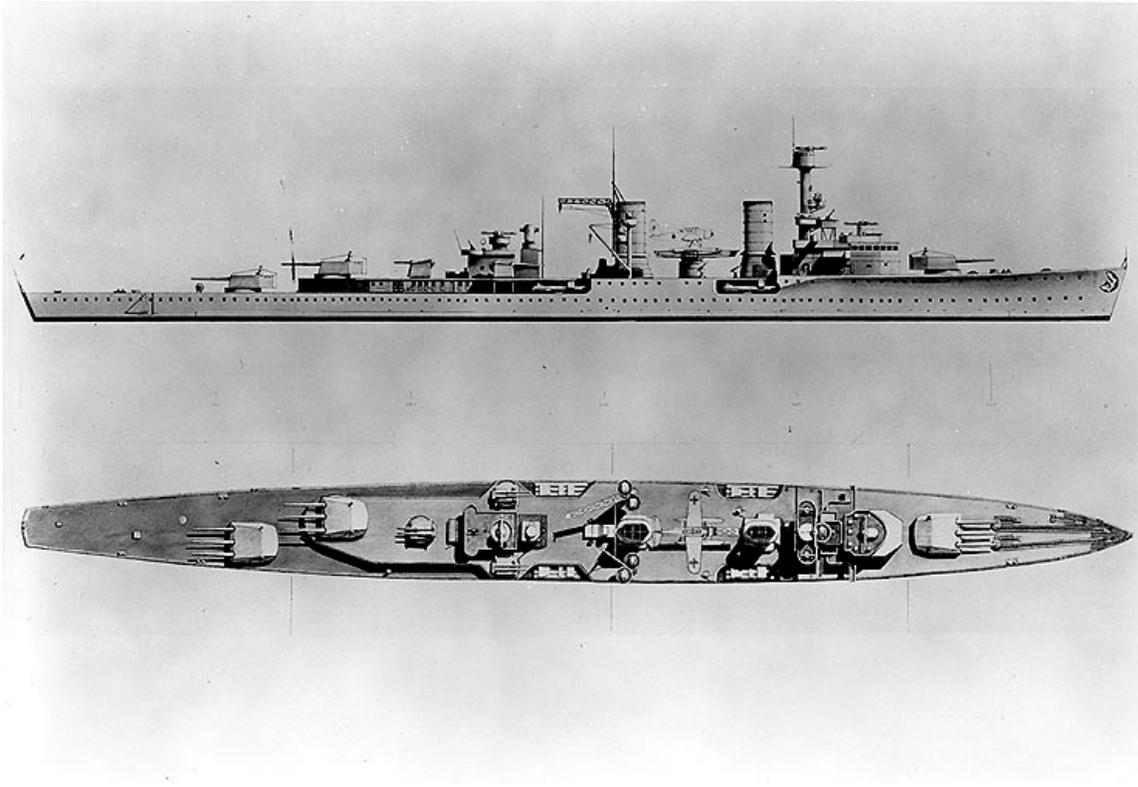


Figure 12 German Light Cruiser Köln (Königsberg Class)

The French, understandably worried about the German buildup, created a *croiseur de combat*, literally a battle cruiser, of 26,500 tons standard, and well-armed with two quadruple 13-inch/50 turrets, capable of nearly 30 knots but with only 9-inch armor. Commissioned in 1937, these *Dunkerque* class ships had both the speed and firepower to overwhelm a *Deutschland*, but they were about twice the size and cost.

The Germans responded to this development by scrapping the last two of the *Deutschland* class *panzerschiffe*, called D and E in official sources, and after a major redesign, laying new keels in 1935. These were to become the much larger battleships *Scharnhorst* and *Gneisenau* (not to be confused with the WWI armored cruisers of the same names), 26,000 tonnes standard (31,500 at delivery), with full battleship-scale armor such as a 350-mm belt (13.8 inches, more than the USN's Iowa class battleships).^{xxxviii} These ships are sometimes called battle cruisers because their big guns were of smaller caliber than battleships serving in other navies at the time, but because of their full battleship protection it seems more correct to call them battleships, as German sources do. Their top speed of 31-plus knots made them faster than most contemporary battleships but slower than most cruisers. Hitler had earlier renounced all restrictions on military rearmament. Later German warship construction included two units of an even larger *Bismarck* class of battleships, 41,700 tonnes standard displacement with 15-inch guns. These were commissioned in 1940 and 1941, and for the first time since WWI, gave Germany capital ships that were at least equal to any in the world. However, German war strategy was to use even their capital ships as commerce raiders, more of a cruiser function as described earlier.

5.2 Wartime roles and missions

World War II was, in many respects, two wars fought at the same time. The war in Europe and the Atlantic was primarily a land war with the Navy either protecting convoys, searching for and sinking submarines and surface raiders, and providing naval gunfire and other support to the landings in Africa, Italy, and France. The Pacific

war, on the other hand, was primarily a naval war as the US and Japanese navies fought to gain or maintain control of the islands from Japan to Australia.

In the Atlantic theater, the cruisers, along with destroyers (DD) and escort carriers (CVE), provided defensive screening support to Allied convoys and task forces. Cruisers played a huge role in hunting down German surface commerce raiders, a classic cruiser mission (counter-sea denial). From the beginning of the war in 1939, three British cruisers (two light and one heavy) fought the *Deutschland*-class *Admiral Graf Spee* to a standstill in the Battle of the River Plate. Other British cruisers played important roles in hunting down the battleships *Bismarck* in 1941 (with HMS *Dorsetshire* actually torpedoing the sinking wreck) and *Scharnhorst* in 1943. The cruisers provided naval gunfire support to all the allied landings beginning with the landings in Africa. During the African landings the cruisers engaged and neutralized the French ships located in a nearby harbor. They also engaged the Italian Navy ships in the Mediterranean. They provided naval gunfire support as well as anti-aircraft support to the landings in North Africa, Italy, and at Normandy. The USS *Augusta*, CA 31, served as President Franklin Roosevelt's personal flagship for his meetings with Winston Churchill at the beginning of the war in Newfoundland, and with Churchill and Stalin at Yalta near the end of the European war.

In the Pacific, the U.S. cruisers fulfilled multiple roles: fleet and task group flagships, carrier/task force screening, convoy escort and protection, surface task forces, naval gun fire support for the marine and army landings, and some merchant interdiction.

In the Solomon Islands, the loss of the American battle line at Pearl Harbor led to cruisers being the heaviest U.S. units available to face the Japanese forces (in some cases including battleships) trying to attack the U.S. forces ashore at Guadalcanal. This led to some extremely heavy losses until improved tactics using radar and properly coordinating the cruisers and destroyers were developed. Subsequently as U.S. forces moved up the islands driving the Japanese forces back and establishing naval and air bases in the islands the cruisers were a major source of naval gunfire support to these

island invasions as the war moved across the Pacific. In the north Pacific the Japanese had occupied a few of the western Aleutian Islands threatening to move down the island chain and possibly attack mainland U.S. targets. This advance was stopped and the Japanese invaders were eventually forced off the islands. The naval support for this effort was primarily by surface task forces without carriers led by cruisers.

During WWII, most cruisers carried four Curtis SOC *Seagull* floatplanes (two on the catapults and two in the hangar). The SOC was a biplane and rather old but was more suitable for cruisers than the more modern OS2U *Kingfisher* because it had folding wings.

Photo # NH 85630 SOC in the hangar on USS Savannah, circa 1938

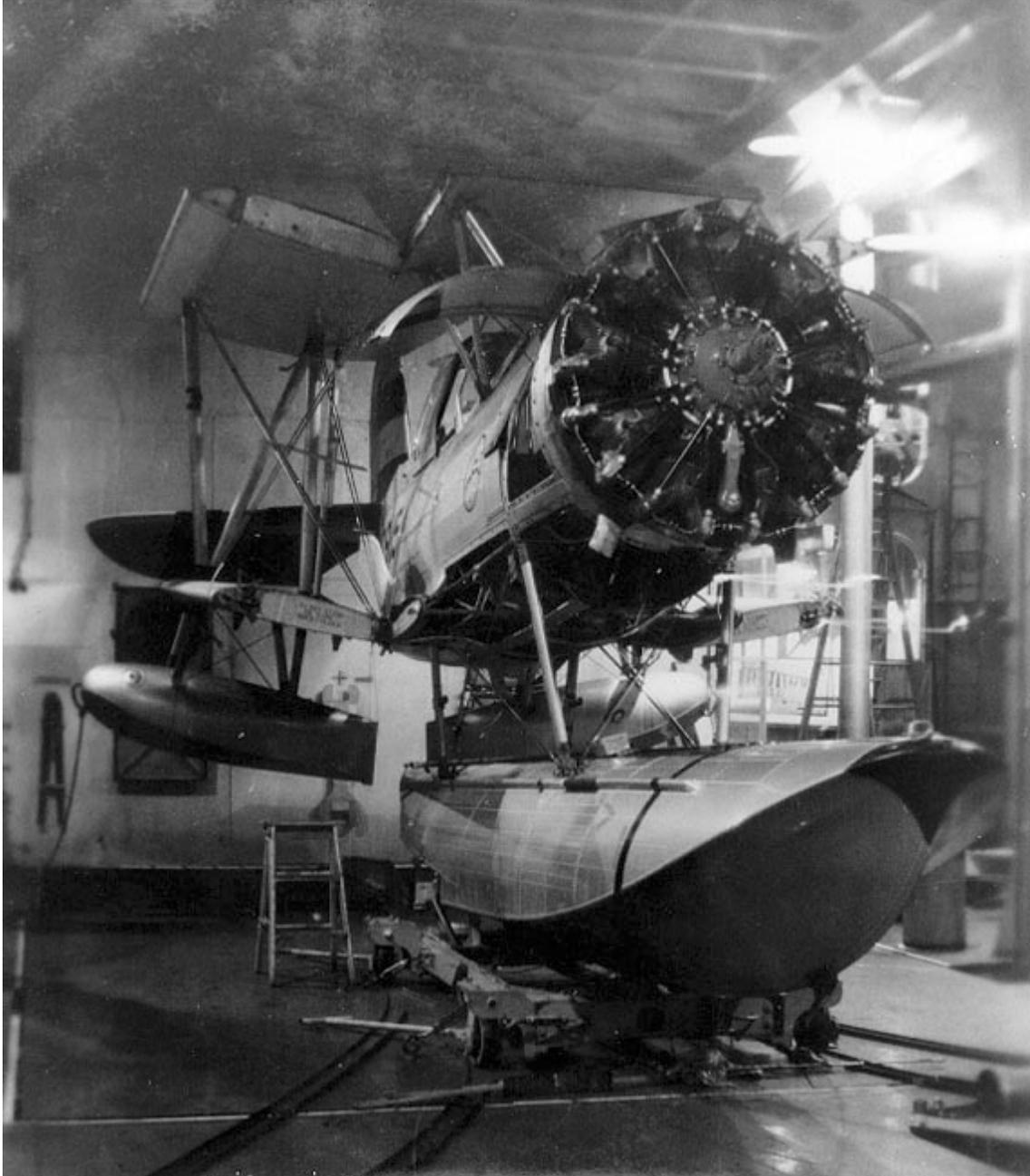


Figure 13 SOC *Seagull* in Cruiser Hangar

The floatplanes had several different roles. Even though the function of scouting for the enemy fleet had largely been taken over by carrier based aircraft, they were still used for anti-submarine patrols around the task force. Other missions included delivering messages during times of radio silence, towing target sleeves for anti-aircraft practice, rescue of downed pilots and of course gunfire spotting for the cruiser. When

escorting a carrier though, if an air attack was expected, flight operations were curtailed because the maneuvering required for launch and recovery would reduce the effectiveness of the anti-aircraft fire.^{xxxix}

One cruiser, USS *Indianapolis* CA 35, played an important part in the end of the war in the Pacific. Following battle damage repairs in Mare Island, CA the *Indianapolis* received orders to proceed at high speed to Tinian, carrying parts and nuclear material to be used in the atomic bombs which were soon to be dropped on Hiroshima and Nagasaki. Due to the urgency of her mission, *Indianapolis* departed San Francisco on 16 July, foregoing her post repair shakedown period. Stopping briefly at Pearl Harbor 19 July 1945, she raced on unescorted and arrived Tinian 26 July, having set a record in covering some 5000 miles from San Francisco in only 10 days (an average of 21 knots).

During the war the US Navy lost ten cruisers, seven heavy cruisers (CA 26, 29, 30, 34, 35, 39, and 44), and three light cruisers (CL 50, 51, 52). All but one of these losses was in the area of the Solomon Islands during the struggle for control of those islands. All these cruisers were sunk by hits from the Japanese Long Lance torpedo. The lone exception was the loss of *Indianapolis* less than two weeks before the end of the war to a submarine in the Philippine Sea after she delivered the atomic bomb material to Tinian. There were no cruisers lost to aircraft bombs or torpedoes, or to the Japanese suicide bombers.

5.3 Wartime Design Evolution and Building Program

During the period before the war from 1924 through 1941 the U.S. Navy commissioned 33 cruisers, an average of 1.8 new cruisers per year. Eleven of these cruisers were commissioned in 1937 – 1939 (9 CLs & 2 CAs) as part of the Roosevelt Administration's WPA "make-work" projects. But, by 1940, with the war going badly in Europe, even this rate of production seemed inadequate. When Congress authorized a 70% expansion of the Navy (the Vinson-Trammell Act) there was a scramble to increase production of all types of warships. Accordingly, the Navy elected to make

only those improvements that would not delay production, relying as much as possible on the existing designs which were considered satisfactory even if not optimum.

In 1942 eight CLs were commissioned and in 1943 seven more CLs and four CAs were commissioned. This building rate continued through the end of the war with 11 cruisers commissioned in 1944 and 18 in 1945. These cruisers were (mostly) divided into *Cleveland* class light cruisers (improved *Brooklyns*) and *Baltimore* class heavy cruisers (improved *Wichitas*). The General Board was not entirely happy with either design; as a result of Treaty limitations and technological changes, the *Cleveland's* were too slow compared to the *Iowa* class battleships and the *Baltimores* lacked protection against more recent 8-inch shells. These arguments were swept away by “mobilization production fever.” Design activity continued, but could not be allowed to hamper production.

With the start of the war, all Treaty restrictions were no longer in force. The U.S. Navy designed two new cruisers, the *Cleveland* class light cruiser (CL) and the *Baltimore* class heavy Cruiser (CA). *Cleveland* was developed from the *Brooklyn* design, while *Baltimore* was based on the heavy cruiser *Wichita*, itself a *Brooklyn* derivative. The *Cleveland* Class had twelve 6-inch/47 in four triple turrets (2 forward, 2 aft) and twelve 5-inch/38 in twin mounts (one each on the center line fore and aft and two each on either side of the ship).

The *Baltimore* class was an enlarged *Wichita*. The *Baltimore* class had three triple 8-inch/55 turrets (two forward and one aft) and six twin - 5-inch/38 mounts (one each on the centerline fore and aft, and two on each side).

World War II saw a major increase in radar technology with new surface search, air search, and fire control radars being developed and installed on the cruisers throughout the war. The growth of radar and the air threat created a need to assimilate a growing amount of information, evaluate it quickly, and then respond to multiple targets. This led to the creation of Combat Information Centers (CIC) in combatants, which grew in the size and importance as technology proliferated. Earlier cruisers had to find space for CIC in their superstructure, but later cruisers (*Fargo* (improved

Cleveland), *Oregon City* (improved *Baltimore*), and *Juneau* (improved *Atlanta*) classes) incorporated fully protected CICs inside the armored box.

As the war proceeded it became clear that the anti-aircraft capabilities of the cruisers had to be improved. This improvement generally involved removing the unreliable 1.1-inch rapid fire AA machine gun (which was complex and developed a poor reputation in service^{xl}) and replacing them with the foreign designed 40mm and 20mm AA guns, as well as adding as many 40mm and 20mm guns as could be fitted on the ship without over loading the hull. Additionally, open bridges were added to allow improved aircraft sight lines for directing the AAW efforts. Many of the cruisers were critically close to being overweight, so to compensate for the additional AAW guns being installed, items had to be removed, such as one of the two aircraft catapults, range finders from some of the turrets, and reducing the height of the masts. When the Japanese began using kamikaze tactics the need for heavier AA weapons became apparent. In addition to adding more AA weapons, multiple AA fire control directors were added. To improve the ability to engage crossing targets, AA guns (usually 40mm) were mounted in the bow and on the stern.

A cruiser hull also had the speed, endurance, and capacity to perform as a light carrier. Nine USN light cruisers (*Cleveland* class) were converted to CVL's (small aircraft carriers) while under construction. These 14,750 ton ships became the *Independence* class. While a small carrier was limited in how many aircraft it could support, the need for additional sea-based air platforms in WWII was very great. This use of cruiser hulls recalled conversions performed by the Royal Navy in the WWI era on the battle cruisers *Courageous*, *Glorious* and *Furious*. The US CVL's used the original cruiser machinery and basic hull, bulged to improve stability, but had all their armament and superstructures removed. A hangar deck and flight deck were added, with funnels trunked over to starboard and a small island. Top speed was 31.6 knots. Many of these ships served along with fleet carriers in Pacific task forces. After the war, they were quickly decommissioned because they were near their stability and volume limits at delivery.

However, a second, *Saipan* class of CVL's was also built, based on the *Baltimore* class heavy cruiser hull widened on paper prior to the start of construction. These 19,100 ton ships had much more growth potential and served as carriers or command ships into the 1970's.

5.4 New US Wartime Designs

In addition to cruiser types that had been in production prior to the war, additional types were introduced during the conflict. These were a specialized minelayer, the battle cruiser, new only to the US Navy, and the anti-aircraft cruiser. Also, small aircraft carriers were built on cruiser hulls.

Many light cruisers were fitted with weather deck mine rails in order to dash into enemy coastal waters and lay down a disruptive string of mines. The mission was so highly thought of that the UK, after a conversion of an existing cruiser (the *Adventure*), built the six ships of *Abdiel* class of cruiser-minelayers just before the war. These 4,000 full load ton ships, fitted with six 4 in AA guns, carried 100-156 mines within their hull. The ship did not do much offensive mine laying in WWII (that role taken over by airplanes) but were found to be excellent fast, heavily-armed transports for emergency shipments of ammunition through the blockade of Malta.^{xli} Separately, the USN constructed the 8640 ton full load *Terror* (CM 5) (Figure 14), armed with four 5-inch guns and built to cruiser standards, in 1941 for offensive laying of up to 800-875 mines.^{xlii}

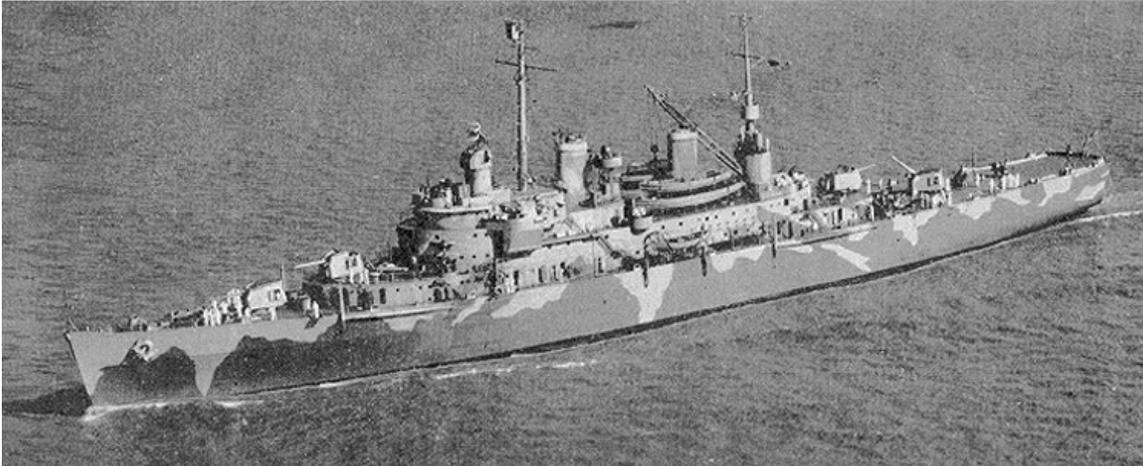


Figure 14 USS *Terror* (CM 5)

Prior to the start of the war the Navy began design work on a 12-inch gun cruiser in response to a belief that Japan was planning to build a 12 or 14-inch gun cruiser. This design work evolved into the *Alaska* Class battle cruiser (CB); the designator actually means large cruiser, as distinct from the battle cruisers that were cancelled in 1922, but functionally these ships were battle cruisers. Six CBs were planned, three were launched, but only two were commissioned. The *Alaska*, CB 1, and *Guam*, CB 2 were launched in 1944 and saw action in the Pacific. Both were used primarily to provide protection to the carrier task groups and also to provide naval gunfire support. Construction of the third CB, the *Hawaii*, CB 3, was suspended in February 1947 when she was about 80 percent complete. These ships were suitable to counter the threat of the *Deutschland* class *panzerschiffe* and *Scharnhorst* class battleships but sources conflict on whether this was a consideration in their design.

In 1935, an experimental modernization was carried out on two British cruisers of WWI vintage, *Coventry* and *Curlew*. Their 6-inch main armament was removed and replaced by 4-inch antiaircraft weapons, “for use in the Mediterranean as AA escorts.”^{xliii} The idea of a specialized AA ship gained surprising traction with the Admiralty (considering how little experience then existed to show how important AA defense was to a fleet). A new 5.25-inch dual purpose gun was being developed for the new *King George V* class battleships, and a new small cruiser was designed, the *Dido*

class, to mount 5 twin turrets of these on some 6850 tons full load displacement. These little ships had 62,000 SHP in a 4-screw power plant, good for 32-plus knots top speed and 4240 miles of range at 16 knots. They were adapted from a more conventional light cruiser design, the *Arethusa* class, already mentioned in the prewar section. *Arethusas* were successful as flotilla leaders. *Didos* were ordered in 1939 and 16 were produced; however, production of the ships outstripped production of the 5.25-inch guns, and some were commissioned with only 4 turrets while others had a turret removed later.

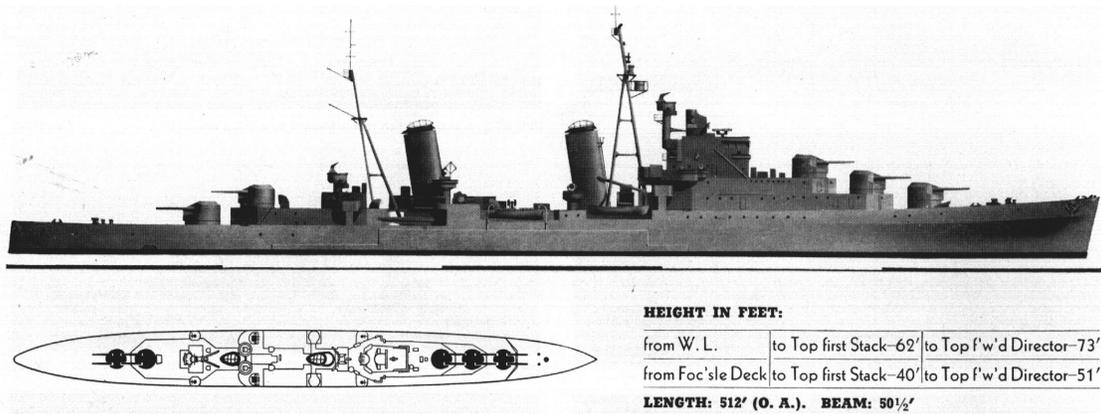


Figure 15 HMS Dido Antiaircraft Cruiser

The American version of the anti-aircraft cruiser is the *Atlanta* (CL 51) class. While its armament resembled the *Dido*'s in photos with three twin turrets forward of the bridge, the actual layout was much different with a total of 8 dual purpose, 5-inch/38 twin turrets. The propulsion plant was also much different with twin screw, 75,000 SHP for a similar top speed of 32.5 knots. Both ships were adequately armored – *Atlanta* had a 3.75-inch belt and 1.25-inch deck, with both being part of the hull girder; she was larger at 8340 tons full load.

Perhaps coincidentally, one of the intended functions of the CL 51 class was to replace aging *Omaha* class flotilla leaders for use in destroyer warfare. A flotilla leader protects destroyers against enemy surface and air attack while the destroyers carry out a torpedo attack against enemy capital ships. The type, sometimes called a destroyer leader, originated with HMS *Swift* in 1907. High speed is usual in flotilla leaders, and *Atlanta* was less outstanding than the *Omaha*'s had been in this respect. However, her

ability to protect against air attack was excellent. Unlike most US cruisers of the period she was equipped with torpedo tubes and depth charges, reflecting her destroyer-like mission. But, *Atlantas* were also intended as close screens for the battle line, protecting the capital ships against destroyer attack.

Photo # NH 57453 USS Atlanta underway, circa late 1941



Figure 16 *USS Atlanta* Antiaircraft Cruiser.

In common with many other cruisers, the *Atlantas* were sometimes used for different functions from those for which they were designed. As a result, two of them were sunk by Japanese cruisers and destroyers while formed up in a battle line of larger US cruisers on 13 November, 1942. The class was most successful as part of the AAW screen around fast carriers, foreshadowing the function of later DL and DLG designs.

6. CRUISER DEVELOPMENT POST WWII TO EARLY 1960'S

6.1 Post WWII Political Environment and Fleet Employment

When World War II ended in 1945, it appeared that air power had been the decisive element in achieving victory in both European and Pacific theaters. Strategic bombing, it was claimed, had weakened the German war machine to the point that the D-Day invasion could succeed, and in the Pacific, of course, the surrender of Japan resulted from the dropping of two nuclear bombs from high-flying heavy bombers. While traditional functions of sea power had also played a very important role in keeping lines of communication with Britain open in the Battle of the Atlantic, and in getting control of the Pacific from Japan, these activities were less dramatic and perhaps less obvious to the non-expert. The aircraft carrier had entirely displaced the battleship as the capital ship of major navies for sea control activities, although the latter still were favored for shore bombardment and antiaircraft screening of the carriers.

At the conclusion of World War II the United States had a large fleet that included light and heavy cruisers in commission with several more under construction. During the postwar period that followed, the United States had to transition from a war footing to a cold-war period of peace. Planners for the military budgets began to question the need for such a large navy. In response, U.S. Navy spokesmen pointed to the need to defend the homeland, to maintain the Monroe Doctrine, and to have the United States preserve the peace of the world. However, President Harry S. Truman wanted to cut deficit spending and ordered defense funding slashed, while relying on nuclear technology to keep the peace. Many ships were decommissioned and even those remaining in service were not always adequately manned.

Tensions with the Soviet Union led to new commitments overseas in the late 1940's. In the Mediterranean, traditionally dominated by the Royal Navy, the United States picked up the slack when Great Britain cut their forces there. Cruisers and other ships made numerous port visits, showing the flag and demonstrating U.S. support to local governments threatened by the Communists. This small initial force ultimately

became the Sixth Fleet and was a major commitment for the Atlantic Fleet through the Cold War.^{xliv}

In the Far East, the mission of the pre-war Asiatic Fleet was continued by Naval Forces Far East, based in Japan, and the Seventh Fleet in the Philippines. These were both much smaller than the names imply and each had a single cruiser assigned as a flagship. With the outbreak of the Korean War, these cruisers, supplemented by Royal Navy cruisers based in the Far East, quickly began shore bombardment duties, supporting the lightly equipped troops ashore.^{xlv}

6.2 Surface Warfare and Shore Bombardment Missions

In this environment, it is ironic that in spite of budget cuts following the war, cruisers continued to be built, and some of them were intended for traditional cruiser missions. The reason for this was that during the war, the Bureau of Ships (BuShips, founded in 1940 from consolidation of the Bureau of Construction and Repair and the Bureau of Engineering) continued designing improved cruisers incorporating the lessons learned through war experience. Freed from Treaty tonnage limits although still concerned about the rapid increase in ship size, BuShips designers attempted to improve main armament performance and survivability compared to the wartime “Tinclads.” Experience in night battles in the Solomon Islands showed that the lower rate of fire of 8-inch guns made it difficult to hit a high speed, maneuvering target, while 6-inch guns were deficient in range.

6.2.1 Culmination of the Heavy Cruiser’s Evolution: *Des Moines* Class

The key to the postwar heavy cruiser design was the fully automatic 8-inch 55-cal. gun. The Bureau of Ordnance (BuOrd), even prior to the war, had been working on larger guns firing cased ammunition, a 6-inch 47 dual purpose, and later (May 1943) the 8-inch 55.^{xlvi} The automatic loading equipment allowed a much higher rate of fire (7 rounds per minute per barrel by design, about twice what previous heavy cruisers could achieve); reloading could occur at any elevation, giving even this major caliber gun a limited antiaircraft capability.

In the design of the new heavy cruiser, both length and beam were allowed to increase to handle the added weight of the new gun turrets and better protection. Power remained the same at 120,000 SHP through 4 shafts, but because the hull was so much larger, it was possible to re-arrange the machinery spaces to have one boiler and one turbine set in each, similar to contemporary battleship practice. Increased length of the hull reduced the wave drag enough that there was little effect on speed in spite of the increase in displacement compared to *Oregon City* class cruisers. The new machinery arrangement provided increased redundancy with reduced need for cross connects that could be damaged in the destroyer (and previous cruiser) arrangement “in echelon”, where boiler rooms and engine rooms alternated (usually, in cruisers, with two turbine sets per engine room). In addition, subdivision bulkheads within the central citadel were extra-thick at .75 inch and made of STS, highly resistant to splinters. The armor belt was 6 inch to 4 inch in thickness, with 5-inch bulkheads at fore and aft ends of the citadel, and a 3.5 -inch protective deck with, as in US battleships, a 1-inch “bursting deck” over it. Internal subdivision was elaborate even above the V-lines, where an extensive series of fire doors could isolate damaged areas.

Like most World War II cruisers, the aircraft hangar was in the stern to reduce the risk of gasoline-fueled fires such as those that had engulfed many US cruisers in the surface actions of the war. The hangar was accessed through a deck hatch with the aircraft lowered into it by a crane. Two catapults were provided in the original design, but seem never to have been installed. By 1948 the Sikorsky HO3S helicopter had begun to supplement the floatplanes on cruisers and had completely replaced them by 1949. The ships spent most of their sea time using the afterdeck as a boat facility (the aircraft crane served admirably for launching and recovering boats). Scouting functions had shifted to aircraft carriers.

By the time the name-ship *Des Moines* was commissioned (November 1948), the probability of a surface action with enemy cruisers was very small. However, the three-ship class was admirably suited as fleet flagships and for shore bombardment. All three ships served as flagships of the Sixth Fleet. Only *Newport News* (CA 148), commissioned

in Jan 1949, used her big guns extensively, and that was on the gun line in Vietnam. *Newport News* and *Salem* (CA 138) were air conditioned; the name-ship *Des Moines* (CA 134) was not.

As classic heavy cruisers, these ships displayed superior firepower, speed, seakeeping, and protection. They could have served as anti-surface raider screens for convoys or task forces in World War II type combat, although they lacked the speed to escape from the fastest of WWII battleships at 32+ knots on trials, and could not stand up to a *Deutschland* or *Scharnhorst* class surface raider. They did good service as flagships and were effective in shore bombardment, although for that mission it is questionable if the rapid fire feature of their big guns was of much benefit. It should be noted that their ammunition capacity was not enhanced compared to WWII production heavy cruisers. In fact, they were obsolescent at commissioning.

6.3 Task Force Air Defense Mission

With the emergence of air power as the trump card in American military strategy, and the “revolt of the admirals” having been put down, naval carrier task forces assumed a tactical role equivalent to battleships in Mahan’s classical doctrine. Both in blue water operations and in power projection missions where air strikes would be launched from the carrier against shore targets, there was an important anti-air warfare (AAW) role for screening ships to protect the carrier from enemy air attacks. Naturally, a carrier could launch short range fighters to provide air cover, but not in all weather conditions in which shore based aircraft could attack. In World War II it became clear that a carrier group needed a deeper defense with surface ships equipped with radar and AAW weapons spread out around the carrier.

During this period the U.S. Navy also recognized the need to respond to new technology, the anti-ship missile and faster aircraft. During the summer of 1943 the Germans introduced the FX-1400 air-launched, radio-controlled anti-ship missile. These missiles weighed about 3,000 pounds and when launched from the correct height could attain a terminal velocity of 800 feet per second, similar to an artillery shell. On 9

September 1943, the Italian Fleet was on its way to surrender to the Allies in Malta when one of Italy's newest battleships, *Roma*, was hit with one of these missiles that caused one of the forward main gun magazines to explode. The battleship broke in two and sank. Another exploded alongside the new battleship *Littorio*, damaging its shell plating. During the invasion of Salerno the U.S. light cruiser *Savannah* was struck by one of these missiles on 11 September 1943. Although the missile exploded in the magazines of No. 3 turret, inrushing water prevented further explosions. On 16 September 1943 the British battleship *Warspite* was hit by two missiles off Salerno, one that passed through all decks, including the armor deck, and through Boiler Room No. 4, finally exploding in the double bottom. This caused severe damage to the under bottom structure. A second bomb exploded in the water alongside Boiler Room No. 5, causing damage to the shell plating.

Experience of Kamikaze attacks in World War II showed that for an airplane diving into a ship with the intention of crashing, an attack profile that resembled a guided missile's, hitting it with the short range AA guns of the period was not enough. The 40-mm Bofors mounts had an effective range of 2,500 to 3,000 yards. The 20-mm Oerlikon was effective against aircraft at less than 1,000 yards. A direct hit from a 20 or 40-mm shell caused the kamikaze to break up, but the pieces continued on in a ballistic trajectory along with the burning fuel to hit the defending ship. Even within this limited range, the majority of shells fired would still miss their intended target; 400 to 500 rounds of 40-mm was needed to achieve a kill. It was necessary to hit the attacking aircraft when it was further away from the ship than the effective range of these smaller weapons of World War II. The 5-inch 38 had an effective range of 7,000 to 10,000 yards, and it could reliably stop a Kamikaze before it entered its final dive. Its effectiveness increased by about a factor of five when the Variable Time/proximity (VT) fuse was introduced.^{xlvii}

The Japanese were also working on a "Baka" bomb, a manned suicide missile patterned on the German V-1 that because of its higher speed represented even a greater threat. This combat experience drove the development of a number of new AA

weapons that came into use in the postwar period. One was the 3"/50 gun, chosen both for its longer effective range compared to the 40-mm guns it replaced and for its ability to carry the VT fuse.

6.3.1 The Antiaircraft Cruiser

Antiaircraft cruisers evolved during World War II and were discussed in a previous section. The automatic 6-inch 47 gun mentioned earlier was mainly inspired by the need for a heavier, longer range AAW gun to attack heavy land-based bombers, then anti-ship missiles. Accordingly, BuShips developed a new antiaircraft cruiser around this high angle gun. However, the new cruiser proved to be much bigger than its 8500 ton predecessor. Because of the greater size of the turrets and the increased protection and sturdier construction incorporating war experience, the new ship was actually close to 18,000 tons, with the same power as the contemporary heavy cruiser (wartime light cruisers had been found to be slower than predicted, so more speed was another requirement for keeping station on a carrier). There was no secondary battery, since the six twin turrets for the main armament were dual purpose, greatly simplifying fire direction. Only two were built, *Worcester* (CL 144) and *Roanoke* (CL 145). They were commissioned in 1948 and 1949 respectively and served only until 1958, being maintained in mothballs for a substantial time after that.

The gun-armed antiaircraft cruiser proved to be a dead end in cruiser design. The large automatic gun turned out to be unreliable, and as aircraft speeds increased and smaller, more agile fighter-bombers became more common, it became apparent that missiles or smaller guns were a better bet to defend the task force against air attack. The *Worcester* class was obsolete when commissioned, and because of its low freeboard (an attempt to reduce the ships' huge size), had a reputation for being wet. They did not, like the *Des Moines* class, find a secondary mission they could take over to prolong their useful lives.



Figure 17 *USS Worcester* Anti-aircraft Cruiser

6.3.2 Missile developments

Towards the end of World War II, in both theaters of the war, serious airborne threats appeared. In the European theater, the Germans deployed guided glider bombs (previously mentioned) that made it possible for a bomber to attack a ship without coming very close to it. In the Pacific, the Japanese Kamikazes showed how much damage a guided missile could do if it hit a ship, as well as how much harder it was to shoot down the attackers compared to conventional bombers. Since an aircraft carrier, especially in that time period when instrument flight was in its infancy and the carriers were much smaller than they are today, might under some weather conditions be unable to launch fighters, AAW capability in the surface screen was essential. And with the new stand-off threat coupled with the indifferent performance of the 6-inch/47 automatic gun, it was evident well before 1950 that surface to air missiles were one promising answer. Surface to surface missiles were also shown to be effective by experience with the German V-1 and V-2.

By 1944, a “Project Bumblebee” existed at the Applied Physics Lab (APL), to develop a ramjet-powered surface to air missile (SAM), eventually to see production as the Talos. Rear Adm. H. G. Bowen, who also had had a role in the 600-psi steam plant

development before the war, headed the Navy's R & D office in the postwar period. He recognized that SAM's would require extensive ship volume to deploy. Destroyers of the time were too small, battleships had more weight-carrying capacity than cruisers without so much more enclosed volume. Cruisers seemed adequate to the task and, more important, there were a large number of them that were no longer needed for traditional cruiser missions with the disappearance of an enemy surface fleet. Battleship conversions would also have involved removal of some heavy armor to provide large enough spaces for missile handling; this would compromise survivability. By 1955-6, the Terrier missile would be ready to enter service after a high priority development program at APL and the Navy Research Lab (NRL).

A very serious drawback to the whole concept of a SAM was (and is) that in order for the missile to find its target, an incoming aircraft at first and later an incoming missile that could be much smaller, it was necessary to have a long range, high accuracy radar to find the target far enough away to give time to achieve a firing solution. Also, a fire control radar (that could be the same device) had to track the SAM and the target during the flight of the SAM and either give the latter command guidance, or provide enough information that the SAM's warhead could calculate interception courses and guide itself to the target. This led to enormous demands for complexity in the ship's electronic installation, and also to substantial electronic "smarts" in the missile itself, so that a small weapon could not contain the necessary equipment. The large size of the warhead dictated rather a big missile, with dire results in terms of high cost and large volumes required to install it in a ship. Needless to say, there's only so much complexity that can be put into something that will only be used once. And as hardware evolved, it became apparent that early SAM's were not very accurate or reliable.

6.3.3 Electronics

One of the most significant developments in post-World War II cruiser design were the rapid advancements in electronics, both radar and sonar, that would be able to

detect threats at longer ranges than had been possible in World War II. The growth in electronic equipment had significant effects on ship size, configuration, powering, and cost. All of the electronics and weapons had to be controlled by the ship's Command and Control system. This greatly increased the volume of electronic spaces for communications, computers, and control equipment, particularly in the Combat Information Center (CIC). This was important because with the increased speeds of the submarine, small missile boats, missiles, and aircraft, targets had to be identified at greater distances from the ship. This also required correct placement of this equipment and antennas to minimize interference with each other. The radiation emitted by these more powerful radars presented an increased hazard to personnel, restricting the admissible locations of the antennas and complicating superstructure and mast arrangements. All of these topside electronic devices, guided missile installations, and the larger superstructures to support and house them resulted in higher vertical centers of gravity, affecting stability of the ship. Therefore, aluminum superstructures were used in cruisers, destroyers, and frigates to reduce topside weight. Topside weight also tended to lead to larger beam, changing the proportions of the ships.

6.3.4 Missile Cruiser Conversions

Conversion plans were developed for the battle cruiser *Hawaii* and the unfinished battleship *Kentucky*. These plans were cancelled as it became apparent that the missiles were not sufficiently mature. *Boston* and *Canberra*, two *Baltimore*-class heavy cruisers from WWII production, were converted to CAG 1 and 2 respectively in 1952. Each ship had two Terrier launchers in X and Y (aft) positions, retaining A and B turrets with the original 8-inch guns. The aft 8-inch turret (including its armored barrette) and the aft 5-inch /38 twin had been removed. A lattice foremast carried an SPS-8 height-finding radar, while a new pole mainmast carried a CXRX hemispheric scan radar used for missile target acquisition. Aft of that there were two illuminators; only two missiles could be airborne at a time, even though each launcher was double-

arm. Evidently, this was not a very good solution and could easily be saturated by even a small attack.

Next, BuShips sought a conversion candidate for the larger, ramjet-powered Talos missile. The Talos antiaircraft missile was a long-range, ramjet, beam-riding surface to air missile with semi-active terminal homing; it was introduced in 1957. The Talos missile was therefore larger than Terrier and called for even more elaborate guidance equipment. Because of a belief, which seems rather irrational in hindsight, that there would eventually be numerous Talos conversions, the few heavy cruisers available were considered unsuitable for conversion because they didn't provide a sufficient number of identical hulls. Therefore, the Bureau picked the *Cleveland* class light cruisers, all of them in reserve by this time, as candidates. The first to be converted was *Galveston*, recommissioned in 1958. The other two ships with similar conversions differed in that they had flag facilities; they were *Little Rock* and *Oklahoma City* (1960). In these conversions, the two aft 6-inch turrets and three aft 5-inch turrets were removed and a complete new aft superstructure was provided to house the missiles and guidance radars. New search radars were also installed. In the flag conversions, B turret was removed and two of the forward 5-inch guns were removed; one 5-inch twin was mounted in B position and the superstructure was expanded to provide accommodation.

Similar conversions were performed for Terrier from identical *Cleveland* class hulls, *Providence*, *Springfield*, and *Topeka*. These differed from the *Boston* class in that they mounted only one Terrier launcher aft, but had substantially better electronics, including two missile control radars (one per launcher arm). The light cruiser hulls were smaller than the *Baltimore* class hull, and therefore could not support two launchers.

The air threat to a task force was still a dominant element in US strategic thinking, while the long term need for gunfire support had yet to register before Vietnam. Also, actual missile combat experience was lacking, so that decision makers tended to believe the claims of a high kill ratio made by SAM proponents. Accordingly,

in 1962, the US commissioned its first “double-ended and double-sided” missile conversion of a heavy cruiser. This *Albany* class of 3 ships (two additional sisters were cancelled) had no guns at all as designed. Two of these were *Oregon City* class ships, (CA 123 and CA136), and one was *Baltimore* class (CA 74), all commissioned 1945-6 and identical after conversion. With a futuristic superstructure of enormous height and the funnels and masts integrated into “macks”, the main armament was Talos with launchers fore and aft, and Tartar, a new smaller missile, mounted in wing launchers port and starboard of the fore superstructure. The Tartar supersonic surface-to-air missile was developed in the 1950’s primarily for destroyers, and was designed to attack low altitude, high-speed threats. Later improvements in the Tartar missile extended the range from 7.5 to 18 miles. Tartar was later superseded by the Standard 1 (MR) missile.

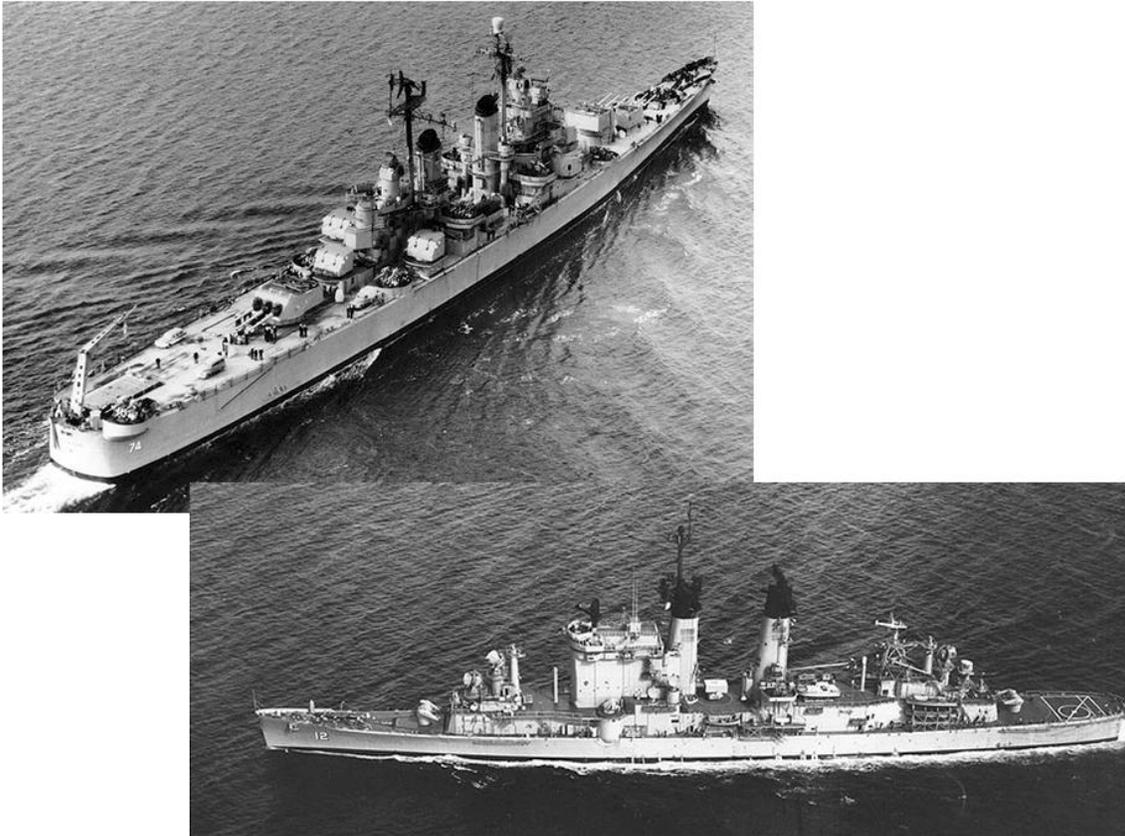


Figure 18 *USS Columbus* as CA 74 (top) and After Conversion to CG 12.

These ships were intended to mount the Regulus surface to surface missile, but ASROC was substituted during construction in the space between the fore and aft superstructures; after completion, two 5-inch 38's were added amidships. These ships were successful; *Chicago* was credited with shooting down a MiG fighter at a range of 48 miles, off Vietnam in 1972. *Albany* was modernized in 1973-74, and became flagship of the Second Fleet afterwards^{xlviii}.

6.3.5 DLG evolution

The DLG 6 (*Farragut*) class (also sometimes referred to as the *Coontz* [DLG 9] class) was a continuation of the US response to the Soviet air threat to the carrier task force. In parallel with the cruiser SAM installations, more launch platforms were needed to deal with the saturation attacks that might be possible in the late 1950's. Accordingly, tests of a Terrier installation on a *Gearing* class destroyer were performed, and a follow-on to the DL 2 design (see the ASW section below) was proposed as an AAW frigate for task force defense. Whether the DL 2 should be considered a destroyer or a cruiser might be argued, but in the DLG 6 design the size of the ship increased substantially, driven by the volume, weight, and electric power demands of the new, smaller Terrier system as well as by the need for high speeds in rougher sea states to overcome drawbacks to the World War II-era destroyers that, in their postwar overloaded condition, often could not keep station on the postwar carriers of the *Midway* and *Forrestal* classes.

At the same time, ASW developments continuing the evolution of the CLK 1 (see below) created a larger, lower-frequency sonar and a weapon to take advantage of it, the Anti-Submarine ROcket (ASROC). Both of these devices called for additional ship size to support their hydrodynamic drag, weight, and volume. Early on in the design process, a BuShips footnote remarks that “installing the SQS-4 sonar on a CLAA class will give similar capabilities,”^{xlix} showing that designers of the time were well aware that they were entering cruiser territory.

The DLG 6 class commissioned starting in 1960 with a twin-arm Terrier launcher aft, a 5-inch /54 gun in A position, an ASROC “pepper box” launcher in B position, and to begin with, SPQ-55 illuminators for beam-riding control of the missiles. This missile installation was less capable, both in guidance and in magazine capacity (40 rounds) compared to the cruiser conversions. Two secondary 3-inch /50 guns were also carried. *Farragut* turned in an excellent performance on sea trials, running above 33 knots on essentially her designed power of 85,000 SHP at 5450 tons, only slightly below full load displacement of 5648 tons. Design speed was 32 knots.

While *Farragut* class ships were never designated as cruisers (they were eventually redesignated as DDG’s or guided missile destroyers), they are a link between the later DLG’s that were redesignated as cruisers in 1975 and the wartime anti-aircraft cruisers and have been included in this account.

6.4 Antisubmarine Warfare Mission

6.4.1 The Hunter-Killer Cruiser *Norfolk* (CLK 1)

The end of World War II also produced new, deadlier submarine threats. Late U-boats of the Type 21 (somewhat like the USN’s postwar “Guppy” conversions, with better streamlining, more battery power, and a snorkel for charging batteries at periscope depth), and Walter type (powered when submerged by hydrogen peroxide, requiring no air for propulsion) had much higher submerged speed than wartime production models. Postwar, the US Navy discovered that U-boats had had greater depth capability than our submarines, and the high-tech late U-boats were also deep divers. The Type 21 had a maximum depth of over 900 feet.¹ Like the late war airborne threats, these late war submarine threats suggested that World War II type escorts were inadequate and that new kinds of antisubmarine warfare (ASW) ships would have to be created.

One type was the “hunter-killer cruiser”, using the new designation CLK. The Bureau of Ships developed the design from the wartime *Atlanta* anti-aircraft cruiser. Its main features were large size and good seakeeping so that even in bad weather it could

overhaul a 25-knot submarine. It was to be armed with new, trainable Weapon Able (or Alpha) ASW rocket mounts whose size and ship impact was similar to a medium caliber gun turret, as well as homing torpedoes and an elaborate sonar for targeting. All these features led to rather a cruiser-size ship, which is why BuShips picked *Atlanta* as the starting point. The ship had a double bottom that went up to the second deck – clearly a cruiser rather than destroyer feature. The two machinery units were separated by 20 feet to improve survivability. The ship was finally commissioned as USS *Norfolk* in 1953. She had four twin 3-inch /70 turrets as “main” armament, but the four Weapon A launchers and eight torpedo tubes were really her reason for being. At 520 feet LWL and 6600 tons, this was a small cruiser even compared to its WWII prototype, with a twin 80,000 SHP powerplant that resembled the *Atlanta’s* except that it was 1200 psi. However, compared to wartime destroyers then in service which were in the 3000 ton range, it was something more than a destroyer.

The designator CLK 1 didn’t last long. The new category was abolished in 1951, and *Norfolk* was redesignated as DL 1, with the *Mitscher* class (formerly DD 927, a 4500 ton AAW destroyer of about the same date as *Norfolk*) becoming DL 2-5. The new designator DL stood for “Destroyer Leader” – a term dating from before World War I, referring at that time to a destroyer flotilla leader. But, in the postwar US Navy, the DL designator was associated with the term “frigate”, and meant a type intermediate between destroyer and cruiser, functioning as a multi-role task group escort. This designator continued to be used for mainly AAW battle group escorts into the 1970’s. The confused terminology did not conceal the reality that a more cruiser-like ship was needed for both fleet AAW and ASW defense in the postwar era.

6.5 Command Cruiser Mission

6.5.1 CA/CLG/CG Fleet Flagships

In addition to the specialized command cruisers discussed in the next ship, WWII built cruisers served as flagships for the various numbered fleets until they reached the end of their service lives and were decommissioned in the 1960’s and

1970's. The ships used in this role had extra volume built into their superstructures (with some armament removed as weight and moment compensation) to accommodate the staff and equipment. They presented an impressive, powerful appearance, useful in showing the flag in foreign countries.

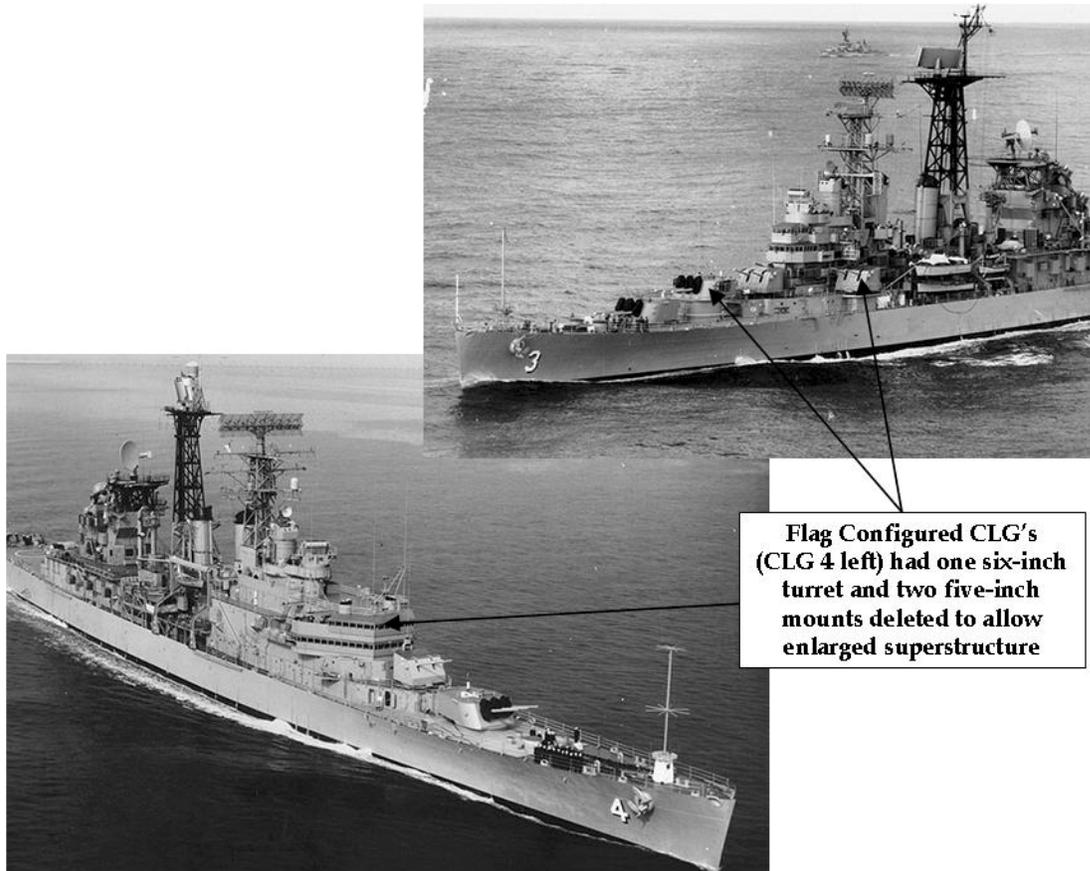


Figure 19 Flag vs. Non-flag Configured CLG's

6.5.2 Command Cruisers

As aircraft range and speed and ship-mounted sensors' detection capabilities increased following World War II, coordinating the activity of a carrier group became more complicated. Better facilities were required to sort through the detection and intelligence data, with additional personnel to select targets and manage fleet ships and aircraft in defense and offense in a coordinated manner. If this facility was to stay with

the carrier, it had to be on a high speed ship, and a rather large ship at that. While one might suppose that the development of computers could in principle reduce the manpower required for these command functions, the space required for computers and sensors continued to increase in this time period, leading to a cruiser size ship being needed to perform the command ship function. It is implicit in this description that the Admiral and his staff would be embarked on the command ship, which could act as the nerve center of the fleet.

In 1945, work had been stopped on the *Oregon City* class heavy cruiser *Northampton*, then some 54% complete. She was ordered completed as an AGC (amphibious group flagship)^{li} with fleet flagship capabilities. The ship was commissioned as CLC 1 in 1953. She had been totally transformed from the original design, with an additional deck, a much reduced armament (four 5-inch /54's in single mounts, plus 3-inch /70's and 20-mm secondary batteries), and an extensive suite of radars and radios. Although amphibious assaults also needed sophisticated coordination, a high speed hull was not required for this mission.

A subtext of the development of the command cruiser is the evolution of the aircraft carrier. These ships, as their airplanes became bigger and heavier, were becoming overloaded, even as BuShips policy discouraged them from increasing too much in size in order to avoid an expensive infrastructure investment such as new drydocks and harbor dredging. Also, in the immediate postwar period, before the adoption of angled decks, it appeared that islands would have to be reduced in size or possibly even eliminated, so that radars on carriers would have to be small or of limited number. While radars on the carriers themselves could do some of their own detection, *Northampton* carried a more elaborate array, including SPS-2 long range air search, SPS-3 zenith search, and SPS-8 height finder. This combination couldn't fit on a carrier's island without interfering with each other. Radio antennas and transceivers on the command cruiser could communicate with not only ships and aircraft in the battle group, but from most parts of the world, directly with Washington. Therefore, the

command cruiser was equipped not only as a tactical flagship for the battle group surrounding it, but also to be a fleet or larger scale force or theater flagship.

“By 1960 the US Navy had five cruisers fully effective as flagships: one each for the two forward-deployed fleets, one relief for each fleet, and the *Northampton*...”^{lii} The missile cruisers were integrated into their respective carrier task force, providing significant AAW defense capability, while *Northampton* provided sensor and processing ability only to any battle group she was in.

After 1960, *Northampton* was modified as a National Emergency Command Post Afloat (NECPA), with most armament removed and additional communications equipment. The NECPA function, today performed by Air Force One and several reserve aircraft, is a position where the President and a small military command staff could be evacuated in the event of an impending attack on the capital. From the NECPA, the entire war could theoretically be controlled for a substantial period of time. Whether this function was fully thought out is doubtful; however capable *Northampton* was of carrying out the C³I tasks required, an evacuation of VIPs from Washington in the amount of time after detection of missile launch by the Soviet Union and before those missiles hit their targets seems barely possible by air from Andrews. It does not seem possible to make a connection with a warship in the Atlantic during that rather short time period. A second NECPA was converted from the *Saipan*-class light carrier *Wright*, and recommissioned in 1963; designations changed to reflect this function, with *Northampton* becoming CC 1 and *Wright* CC 2. It should be noted that *Wright*, while built as a carrier, was also a WWII cruiser-based design, as mentioned earlier.

Today, the command cruiser appears to be obsolete. *Northampton* and *Wright* have been scrapped and were never replaced. With satellite communications becoming reliable, fairly secure, and associated equipment more compact, it no longer seems critical to have the fleet flagship with a battle group. AEGIS cruisers (and even destroyers) can provide the AAW detection and coordination functions for which *Northampton* was originally converted, because of a similar improvement in computer and radar equipment. Today, it is common for an amphibious command ship (LCC) to

act as a numbered fleet flagship – and to spend most of its time in harbor, since its 20-knot top speed would not be satisfactory for it to accompany the battle group. While there is still need for a special ship to carry out the command function, it does not seem that a ship as fast as a cruiser is required. Since the LCC’s in commission today are already cruiser size ships, even with their more modest speed, any future CC would probably be over 20,000 tons.

6.6 Parallel British Developments

The Royal Navy had some incomplete cruiser hulls that were laid up upon the cessation of WWII. When mechanically-loaded dual-purpose six-inch and mechanically-loaded three inch mounts were developed, three hulls (*Lion*, *Tiger* and *Blake*) were completed as anti-aircraft cruisers (two six-inch twin mounts, four three-inch twin mounts). The rate of fire of the weapons was so high the barrels were fitted with water cooling.

The RN studies of new generation guided missile ships (G.M.S) resulted in a very large (for the time) 6,000 ton destroyer. During the requirements generation process, the RN naval architects were asked “what would change if the ships were considered cruisers instead of destroyers?” Naval architect W.G. John produced, in October 1957, the comparison contained in Table 2.^{liii} The *Royalist* mentioned in the table is a member of the *Bellona* class anti-aircraft cruisers (four 5.25-inch twin mounts) completed in 1943 with similar overall dimensions to the G.M.S. study. The G.M.S. studies evolved into the eight ships of the “County” class DDGs of 6,800 tons full load.

Table 2 Royal Navy Destroyer vs Cruiser Practice in 1957

Protection – Splinter protection added to cruisers around magazines and gunbay, action office, steering gear.

<u>Size/Complement</u> -	<u>G.M.S.</u>	<u>Royalist</u>
W.L.	505 ft	506 ft
Beam	55 ft	50.5 ft
Draught (deep)	16 ft	18 ft
Displacement (deep)	6000 tons	7500 tons

Officers	36	46
Senior rates	125	142
Junior rates	334	413
Marines	0	49
	-----	-----
	495	650

Cruiser manning necessarily greater:

- (a) More self maintenance. Destroyer 3 months, Cruiser 6 to 8 months.
- (b) Flagship. Accommodation and offices and provision for more ceremonial work – marines and band.

Workshops and Spare Gear Stores

Space requirements about doubled for cruiser

Communications

Scale for cruisers requires space of order of 950 sq.ft. increased to 1800 sq. ft.

Offices

About 50% increase [700 sq.ft. to 1000 sq.ft.] for a cruiser

Provisions

	<u>Destroyer</u>	<u>Cruiser</u>
Food and Stores	45 days	70 days
Fresh Water	50 g.p.m.	60 g.p.m.

Bakery & Captain' galley – Separate in cruiser (300 sq.ft.)

Medical – Add examination room, dispensary and dental surgery to cruiser (about 300 sq.ft.)

Recreation, etc. – Add recreation space, bookstall and church to cruiser

Damage control – Add redundant H.Q. (DC central) to cruiser

General – The above features bring a number of complementary items in their train, i.e., as the ship becomes bigger the question of separation of the main machinery units need reconsideration increased electric power, and more elaborate electrical distribution system, all ship systems grow bigger, additional boats are required.

7. CRUISER DEVELOPMENT MID 1960'S TO EARLY 1980'S

7.1 US Missile Cruiser Designs

7.1.1 CGN 9 *Long Beach*

With the introduction of the *Forrestal* class supercarriers starting in 1955, aircraft carriers had reached such a size that weather hardly slowed them down and steaming endurance was far greater than could be provided for their escorts. This created

inherent logistic problems for the Fleet. One possible solution was to use nuclear power in the escorts, since nuclear fuel lasts a number of years. Although nuclear propulsion had been successful in the submarine *Nautilus* (1954), no suitable nuclear plant was available to power destroyers and cruisers

Informal work had been underway at the Bureau of Ships on a nuclear cruiser (CLGN-160), but it was not until Admiral Arleigh Burke became CNO (1955) that the nuclear cruiser program was given focus. He wanted to investigate the feasibility of a nuclear cruiser capable of operating independently as well as supporting a nuclear carrier. With shipbuilding money at a premium in the late 1950's, it was felt that a nuclear cruiser should have both ASW and AAW capabilities and the *Long Beach* was provided an SQS-23 sonar.

A problem, however, was the limited horsepower of the nuclear plants; the ship would have problems meeting a 30-knot design requirement. As the ship design evolved, the deficiency in power became more evident and the ship length grew to provide a better speed-length ratio for reduced wave-making resistance to facilitate a 30-knot speed. The increased length allowed additional weapons systems to be accommodated including a RAT (rocket-assisted torpedo, replaced in the final design by ASROC) and the Regulus surface-to-surface cruise missile. After Regulus was canceled, a Polaris missile armament located in eight silos amidships was proposed as alternate but was never installed.

An issue of continuing debate during the design period was the mix of missiles and guns in the design. The Ship Characteristics Board wanted to retain the 5-inch/54 single mount (Mk 42) gun since it was believed that a missile-defense armament would be ineffective for close-range fire. The type of missile armament was also debated. The Talos missile ship was more desirable, since these had longer ranges than the Terrier missiles, but it resulted in a larger and more expensive ship. However, more Terrier missiles could be carried than in the Talos version because missile stowage for the latter had to be horizontal, requiring a compartment 36 feet long.

It was finally decided to provide two Terrier missile launchers forward and one Talos missile launcher aft to give this nuclear cruiser maximum anti-aircraft capability. With the missiles and electronics specified, they could engage four air targets simultaneously. As with several of the missile cruiser conversions, no guns were provided; however, as recounted later, this changed in service.

Special fixed-array radars, designated the SPS-32/33, were fitted on the sides of the superstructure. With steerable beams, the distinctive flat-faced antennas could track automatically six medium and long-range targets simultaneously. The great merit of electronic scanning is that no mechanical inertia is involved and high data rates are possible. For the first time these radars were also integrated into a weapons direction system that was connected to the Naval Tactical Data System (NTDS). However, radar technology on *Long Beach* was in 1961 ahead of its time and suffered from a significant failure rate and very high cost. The SPS 32/33 appeared on only one other ship, the carrier *Enterprise*.

The *Long Beach*, now designated CGN 9, was commissioned in 1961, the same year as *Enterprise*, CVA(N) 65, the world's first nuclear carrier. A pivotal incident occurred, affecting *Long Beach* as well as future CG/DLG designs, when the new frigate *Dewey* (DLG 14) was assigned to shoot down a propeller drone during a fleet review that was witnessed by President John Kennedy. Three Terrier missiles were fired at an approaching drone but all three missed their target. Kennedy was alarmed at this failure and personally ordered the new missile cruisers to be equipped with guns. A ship alteration in 1962-1963 added two 5-inch/38 single gun mounts. The 5-inch/38 guns in single mountings looked quite antiquated on such missile ships as *Albany* and *Long Beach*, but the old weapons did give some defense capability absent in the ship as completed.

The combination of NTDS and Talos made *Long Beach* an effective Positive Identification Radar Advisory Zone (PIRAZ) ship during the Vietnam War. During May 1968, *Long Beach* was given clearance to fire on a North Vietnamese MiG. Although she missed one on 11 May, twelve days later she fired two Talos missiles two

minutes apart at a pair of these enemy aircraft some 65 miles away. One MiG was destroyed by one missile and the second exploded among its debris. This was the first occasion in which a ship destroyed a hostile aircraft with guided missiles, and also the first time that nuclear surface warships had scored a missile hit against an enemy. In September 1968, *Long Beach* shot down a second MiG at 61 miles. However, many other Talos and Terrier shots missed.

In 1977 *Long Beach* underwent a major overhaul during which her armament was changed to include the ability to land, but not stow a helicopter. A conversion to the AEGIS system was contemplated, but not done due to the fact that her missile armament was obsolete and funds would have to be diverted from new construction ships such as the *Ticonderoga* Class (CG 47) and the *Perry* Class frigates. Talos was removed in 1979 along with the Mk 77 guided missile fire-control system and replaced with Harpoon canister launchers and Tomahawk armored box launchers.

Long Beach was the first nuclear-powered surface combatant and she was a technical success. But, she was too big, too slow, and too expensive. The nuclear frigates (later re-designated as cruisers) that would follow her were somewhat more affordable and better suited to task force defense. In 1957 the shipbuilding budget of the U.S. Navy was under severe assault with missile programs proving far more expensive than had been anticipated. Therefore, a repeat of the *Long Beach*, costing \$187 million, was cancelled.

7.1.2 *Leahy* (DLG 16) Class

These futuristic-looking U.S. cruisers were the first double-ended guided-missile launching surface ships in the U.S. Navy. They originated at the suggestion of Admiral Sanders, Chairman of the Long-Range Shipbuilding and Conversion Committee. Ships Characteristics Board Project Number 172 was promulgated as requiring a double-ended missile frigate. Two designs were considered: one based on a hull like the *Norfolk* (DL 1) and the other on a long forecastle-deck ship. In the interests of costs, seakeeping, and stability, the long forecastle-deck design was chosen.

Photo # KN-23732 USS Dale off Roosevelt Roads, Puerto Rico, 5 June 1975



Figure 20 *USS Dale* (DLG 19)

One of the principal missions of these ships, like their predecessors, the *Farragut* Class (DLG 6), was to form part of the anti-air and antisubmarine screen for carrier task forces. They were expected to be able to control aircraft from the carrier, vectoring them to their assigned targets. With no 5-inch gun aboard, two 3-inch/50 twin mounts were the only gun battery. The gun aspects were sacrificed to achieve a higher number of SAM's. These ships carried two Terrier missile launchers, one forward and one aft. There were some early problems with the Terrier missiles that were very complex with 100 vacuum tubes and 1,000 resistors, all of which had to function under wildly varying conditions of shock, humidity, temperature, and pressure. The missile weighed over a ton and achieved supersonic speed within three seconds. After launch, the missile was captured by a radar beam and handed off to a guidance beam which the Terrier missile rode to its target. One commanding officer of *Leahy* commented on the missile control

radars, “two of the four were installed were usually spare parts lockers for the two years that I was aboard.^{liv}”

The spartan antisubmarine weapons system featured the Mk 32 triple torpedo tubes and an ASROC launcher with no reloads for either. The ASROC required the AN/SQS-23 sonar system, which was mounted in a bow dome.

The endurance in these ships was increased, which was one of the major reasons for the growth in length over the DLG 6 Class. During a high-speed deployment of a carrier task force, the *Leahy* retained a higher percentage of her total fuel than did the heavy cruiser *Boston* (CAG 1). Although the steam propulsion plant of the DLG 6 was retained, the electrical plant experienced major growth because of the increases in the power requirements from the missile launchers and their requisite electronics.

These ships introduced the "Mack" (combined stack and mast) on which the new radars could be mounted without smoke interference. To provide a measure of ballistic protection and notch-tough steel, the sheer strake and outer deck strake on the 01 Level were constructed of HY 80 while the hull itself was HTS.

These vessels were equipped with a knuckled hull forward to protect the forward Terrier launcher from green seas washing aboard. They were excellent sea boats. The knuckle forward allows a very hollow, flared forefoot area without excessive beam at the weather deck. It is a common feature of 20th century cruisers and appears to have originated with the British *Kent* or *County* class in 1928.

The *Leahy* class were the first close escorts of the *Midway* (CVA 41) and *Forrestal* (CVA 59) carriers. Compared to the earlier *Farragut* class, the increased endurance improved their ability to stay with these carriers and provide the air and submarine defenses that these ships required. This increased capability also was reflected in the fact that the *Leahy*'s and following DLG/DLGN were assigned captains (O-6) as commanding officers (following cruiser practice) instead of commanders (O-5) as the *Farragut*'s had.^{lv}

7.1.3 *Belknap* (DLG 26) Class

The explosive growth of electronics and guided-missile systems overtook the DLG 16 design, which exceeded its design displacement by some 400-500 tons. In the next purchase of guided missile frigates, several new weapons systems were available that altered the characteristics of the follow-on designs. The Drone Anti-submarine Helicopter (DASH), a new and more powerful sonar, AN/SQS-26, and Naval Tactical Data System were now available and enthusiastically supported for use by the Commander of the Cruiser Destroyer Force of the Pacific Fleet. To aid in the placement of the combat system, the ASROC launcher was eliminated and its missiles loaded in the forward Terrier magazine, which was enlarged to handle 60 missiles instead of 40. This was done by the addition of a third 20-round horizontal carousel to the two in the *Leahy's* forward magazine.

There were many critics of the all-missile DLG 16 class as lacking a sufficient gun armament. Experience during the Cuban Missile crisis during the fall of 1962 confirmed the need for a gun armament. Therefore, a 5-inch/54 gun was added in place of the aft Terrier launcher to provide a shore-bombardment capability, in addition to the anti-ship function, that was absent in the DLG 16 Class. The tradeoff was that if the forward missile launcher malfunctioned or was damaged, the entire antiaircraft and anti-submarine capability of these ships would be lost. Also it resulted in only having two missile directors instead of four, reducing the number of air targets that could be engaged simultaneously.

The DASH program was not successful and was ultimately replaced in the 1970's on the DLG 26 by one LAMPS Kaman SH-2D Seasprite helicopter in a hangar at the aft end of the superstructure.

The Naval Tactical Data System was provided starting with the DLG 28 and was backfitted to all earlier DLG's as well.

The DLG 26 was basically a lengthened DLG 16 hull with the addition of a 14-foot insert between the forward engine room and after fire room. Since the ship had significant curvature at the insertion point, the section was not a parallel-sided section

but one with form. Although the added length resulted in more frictional resistance, the ship had a more favorable speed/length ratio, so that speed loss was minor.

The engineering plant was the same one as in the previous *Leahy* class with 1200 psi and 950°F steam conditions. The maximum shaft horsepower was identical but the displacement was greater. Therefore, maximum speed was 0.1 knots slower in the DLG 26, despite a more advantageous speed-to-length ratio. The RPM's of the shafts were decreased to reduce propeller noise and achieve greater efficiency. The most significant difference was in the electrical generators where a 50% increase in KW was provided for the combat system specified for these ships.

To improve their capabilities when assigned as a flagship, three of the class were fitted with a tactical flag communications center (TFCC) from 1983-1985.

The *Belknap* was rebuilt after her collision with the carrier *John F. Kennedy* in November 1975. She was extensively modified to serve as a numbered fleet flagship for the 6th Fleet. She was equipped with a fleet command center (war room), improved communications, drafting and photographic facilities, additional berthing and messing for flag personnel, an office and reception area for a fleet commander and an expansion of the helicopter landing area aft to receive the SH-3 Sea King helicopter. The ship's hangar was converted into a berthing area. She did not receive the New Threat Upgrade (NTU) provided to other eight ships in her class.

7.1.4 *Bainbridge* (CGN 25)

Early studies of destroyers with nuclear propulsion plants showed that such plants alone weighed as much as a World War II destroyer. Because of the size ship that would be necessary to contain the space and weight of such a plant, it was not until the advent of the *Enterprise* (CVAN 65) that an intensive design effort was begun to provide nuclear escorts. The design of nuclear surface ship escorts was complicated by the following factors:

- the space required for a nuclear plant,

- the manning for a nuclear plant was more than conventional power plants,
- available nuclear power plants were too heavy for the power they produced to use in destroyer-sized ships,
- and they were more expensive to build than conventional plants.

Another problem was in the arrangement of the ship due to radiation hazards and the need to restrict the location of living spaces, which if adjacent to the reactor spaces could necessitate increased lead shielding. However, it was recognized that nuclear power was, in some ways, the propulsion plant of the future.

When Admiral Arleigh Burke became CNO in August 1955, he authorized studies to determine the feasibility of installing nuclear power plant in a DLG 6-type hull. These studies showed that the smallest hull, due to limitations in power, would be 540-feet long with an 8,500-ton displacement to achieve a 30-knot speed. Smaller ships were studied, but it was found that nuclear propulsion was not possible in ships with less than 6,900-ton displacement. The resultant ship platform had excessive weather deck area for the weapons suite specified. The most unattractive factor in nuclear propulsion, however, was cost. These ships with their special requirements cost some \$20 to \$30 million more in 1955 dollars than a conventional power plant of the same shaft horsepower and with the same weapons systems to achieve a 30-knot speed. Added to this was the heavier weight and higher vertical center of gravity of the machinery and shielding. The hull of a nuclear destroyer had to have more beam to accommodate all of the propulsion plant and its auxiliaries as well as provide adequate stability.

Bainbridge was, from her conception, the source of great contention within the destroyer force. Although the Type Commander, Atlantic wanted her, his opposite number in the Pacific opposed it on the basis of cost. He argued that one *Bainbridge* could buy three or four non nuclear equivalents. Admiral Hyman Rickover was in

favor of the ship, which may have been a factor in its approval. His Code 08 designed a light-weight reactor especially for *Bainbridge*^{lvi}.

The nuclear reactor meant that this ship could travel 5,000 hours at full power (3 or 4 years before refueling). She traveled 75,000 miles during her first two years of service and 180,000 miles before her first nuclear refueling. Improvements in the core of the reactors soon led to ones that would last ten years^{lvii}.

Nuclear power provided a plentiful power source that was almost inexhaustible for the voracious demands of modern electronics and weapons. Freedom from fossil-fuels allowed the *Bainbridge* and other nuclear cruisers to travel faster, skirt storms, and avoid problems with dwindling fuel supplies on stability. With the absence of stacks these ships also permitted a tighter protection against nuclear, biological, or chemical attack. It also meant less problems from smoke and the ability to find better positions for the antennas. But, the exhausts of the emergency diesel and the auxiliary boiler had to be made integral with her foremast upon which was mounted the surface search and 3-dimensional air search radars. A two-dimensional air-search radar was mounted on a smaller lattice-type mast aft of her boat stowage.



Figure 21 All Nuclear Task Group including *USS Bainbridge* (DLGN 25) (top) and *USS Long Beach* (CGN 9) (middle).

The armament of the *Bainbridge* was patterned after the *Leahy* (DLG 16, later CG 16) Class with a few changes. The nuclear escort was equipped with larger Terrier missile magazines; twin 3-inch/50 gun mounts were specified instead of single mounts; and there were no reloads provided for the ASROC launcher.

7.1.5 *Truxtun* (CGN 35)

The actual cost of the *Bainbridge* was \$60 million more than the \$108 million initially estimated to build the U.S. Navy's first nuclear frigate. This development eroded support within the U.S. Navy for ships of her type. During discussions on the Navy's Fiscal Year 1962 budget, however, Congress arbitrarily substituted a nuclear frigate for one of the ten ships the Navy had projected for the *Belknap* (CG 26) class. A repeat of the *Bainbridge* design was sought at first, but since the large AN/SQS-26 sonar was being introduced in the CG 26 class, it was decided that the nuclear version of these ships should be also equipped with the same sonar.

The hull form of the *Truxtun* was made similar to that of the *Bainbridge*, but with the addition of the SQS-26 dome. The weapon arrangement was modified with the 5-inch gun placed forward instead of aft as in the *Belknap* class. The ASROC launcher was deleted as its missile could now be accommodated in the Terrier launcher and magazine. Since the Terrier launcher was located aft, the ASROC could only be launched in a forward quadrant not directly over the bow. A Terrier launcher forward would have been better suited for anti-submarine operations.

The *Truxtun*, like the *Bainbridge*, was a single ship class: a nuclear version of the *Belknap* class. As built the ship had two Mk 25 torpedo tubes for 21-inch Mark 48 wire-guided torpedoes built into the stern structure with the provision of ten reloads. They were subsequently removed. The *Truxtun* was then equipped with Mk 32 tubes that were built into the after deckhouse.

A helicopter landing platform was provided aft just forward of the Terrier missile launcher at the aft end of the raised forecastle deck. Although the *Truxtun* had been intended to operate drone anti-submarine helicopters (DASH), cancellation of this program led to the redesign of the helicopter facility to handle the SH-2 LAMPS. This helicopter could work with the long-range AN/SQS-26 active search and medium frequency sonar.

7.1.6 *California* Class (CGN 36, ex-DLGN 36)

These double ended, flush-deck ships were essentially nuclear-propelled versions of the guided missile frigates proposed in the early 1960's with the Tartar D missile system vice the more capable Talos and Terrier missile systems of the cruiser conversions. Their construction was delayed because of opposition to nuclear ship construction by Secretary of Defense Robert McNamara and the fiscal demands of the Vietnam War. In June 1968 Congress, despite administration objections, insisted on ordering two nuclear frigates, *California* (DLGN 36) and *South Carolina* (DLGN 37). The Preliminary Design of this Class was begun in mid-FY 64 as Ship Characteristics Board (SCB) Project No. 241.66. These ships were intended to be the first nuclear ships for

series production. Although a third ship was authorized as part of the fiscal 1968 budget, it was not built due to rising costs and the emergence of the more capable *Virginia* class design.

These were unquestionably capable ships with a displacement of 10,000 tons, armed with two Tartar / Standard missile launchers, and two of the new 5 inch Mk 45 gun mounts. The missile launchers were located forward and aft from superstructure at a significant distance to allow excellent arcs of fire and access for refueling the nuclear plant. The digital electronics suite was the most modern available with SPS 48A 3-D radar and a missile guidance system capable of controlling four missiles simultaneously. It was considered the most capable ship in the fleet even without AEGIS. As for its ASW capabilities, the ship mounted the SQS-26 sonar dome and was equipped with a quick reload ASROC launcher.

These ships were provided with a large helicopter-landing platform aft, but were not equipped with a hangar or maintenance facilities for helicopters.

The CGN 36 design was started amid the turmoil of the 1960's that included the introduction of "Concept Formulation/Contract Definition" and "Total Package Procurement" to weapon system procurement. At the same time, this approach was being applied to the DX Program, which resulted in the DD 963 design. The Navy pursued the DLGN 36 design and it was planned to reap the advantages of nuclear power on a missile ship using the Tartar guided missile system, which was far less complex and bulky than the previous Terrier system and yet was considered a weapons system equal or more effective in providing area air defense. Congress had also stipulated that any combatant ship over 8,000 tons displacement had to be nuclear powered.

The design used the earlier DLGN 35 (USS *Truxtun*) as a parent ship and, although Terrier/Tartar competition existed during the Feasibility Study phase, the decision favoring the Tartar system (MK 13) was firmed up early in the preliminary design phase.

The resultant ship grew rather significantly over its parent ship e.g., about 30 feet in length, 2.5 feet in beam, and 900 tons in displacement, with essentially the same twin D2G pressurized water reactor propulsion plant improved to yield increased power and endurance. Of course, the gun and missile systems and the inclusion of many upgraded weapon controls drove the topside configuration. Other electronic systems affected the design and habitability standards were changed so that arrangements of CGN 36 were almost totally changed over those of CGN 35.

These ships have anchor stowage integral with the keel to reduce excessive flare and prevent anchor fluke damage to the sonar dome. This installation followed the concept first introduced in the *Knox*-class Frigates (FF 1052) Class.

During the ship design, the 5-inch /54 (Mk 45) lightweight gun had not progressed far enough for it to be used aboard this ship, so the 5-inch /54 guns (Mk 42) was specified instead. This use of the heavier gun brought about a significant increase in crew since the lightweight version required only three men to operate. The gun location vis-à-vis the Mk 13 Tartar launchers and the superstructure, however, was a subject of debate until nearly the end of the preliminary design. The inability to perfect an ASROC missile that could be launched from a Mk 13 Launcher dictated the inclusion of a trainable Mk 16 ASROC box launcher. In order to provide reload capability and maintain clearance for reactor servicing, a distinctive structure, commonly termed the "Doghouse", was provided forward of the ASROC launcher close to gun mount No. 51.

Subsequent to their Preliminary Design, these Nuclear Powered Guided Missile Frigates were re-designated as Nuclear Powered Guided Missile Cruisers on 30 June, 1975. Originally, three ships were planned for and actually authorized; however, the third ship was built to a different design as CGN 38. While the class was under construction, the 5-inch /54 (Mk 45) lightweight gun was approved for service, so it was substituted for the heavier 5-inch/54 (Mk 42) that had been chosen in Preliminary Design.

It was planned to install Tomahawk missiles as an upgrade, but the project had to be canceled when it was determined that these ships could not sustain large increases in topside weights, which also prevented the use of the AEGIS system.

7.1.7 *Virginia* (CGN 38) Class

The design of these ships was the result of several influences in the ongoing program of surface combatants during the 1960's and early 1970's. They were an improved design, superior to their previous *California* class with a flush deck, the Mk 26 missile launcher and an embarked helicopter. The perfection of the Mk 26 guided missile launcher systems and the SM-1 Standard missile offered better performance in the face of electronic countermeasures, faster reaction times, and an increased kill probability. The SM-1 still used the continuous rod warhead, but with a new fuse whose sensing cones and digital electronics triggered it to cause maximum damage depending on whether the target was a surface ship, jet bomber, or cruise missile. Also under development was the SM-2 missile with a range of 100 miles and a programmable autopilot. Although SM-2 was intended principally for Aegis ships, the Terrier and Tartar vessels could benefit from this asset as well when the new missile was coupled with better detection and tracking equipment. The SM-2 first deployed on board *Wainwright* (CG 28, ex DLG 28) in 1976.

There were two novel features of the Mk 26 launcher, its fault isolating equipment and modular design. The former reduced maintenance down-time. The modular design of the system allowed the entire launcher with its vertical rotating carousel with missiles to be “plugged in” to the ship. The base of the module rested on prepared foundations within the ship. Once lowered in, the system needed only electrical and utility connections.

The effectiveness of the Standard missile was enhanced by the Mk 26 launcher. Even in the worst sea conditions that could cause heavy pitch and roll, the launcher could fire in rapid succession several kinds of missiles that included variants of the

Standard missile, Harpoon, and ASROC. A jettison device was fitted to shove any dud missile overboard.

Another influence in the CGN 38 cruisers was the DX/DXG Program that used a Concept Formulation/Contract Definition procurement strategy for the acquisition of surface combatants. This latter program resulted in the DX, which became the DD 963 Class ships.

The "High End" of the DX Program was envisioned as a nuclear powered DXG, the DXGN, later, CGN. The successful development of the Mk 26 guided missile launching system and the promise of early availability of the long awaited Advanced Surface Missile System (ASMS, later to be called AEGIS) led to the decision that a design based upon the as-yet-unbuilt DLGN 36 Class would fulfill the DXGN unit's role. Accordingly, the preliminary design of the CGN 38 (then called DLGN 38) commenced in late 1968.

The resulting ship was approximately 20 feet shorter than its predecessor but some 3 feet wider. The full load displacement was about 200 tons more than the earlier design with very nearly the same draft, but increased trim aft. Due to unavailability of the ASMS, the missiles in the Mk 26 launchers were controlled by two Tartar D missile fire control systems fore and aft. The helicopter facility was to consist of a landing area with refueling capability but without any hangar.

During contract design some further modifications were made with the ASMS (later to be called AEGIS) included as a space and weight option. An intensive effort was made to reduce the displacement to less than 10,000 tons. Important at this point of development was the inclusion of the SH-2 LAMPS helicopter. There was some unassigned space in the stern and it was decided that this could be used as a below-deck hangar to house the helicopters plus the associated magazines, stowage, and ammunition. The concept was based upon the seaplane hangar arrangements used in the *Baltimore* (CA 68) class and later cruisers. The helicopter would land on the raised elevator platform; with the platform lowered the hangar would be enclosed by sliding doors or hatches. In concept it seemed to be an excellent one, but in practice it proved

to be unsuccessful. The seals to the hatches enclosing the helicopter hangar leaked seawater onto the hangar area below onto the helicopters, necessitating extensive freshwater washdowns. There were also problems with the elevators. The helicopter facility was later removed and Tomahawk box launchers were installed on the main deck where the elevator platform had been. These launchers were mounted in armored box launchers at the transom with control spaces located below in the old hangar complex. Earlier proposals to provide a VLS launcher for the Tomahawk missiles in place of the hangar were dropped.

The CGN 38 class had a distinctive bow anchor arrangement unlike their predecessors. Because of bow trim problems in early contract design, the keel-stowed anchor was eliminated and replaced with a bow-stowed anchor and an on-deck stowed lightweight anchor, based on German World War II experience with their battleships and battle cruisers. The bow flare was increased slightly to allow these anchors to clear the AN/SQS 53A bow sonar dome and improve dryness of the foredeck area.

These guided-missile cruisers were the last nuclear-powered surface combatants, other than the nuclear carriers of the *Nimitz* (CVN 68) class. Four ships were completed although the last two were completed much later than their earlier sisters due to substantial cost increases of \$140 million. The fifth ship, which would have featured the AEGIS weapons system was canceled as the result of costs and the emergence of a new "Strike Cruiser" (CSGN) concept.

Three of the ships were slated for nuclear refueling, starting in Fiscal 1994, and a study was made in 1989 to also upgrade these ships. As part of the refueling a complex overhaul was studied to have two 64-cell VLS launchers replace the Mk 26 launchers and the AEGIS SPY-1B radar complex would be installed. The cost of refueling and the changes in the weapons and electronics were prohibitive and it was decided to scrap all four vessels.

7.1.8 Vietnam Employment

U.S. cruisers in the Vietnam conflict repeated their Korean War mission of providing naval bombardment both in the South, firing in support of friendly forces as well as in the North where they sometimes had their fire returned by North Vietnamese shore batteries. In addition, CG's and DLG's were stationed as radar pickets between the carriers and the coastline, maintaining a PIRAZ (Positive Identification Radar Advisory Zone) to maintain an air picture and guard against MIGs that might be attacking naval aircraft or the fleet. The DLG's in addition served as forward platforms for SAR helicopters.^{lviii}

7.1.9 DLG Redesignation to CG

Since the end of World War II, the US Navy had gone its own way in naming its ship types. Once the CLK designator was deleted in 1951, and the DL and DLG designator introduced, US "frigates" became large, capable ships. US destroyer escorts (DE), introduced during the war, were a mass production ASW ship generally smaller, slower, and less capable than a destroyer, and US cruiser production (once that CLK designator was retired) gradually petered out.

In other navies, different terminology was in use. No one used the DE designator. British "corvettes" were extremely austere escorts, even smaller than our DE's. Most European navies, including the RN, were calling their larger escorts "frigates." Both these terms were re-used in the 20th century from Age of Sail types of lighter craft, smaller than a ship of the line; they have been mentioned in Section 2. By 1975, with US frigates growing bigger and bigger our terminology seemed even more out of line with that of other navies.

On June 30th, 1975, much of this changed. All of the destroyer leader frigates (DL), except for the *Coontz* Class, consisting of the *Virginia*, *California*, *Truxtun*, *Belknap*, *Bainbridge*, and *Leahy* Classes were redesignated as guided missile cruisers (CG/CGN). The *Coontz* Class was redesignated as Guided Missile Destroyers (DDG). The ocean

escorts (DE), consisting of the *Perry*, *Brooke*, *Knox*, *Garcia*, and *Bronstein* Classes, were redesignated as frigates (FF).

7.1.10 Major In-Service Upgrades

During the late 1970's and through the 1980's several modifications were made to the former DLG/DLGNs to upgrade their ability to meet changing threats and add new capabilities. This illustrates the necessity for a cruiser design to have flexibility to evolve during its service life.

The Soviet Navy had developed the SS-N-2 Styx missile late in the 1950's and deployed it aboard a small missile patrol boat of the Komar class in 1961. With a 1,000-kilogram shaped charge and a speed of Mach 0.9, the Soviets believed that two of these missiles could sink a destroyer. An important development in warship design came during the Six-Day War in 1967 with the sinking of the Israeli destroyer *Eilat* by three Egyptian Styx missiles, the first warship to be destroyed in this manner. This event had a great impact on the U.S. Navy as it illustrated the vulnerability of large surface ships to a relatively cheap weapon. This lesson was reinforced by the British experience in 1982 in the Falklands against the Exocet missile.

As a counter to the cruise missile threat, the existing cruisers were fitted with several systems to provide a point defense capability. One was the Phalanx Close-In-Weapons-System (CIWS) which provided a hardkill capability and was a modern day counterpart of the 20mm and 40mm guns used in WWII. Electronic warfare systems were also upgraded with the installation of SRBOC chaff launchers and the SLQ-32(V)3 system with active jamming capability. Some classes also received selective armoring against fragmentation threats to avoid a "cheap kill" as happened to the *USS Worden* (DLG 18) off Vietnam (ironically from an accidentally fired US Shrike missile)^{lix}.

All the cruisers were provided with dual quad launchers for the Harpoon cruise missile, giving them a capability against surface targets beyond gun range. These were normally installed in place of the existing 3-inch guns. In addition, several of the CG 26

class and the CGN's had a signal exploitation capability added with the Classic Outboard system.



Figure 22 *Belknap* Class *USS Fox* (CG 33) after installation of Harpoon and CIWS.

Finally, the New Threat Upgrade (NTU) program provided additional capability beyond the original Terrier and Tartar missile fire control systems in two ways. Targets could be engaged at longer range due to the use of the autopilot in the SM-2 missile which could be updated during flight via a data link (similar to Aegis) and fly a more energy efficient interception path. Also, with NTU (similar to Aegis) the illuminators were only required for the terminal phase of missile flight (instead of during the entire flight time), allowing a greater number of targets to be engaged simultaneously.

7.2 Aviation Capability Evolution

7.2.1 DASH to LAMPS

The Drone Anti-Submarine Helicopter or DASH was developed starting in the late 1950's to deliver an anti-submarine torpedo or a nuclear depth charge out to a range that matched the expected ranges from the new sonars being developed and which was further than ASROC was capable of. Although primarily assigned to smaller ships, the DLG 26 class was also intended to operate DASH. DASH had a poor reputation in service and suffered a high crash rate. In retrospect, some of the reasons seem to be lack of redundancy in the control systems (intended to reduce cost), rapid turnover in maintenance and operations personnel and being a system operated by the surface community but depending on support from the aviation community. Before being retired in 1970 however, some of the drones were modified to carry a television camera and a telemetry system. These "Snoopy" drones were used to spot naval gunfire in Vietnam and were an early version of today's VTUAV's.^{lx}

DASH was replaced in the early 1970's by the SH-2 *Seasprite* LAMPS I manned helicopter which were converted from existing airframes. LAMPS provided additional capabilities and could accomplish additional missions beyond DASH. These capabilities were extended further with the purpose built and larger SH-60 LAMPS III which became part of the CG 47 outfit.

7.2.2 NATO Aviation Capable Cruisers

Starting in the late 1950's, three NATO navies built or converted cruisers with a large flight deck aft capable of operating a large number of helicopters, usually in the anti-submarine role. An alternate role for some of them was as a commando carrier with marines embarked. The first built was the *Jeanne D'Arc* by France which was also used in peacetime as a training ship for naval cadets.^{lxi}

The Italian Navy built three of this type in two different classes, two of the *Andrea Doria* class and an improved version, the *Vittorio Veneto*. These ships included a Terrier missile system forward, giving them an AAW capability as well.^{lxii}

In the late 1960's, the Royal Navy converted two of the previously discussed (see 6.6) *Tiger* class into command helicopter cruisers by removing the aft six-inch mount and replacing it with a flight deck and hangar capable of carrying four *Sea King* helicopters. They also had extensive command and control facilities and acted as the flagships for ASW task forces. They could also carry Royal Marines and act as a commando carrier.^{lxiii}

As a replacement for the *Tiger*'s, the Royal Navy developed the *Invincible* class of "Through-Deck" Cruisers. These are now classified as light or anti-submarine carriers and many believe that calling them a cruiser was a subterfuge because the British government had cancelled an earlier carrier program. However, they were originally fitted with the Sea Dart AAW missile system which compromised the flight deck somewhat (since removed) and the decision to order the *Sea Harrier* fighter was not made until 1975, two years after the first ship was ordered, providing some evidence that they were really intended for the NATO ASW mission.^{lxiv}



Figure 23 HMS Invincible.

7.3 Soviet Union Developments

7.3.1 Pre-1960 Developments

While Soviet Russia inherited a number of ships from the Imperial Russian Navy, it was for most of its existence radically different in function from a conventional navy. More like France or post-WWI Germany, the Soviet Union pursued a sea denial rather than a sea control strategy. The Soviet Navy's main function was to defend the Russian homeland by stopping enemy warships before they could get close enough to carry out any aggressive intention. This mission was variously interpreted over the time span of Soviet history, but remained fairly consistent in principle.

During Stalin's rule, Soviet naval activity was oriented towards creating a large conventional fleet, with cruisers, destroyers, and a small number of battle cruisers and aircraft carriers (the latter never completed). Submarines were an important element of this force, but not the predominant one, and all types were intended for sea denial functions even though their design was not necessarily different from foreign "equivalents" with different functions.

In the 1950s the Russian Navy had in service fourteen *Sverdlov* class light cruisers (17,000 tons full load, twelve 6 inch guns) from Stalin's cancelled big ship building program. USN analysis of those ships tracked their technical ancestry back to a 1930s collaboration between the Italians and the Russians on the *Kirov* class (not to be confused with the later *Kirov* discussed in 7.3.3.) The Italian influence resulted in ships that were fast and heavily armed with some sacrifices in ruggedness and range. However, they remained a threat-in-being for convoy raiding and even bad weather attacks against USN carrier battle groups (quite possible in long winter North Atlantic nights) which kept USN gun cruisers in the inventory as a counter. Late in their careers, they took on a super-AGI role following US carrier groups in peacetime since, unlike the trawler hull intelligence ships, they could not be run away from (either by speed directly or running them out of fuel).

Stalin died in 1953 and with him died the fleet he envisioned. Under Nikita Khrushchev, his successor, who is famous for saying that cruisers were only useful for carrying political leaders on state visits, most of Stalin's program was cancelled (although completed *Sverdlovs* were kept in service), and the challenge to the Soviet navy was to develop new, less expensive weapons to counter the U.S. Fleet, particularly the aircraft carriers which had a strategic strike role.^{lxv}

The Soviet navy met this challenge by developing two different anti-ship cruise missiles (the SS-N-2 Styx and the larger SS-N-3 Shaddock [originally a land attack weapon similar to the US Regulus]) and a fleet dominated by submarines, small combatants and patrol craft to carry them. As discussed previously, defeating the cruise missile threat later drove modifications to the U.S. cruiser fleet as well as development of the Aegis system.

Starting in 1959 and continuing until 1965 the Soviets built four RKR's (*raketnyy kreyser* or rocket cruiser) of the *Kynda* class of 5,500 tons, armed with the large SS-N-3 Shaddock as well as a SAM system and 76.2mm guns. At the time, the U.S. Navy classified these and subsequent similar ships as DLG's until the U.S. dropped that designation in 1975 at which time they were labeled guided missile cruisers.

7.3.2 1960's & early 70's Developments

The Soviet Union accelerated their naval construction during the 1960's while U.S. programs were reduced due to the financial constraints of the Vietnam War. By 1970 the Soviet Navy was a modern force with only 1% of its vessels older than 20 years. The U.S. Navy, in the meantime, had a naval force with 58% of its vessels older than 20 years.

Starting in the mid-1960's the *Kynda* class was followed by four larger *Kresta I* class RKR's which had a displacement around 7,500 tons and again carried SS-N-3 Shaddock missiles as well as SAM's but now supported by an organic targeting helicopter. The *Kresta Is* had two twin launchers that were armed with the SS-N-3

surface-to-surface missiles with no reloads compared to eight launch tubes plus eight reloads on the preceding *Kyndas*.

At this point in time, the emphasis in Soviet cruiser design shifted to anti-submarine warfare (the anti-carrier role was shifted to cruise missile armed aircraft and submarines^{lxvi}) due to the U.S. Navy's threat to the Soviet homeland shifting from carrier aviation to the submarine launched Polaris missile. Later on, as the Soviets developed their own missile submarines, protecting them from U.S. and British attack submarines also became a mission.

Reflecting this change in mission, the *Kresta IIs* were introduced starting in 1970. A slightly larger version of *Kresta I*, these vessels carried two quadruple launchers that were armed with the SS-N-14 anti-submarine missiles (originally thought to be a new type of anti-ship missile though^{lxvii}) and a powerful antiaircraft battery of Surface to Air Missiles (SAM). Reflecting the change in mission the Soviets designated these ships as BPK's (*Bol'shoy Protivolodochnyy Korabl'* (Large Antisubmarine Ships). Ten of the *Kresta II* ships were built.^{lxviii} These ships carry the Kamov Ka-25 helicopter that was designed for anti-submarine work, but could also be used for mid-course guidance for anti-ship missiles. The SAN-1 Goa SAMs in the *Kresta I* cruisers were replaced with the improved long-range SAN-3 Goblet SAMs in the *Kresta II* cruisers.

Moving into the 1970's, construction of the seven *Kara* Class BPK's overlapped with the *Kresta II*. They were almost the size of the *Spruance*-class destroyers and had an armament similar to the *Kresta II* cruisers. The *Kara* cruisers were powered by gas turbines vice the steam plant of the earlier classes. The extra displacement was used to mount two retractable SAN-4 SAM twin launchers, and the gun armament was increased from 57-mm in the *Krestas* to 76 mm.

Although these Soviet cruisers were more heavily armed than their American counterparts, the American cruisers of the *Leahy* and *Belknap* classes had a greater endurance and sustainability. The American cruisers were intended to be anti-submarine and antiaircraft escorts, whereas the Soviet cruisers were intended to protect against the more sophisticated American submarines and aircraft, but still be capable of

mounting a long-range anti-ship attack. As a result they may not have been able to function in battle as well as the less cramped American vessels.

The Soviets also introduced hybrid cruisers with a significant aviation capability with the introduction of the *Moskva* (1967) and the *Kiev* (four ships, commissioned starting in 1975). Although usually classified in Western literature as carriers, both of these classes were called cruisers by the Soviets and carried a significant missile armament and both hull and variable depth sonars. The *Moskva*-class helicopter carriers were designed to counter the threat of the NATO nuclear-powered submarines armed with ballistic missiles and were based in the Black Sea with periodic operations primarily in the Mediterranean. They were not intended to be deployed alone and, therefore, were not armed with surface-to-surface missiles (SSM). They were designed to carry 14 Kamov Ka-25 Hormone anti-submarine helicopters. Probably due to the increasing range of the submarine ballistic missiles which moved the operating areas of the submarines carrying them further away from the Soviet Union's home waters, this class was terminated after only two units.^{lxix}

The *Kiev*-class was significantly larger (43,000 tons) and designed to handle the first Soviet V/STOL aircraft as well as helicopters. She was also a very heavily armed ship with eight SSM launchers on her forecastle and missiles of other kinds along her flight deck. New radars were carried and she was equipped with a bow sonar that is different from US aircraft-carrier practice. The *Kiev* allows the projection of Soviet air power at sea and a marked departure from Soviet strategy in the mid-1960s. Soviet tactics up to 1980, however, were still oriented towards ASW and supporting their own submarines by keeping Western surface forces away from them. "Power projection" ideas were confined to "showing the flag" to influence Third World nations to lean more towards the Communist bloc.^{lxx}

7.3.3 Final Soviet Cruiser Developments

The 1980's saw two final classes of Soviet cruisers introduced before the Cold War ended and the breakup of the Soviet Union.

The emergence of the *Kirov* class missile cruisers in 1980 marked a significant addition to the Russian Navy. The four ships of the class are the world's largest surface combatants built since WWII except for aircraft carriers and have been referred to as "battle cruisers." The design has capabilities to search for and then engage NATO ballistic missile submarines. *Kirov's* mission also includes engaging large surface ships (U.S. carriers) and providing air and antisubmarine protection to naval forces with the introduction of the Granit (SS-N-19) anti-ship missile system. The ships of the class are not identical.

These ships are heavily armed with multiple types of surface to surface, surface to air and anti-submarine weapons. They also carry three helicopters as opposed to only one in earlier Soviet cruisers.

This was the first Russian surface warship with nuclear power. The ship's propulsion system is based on a combination of nuclear power and steam turbine, with two nuclear reactors and two auxiliary boilers. The oil-fired boiler system was provided to provide a superheat capability that boosted the normal steam output by 50 percent. However, according to some sources the two steam systems are separate and work on separate turbines. The propulsion system provides a maximum speed of 31 knots. When only operating on the auxiliary boilers, the ship's maximum speed is 14 knots with an endurance of 60 days.

The final class introduced was the *Slava* (now *Moskva*). This class, larger than the earlier *Kara* class, was primarily intended for the anti-ship role with a load out of sixteen SS-N-12 (an improved version of the earlier Shaddock) missiles although it also has AAW and ASW capabilities. Construction of this class coincided with the end of the Cold War and only a handful of the originally intended number were completed.

8. CRUISER DEVELOPMENT: AEGIS ERA AND BEYOND

8.1 The Aegis Era

The Aegis Era began in earnest on April 25th, 1981 with the launch of CG 47, the USS *Ticonderoga*. To be sure, the *Ticonderoga* was not the first ship fitted with the Aegis system. That distinction belongs to the USS *Norton Sound*, a WWII era seaplane tender converted to a guided missile test ship. The *Norton Sound* was fitted with the Aegis system in 1974, and was also the first ship to fire a ship launched VLS missile.



Figure 24 USS *Norton Sound* fitted with AEGIS System^{lxxi}

The roots of the CG 47 class can be traced back to a paper written by Mr. R. Murray in 1965, who was then Assistant Secretary of Defense. Mr. Murray contended that to control or reduce the costs of naval ship construction, modern manufacturing processes would have to be employed. This led to the introduction of the DX/DXG Project, formally proposed by the Secretary of Defense, Mr. Robert McNamara, in the fall of 1966. Mr. McNamara initiated the Major Fleet Escort Study to determine what new family of destroyer types would be necessary for the Navy of the future.^{lxxii} The DX/DXG Program began to mature and take shape, eventually resulting in the design and construction of the DD 963 *Spruance* Class destroyers. The DD 963 Class is pertinent to the current discussion because they were designed with the intention of following them with a new guided missile-equipped fleet escort (DDG or DLG) class,

based on the DD 963 design (the U.S. Navy never ordered the DDG but ended up with four ships (the DDG 993 *Kidd* class) originally ordered by the Shah of Iran).

The objective was to save cost by retaining the same hull, hull arrangements, and machinery plant as the DD 963 in the new design. The notion that 60 identical hulls with 40 of them equipped as austere ASW escorts and 20 as AAW escorts (the intended split in 1966) would cost less than two classes of 40 DD's and 20 DDG's was based on a primitive understanding of mass production. It is likely that the savings by series production in 60 units was minuscule; true mass production requires far greater volumes, in the tens of thousands of units, to be effective. Also, there were hidden costs in the commonality of the two designs. To leave adequate room for future upgrades and the AAW variant, the DD 963 Class was designed with larger than normal space and weight margins. While this left room for the as-yet-unnamed DDG or DLG metamorphosis, it resulted in a destroyer with overall dimensions much larger than needed for the light armament carried by most of the hulls. These margins later allowed major upgrades to the in-service DD 963 ships as well as development of the CG 47.

As the first of the *Spruance* Class hulls was being laid down, the Navy began to focus its attention on a new, powerful cruiser design designated as the CGSN Strike Cruiser, a completely new breed of American fighting ship. The CSGN was first studied in the 1973-74 timeframe, with commissioning planned to be in 1984. Although evolved from the earlier *California* and *Virginia* Class cruisers originally designed as DLGN's and intended as screening ships for nuclear propelled aircraft carriers in high threat areas, it could also undertake independent operations.^{lxxiii}

The CGSN was to be the first ship to carry the new Aegis advanced fleet defense system. The classification of "Strike Cruiser" was developed to indicate the offensive capability of these ships. The CSGN was envisaged to carry SM-2 surface to air missiles, Harpoon anti-ship missiles, and Tomahawk cruise missiles, as well as an advanced ASW suite. A larger air capable version with an angled flight deck to support VSTOL aircraft and helicopters was also studied.^{lxxiv} The downfall of the CGSN is

attributable to the high price tag that came along with the offered capability. Specifically the use of nuclear propulsion, mandated by Congress in 1975 for use in all new strike force designs, drove costs outside of a range palatable by Congress.

With the cancellation of the CSGN, the Navy proposed the CGN 42, an improved *Virginia* class with a new superstructure designed for the Aegis system and with a displacement of about 12,000 tons.^{lxxv} Compared to the CSGN this design was not as survivable and had reduced command and control facilities for an embarked commander. Ultimately this design was also cancelled during the Carter Administration due to its increased cost compared to the non-nuclear DDG 47 (which became the CG 47) as well as the administration's plan to stop building nuclear carriers (overridden by Congress in FY80 and reversed by the Reagan Administration) which undermined the case for nuclear escorts.^{lxxvi}

Starting in the early 1970's and in parallel with the Aegis nuclear cruiser design studies, a less expensive destroyer version was also studied. This was in line with the philosophy of buying a "high-low" mix of ships and aircraft to achieve required force levels (the FFG 7, F-16 and F-18 also came out of this philosophy). The CNO, Admiral Zumwalt, imposed a displacement limit of 5,000 tons as well as a cost constraint. These limits turned out to be too constraining and ultimately the *Ticonderoga*, an Aegis DDG based on the existing *Spruance* hull using the growth margins incorporated in the original design was proposed to be built along with the CSGN/CGN 42.^{lxxvii} It appears that this design may have originally been proposed in 1975 as a strike cruiser (CSG) before becoming a DDG.^{lxxviii}

Twenty days before the DDG 47 hull was laid down and with the Aegis nuclear cruisers canceled, the *Ticonderoga* was redesignated as the CG 47, a guided missile cruiser. This action reflects that, although the hull of this class is the same as that of the *Spruance* Class, the *Ticonderoga* Class has a full load displacement 1,225 tons greater than the *Spruance*, as well as a much greater combat capability than the ex-DLG cruisers then in the fleet. Another feature that provides the CG 47 increased capabilities over destroyers is that she is fitted with a Unit Commander Stateroom and an area in CIC for

his use. A Unit Commander is a senior Captain, sometime given the position title of Commodore, who controls a small ad-hoc group of ships such as a merchant ship convoy or ESG escort group. These facilities have also been used on occasion by a flag officer with a reduced size staff. The CG 47 commanding officers are also sometimes assigned duties as anti-air warfare commanders within a battle group and use the additional command and control facilities in this role.

The CG 47 *Ticonderoga* was laid down on January 21st, 1980, as the first of twelve new guided missile cruisers to be procured over the next five years. Ultimately the class would consist of 27 cruisers, acquired through four upgraded baselines. The *Ticonderoga* was launched in March of 1981 and commissioned in January of 1983. She displaced about 9,500 tons at a length of 567 feet overall. The *Ticonderoga* carried 8 Harpoon missiles, and a mix of 88 Standard missiles and ASROCs as in two Mark 26 launching systems, a precursor to the modern VLS. She can make better than 30 knots at 80,000 shp total of two shafts.



Figure 25 CG 62 USS *Chancellorsville*^{xxix}

Starting with the CG 52, the *Ticonderoga* class replaced the Mark 26 system with the Mark 41 Vertical Launching System (VLS). This had the immediate effect of increasing the missile load out to 122 as well as increasing reliability. It also provided flexibility in accepting new weapons, increasing existing capability and providing new roles. An example of this is the land attack mission when Tomahawk missiles are carried. In addition, growth versions of the Standard missile provide both an increased engagement envelope in the AAW role and with modifications to the Aegis system, a missile defense capability.

The *Ticonderoga* class cruisers are the most capable surface combatants afloat in most respects. The Aegis AAW system easily outclasses any other system in service, while the ships also have the most capable ASW suite available in the US Navy. However, due to being based on the existing *Spruance* hull, they lack the survivability features a larger ship would have, and had to be built with reduced service life

allowances for weight and moment, limiting the amount of growth the Aegis system and VLS would otherwise allow.^{lxxx}

Eleven *Ticonderoga* Class cruisers participated in Operation Desert Shield/Desert Storm in 1990-1991. During the war, on February 18th, 1991, the *Princeton* (CG 59) struck a bottom-laid influence mine in 16 meters of water that detonated causing a sympathetic detonation of a second nearby mine, damaging the ship. USS *Princeton* restored her TLAM strike and Aegis AAW capabilities within two hours of the mine strike and reassumed duties as the local AAW commander, providing air defense for the Coalition MCM group for 30 additional hours until relieved by the USS *Valley Forge*. The damage to the *Princeton* required her to be towed to port, although at no time was the ship in danger of sinking, and most of her combat systems remained operational.^{lxxxii} Operation of blue water assets in relatively shallow and confined waters continues to be a major operational challenge for the future fleet.

8.2 The DDG 51 and Alternative Modern CG Studies

From the very first studies, the DDG was given two contradictory roles: 1) to be a smaller force-number-builder and 2) fix things that were perceived to be wrong with the CG 47. Specifically, it was felt that a ship armed with Tomahawk, unlike a carrier escort, could fight while hurt. Even if the ship were slowed and had lost a combat system capability in one or more areas, if it could receive Tomahawk targeting data and launch, the self-guiding missile would be fully functional. Thus the DDG received a steel superstructure, increased blast overpressure resistance, more armor, a collective protection system and radar cross section reduction measures. Thus there is a historically anomalous situation of the destroyer being a more survivable ship than the cruiser.

A question that has continually come up is “what if a new cruiser, with weapons the same as the CG 47 class, were designed starting with the DDG and expanding into the cruiser mission?” In order to have a math model of such a ship for future technology studies, Navy Preliminary design created the Cruiser Baseline (CGBL)

shown in Figure 26. The study also included weapons systems modularity and increased service life reserves. The resulting ship had a waterline length of 600 feet, a beam of 69 feet, a displacement of about 13,500 tons plus a 30+ knot speed.



Figure 26 CGBL; a CG 47 combat system but with the hull features of a DDG 51, weapons systems modularity and increased service life reerves

Another cruiser alternative studied in the late 1980s was variously entitled a Mission Essential Unit (MEU) or CG V/STOL. In a return to the thoughts of the independent operations cruiser-carriers of the 1930s and the Russian *Kiev* class, the ship was fitted with a hangar, elevators and a flight deck. The mission systems were Aegis, SQS-53 sonar, 12 SV-22 ASW aircraft and 200 VLS cells. The resulting ship had a waterline length of 700 feet, a waterline beam of 97 feet, and a displacement of about 25,000 tons. Figure 27 is a painting of that ship concept.



Figure 27 A painting of a hybrid Aegis cruiser and light carrier ship: the Mission Essential Unit

8.3 Beyond the CG 47

The Twenty-First Century Surface Combatant (SC-21) Mission Need Statement (MNS) was approved by the Joint Requirements Oversight Council (JROC) in September 1994. Required capabilities called out in the MNS included: Power Projection; Battlespace Dominance; Command, Control and Surveillance; Joint Force Sustainment; Non-combat Operations; and Survivability / Mobility. In January 1995 the Defense Acquisition Board (DAB) gave approval to Milestone 0 for SC-21 Acquisition Phase 0 (Concept Exploration and Definition).^{lxxxii}

In February 1995, Mr. John Douglas, Assistant Secretary of the Navy initiated a Cost and Operational Effectiveness Analysis (COEA) effort to recommend a design for the 21st Century Surface Combatant (SC-21). The COEA was under the direction of RADM Phil Coady and Mr. Ron Kiss, Deputy Assistant Secretary of the Navy. The tasker required the COEA team to identify mission deficiencies, estimate the

requirement for the naval surface forces, and to evaluate the costs and benefits of reasonable alternative designs for the new surface combatant.^{lxxxiii}

The two-year study reported out in June 1997. It recommended a new DD 21 Maritime Fire Support Ship concept whose missions included strike and long range precision fire support, and whose hull would be common with a follow-on CG 21.^{lxxxiv}



Figure 28 Artist Concept: CG(X) and SC-21 Family^{lxxxv}

Subsequent to these studies a design competition was held between two industry teams culminating in an award in 2002 to the team lead by Northrop Grumman Ship Systems. Along the way, the ship was redesignated as the DD(X) with the CG(X) planned as a spiral development.

As a descendant of the DD(X) program, it is envisioned to share with DD(X) a common propulsion architecture and hull form. This hull form will contain an integrated all-electric power system that is more fuel efficient and flexible than today's propulsion systems, and provides more power capacity for future weapons. CG(X) will also use many of the same transformational technologies used in DD(X) to reduce crew size and operating and support costs. CG(X) will maintain air superiority over the total force. Larger, faster, and longer-range missiles will allow CG(X) to counter state-of-the-art air threats hundreds of miles inland. A generation of air defense radars is currently under development to counter low-radar cross section (RCS) threats at extended ranges; CG(X) will provide sustained air superiority, but potentially will also detect, track and engage ballistic missiles outside of the atmosphere.^{lxxxvi}

9. CONCLUSIONS

This historical survey shows that ships with the name “cruiser” have covered a number of missions over the years:

- Foreign station ships, independently deployed, looked out for national interests around the world. In addition to an extensive gun armament, the station ship had self-repair capability, long range, and “first-responder-to-disorder” equipment such as small arms for the crew and an extensive boat outfit. The disorder could be a revolutionary situation or a natural disaster.
- Sea denial ships, using their pre-deployed location, attacked other nations’ trade routes. Counter-raider merchant ship escorts would, in turn, try to stop enemy sea denial ships.
- The Washington Battleship construction limitation treaties made large cruisers into substitutes for battleships in an alternative battle line (especially for night time combat). The attempt to forge a homogenous cruiser battle line ended up making US and Japanese “light” cruisers the same size and weight as “heavy” cruisers. The French and Italian navies specialized in “interceptor” cruisers – sacrificing many other ship features, such as range, for speed and armament. The Soviet Union’s first cruisers were based on Italian designs which explains their heavy armament on smaller displacements.
- Cruisers have served as command ships at many levels, from small group leader to provisions for carrying the national command authority.
- Cruisers have served as reconnaissance platforms (either directly as fast scout cruisers or via launching and retrieving smaller vehicles such as float planes).
- The “C” in CV reflects the fact some of the first carriers were armed with cruiser caliber guns for self-protection and thus thought of a part of the cruiser family. The CVs lost their gun armament in favor of more aircraft but depended on gun cruiser protection (prior to all weather day/night aircraft) when night/fog/bad weather left a carrier helpless against enemy surface combatants.

- Smaller cruisers (CLAA) took on the role of gun armed AAW specialists able to keep up with the carriers regardless of sea conditions.
- There have been several proposals for cruiser-aircraft carrier hybrids and one Japanese cruiser class was constructed to a float plane version of that concept.
- There have been a few highly specialized variants such as cruiser minelayers and dedicated training cruisers.
- Cruisers served as anti-battleship (UK WWII) and anti-carrier (USSR 1950-60s) barrier picket ships and, once a target had been identified, as high-speed long-distance tattletales.
- Cruisers supplied amphibious gunfire support to land forces at the start of wars until the more operationally expensive battleships could be reactivated.
- Currently, USN CGs and CGNs serve as aircraft carrier escorts, providing AAW and ASW.
- Independent land strike capability became a cruiser feature with the fitting of Tomahawk to the CG 52 onward.

The displacement of USN cruisers was constrained during the Treaty period but grew rapidly during the WWII era, only to drop again with the new primary role of carrier escort (Figure 29 - on next page).

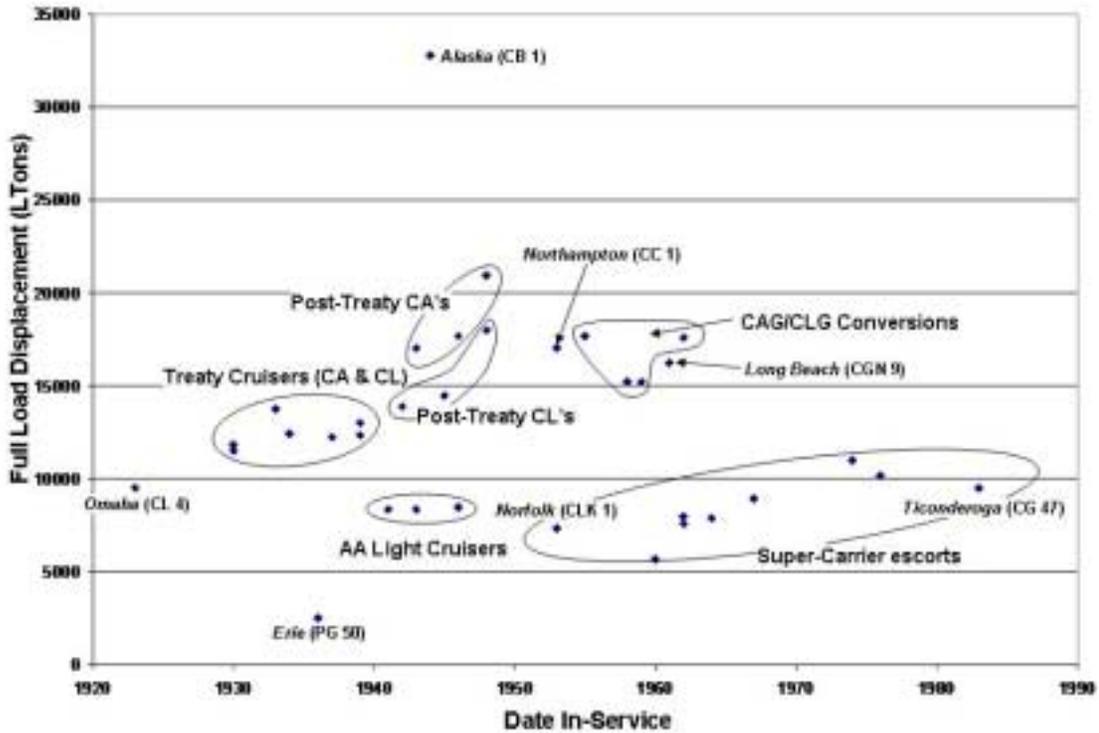


Figure 29 Displacement Trends

There are modern analogs to the historical roles. A forward deployed “Sea Swap” unit, with the carrier battle groups based in the United States instead on constant patrol, would return the cruiser to the independent station ship role. We do not expect cruisers to serve as sea denial raiders in declared war because submarines are so much better at it. However, a modern sea denial role is intercepting and searching merchant ship in remote ocean locations to see if they are transporting terrorists or serving as Trojan horses for destructive weapons to be delivered to a US port. Future cruisers will not conduct anti-surface raider barrier patrols, but could provide a ballistic missile defense barrier, the modern equivalent. This role requires a ship with the traditional cruiser virtues of endless boring patrolling (reliability, seakeeping, crew comfort) with the possibility of sudden unanticipated action (100% availability, time critical response, independent action). Future cruisers will not carry float planes, but they may be a

launch/recovery platform for the modern analog of unmanned vehicles (air, surface or underwater).

A summary of the changing mission assigned to ship designated as cruisers follows in Table 3.

Table 3: The Changing Roles of Cruisers

Traditional Cruiser Roles	1890s to WWI	1920 to 1938	WWII	1945 to 1960s	1960s to 1980s	Current CG	Future CG?	Future Equivalent Cruiser Roles
Offensive								Offensive
Ship barrier patrol	X	X					X	Missile Barrier Patrol
Commerce raider	X	X					X	WMD Interception
Station ship	X	X					X	Sea Swap ship
Deep Land strike						X	X	Deep Land strike
Gunboat Diplomacy	X	X					X	Gunboat Diplomacy
Amphibious cover			X	X				Amphibious cover
Minelayer		X	X					Minelayer
Defensive								
CV SUW defense			X	X				CV SUW defense
CV AAW defense			X	X	X	X		CV AAW defense
CV ASW defense					X	X		CV ASW defense
Counter sea denial	X	X	X	X			X	Counter sea denial
Other								
Fleet Command				X	X			Fleet Command
Local Command	X	X	X			X	X	Local Command
Scouting	X	X						Scouting
Float Plane Carrier		X	X				X	RPV Carrier

It appears that the consistent theme of all the historical missions was a ship with long endurance and the potential for independent operations. Sometimes this theme was strongly emphasized as in ships for the foreign station, commerce raider and commerce defender roles. Sometime those characteristics dwindled in ship customized for specialist roles such as the battle fleet scout cruiser of WWI, the cruiser minelayers and the highly optimized big carrier escorts of the US of the last half of the 20th century.

The difference between gun ship cruisers and their destroyer counterparts were fairly pronounced: an armor belt, bigger guns (6 to 8 in), four screw vice two, provision for float planes and command facilities. Less obvious differences were a large boat outfit plus medical facilities along with marines and/or landing small arms for the sailors. Those features allowed a cruiser to intervene ashore. To maintain long patrols, cruisers were fitted with enhanced stores capacity and self-repair provisions. The destroyers generally had sonars and depth charge racks which, except for all but a few of the smallest classes, cruisers did not. The old destroyers were noticeably smaller than cruisers.

The current generation of USN cruisers is optimized as a large aircraft carrier AAW/ASW escorts. That role drives the designer towards a high speed, lightly or unarmored ship with relatively limited endurance, operating as a component of a deployed carrier battle group. The assumption that the Navy needs a one-for-one replacement for those ships, focused on the carrier escort role, is in question due to the large number of DDG 51 class ships that exist (and are on order) which are carrier escort capable. The fact that the existing USN cruiser class (CG 47) was originally conceived as a big soft DDG, while the current DDG has cruiser-like toughness factors built into it, greatly confuses the cruiser name product line. The DD(X) carrying two cruiser size 155mm (6.1 in) guns on a 14,000 ton hull is another confusing bit of nomenclature.

If a future cruiser is not a dedicated AAW/ASW carrier escort (directly replacing the CG 47 class in the force structure, intended to surge with the carrier battle groups), the ship design features that come from a return to historical mainline of cruiser missions would include:

- Increased survivability, especially against ambush attacks, including a return to structural armor,
- Increased stores and fuel loads for independent operations,
- Increased self repair stores and shops to allow staying on station for an extended period while remaining fully capable,

- First responder capabilities (such as limited medical facilities, small arms for the crew and an extensive boat/helo outfit), and
- Crew sized not only to operate the ship but to put small detachments ashore or onto seized merchant ships.
- Provisions for carrying a small command staff and a senior officer (if assigned a role in the command structure).

The hull features listed above would noticeably increase ship size (dimensions and weight) compared to the current generation of lightly-protected aluminum superstructure ships bearing the cruiser name. However, most of those features have relatively low construction costs and a relatively small life cycle cost impact. Note that the associated higher manning level for self-repair, first responder role and detachment operations would carry a noticeable life cycle penalty. A combined nuclear cruiser with gas turbine boost (CONAG) plant would increase initial cost and crew cost but, at the fleet level, might pay off by reducing the logistic train required to support a ship assigned to a remote station for long periods of time or eliminate the vulnerability caused by using regional port facilities.

APPENDIX A: THE DESIGN AND USE OF WOODEN FRIGATES AS “CRUISERS”

The cruiser as a ship type evolved from the frigate of the Age of Sail. While the term is earlier, it is believed that the first British ships of frigate build were Unicorn and Lyme (1748). The capital ship of the Age of Sail, the ship of the line of First through Fourth Rates, had a basic design feature of multiple covered gun decks one above the other. The lower gun deck was of necessity at least 4, and more commonly some 6 feet above the waterline. A ship of the line could have two, three, or occasionally four armed decks. The frigate, on the other hand, had but one fully armed deck, the main deck. The deck below this one, the berth deck, was about at the waterline since it did not require any gun ports. Inherently, this reduced ship depth, lowered the center of gravity, reduced freeboard with its attendant windage and weight, and reduced overall ship displacement because of the lesser number of guns, lesser scantlings required to hold up the guns' weight, and the lesser amounts of ballast required to maintain stability.

Frigates were typically of about the same length and beam as a small ship-of-the-line. Having the same hull length on which to mount sails meant they had the same propulsion power. However, being of smaller hull depth and carrying fewer guns, they had a smaller displacement (hence, less drag) so the frigate could sail faster on every point of sail in almost all conditions. The berth deck offered the better living condition of an unobstructed area for crew living as opposed to living among the guns on the larger ships. The frigate also had a smaller crew compared to a ship-of-the-line of the same size.

A frigate had lightly armed quarterdeck and forecastle decks above its main deck with the space below the quarterdeck providing accommodations suitable for a senior officer. The 'tween decks of a corvette (the next smaller ship type), which also usually

lacked even a non-armed quarterdeck, were much less comfortable because it lacked opening windows.

The USN produced the wooden equivalent of the German “pocket battleship” with the Constitution class frigates which were big enough and heavily armed enough to assure the defeat of British frigates, but also fast enough to run away from multi-deck ships-of-the-line. The interim British counter was the razee, which was a small ship-of-the-line with her upper decks cut away converting it into a large and powerful frigate.

A contemporary British definition of a cruiser from 1815 is:

“CRUISER: a vessel employed in cruising.

They are small men of war, employed to sail to and fro in the Channel, and elsewhere, to secure our merchant ships and vessels from the enemy’s small frigates and privateers. They are generally such as sail well, and are commonly well manned: indeed, the safety of the trade in the Channel, and up and down the Soundings and other places, absolutely require the constant keeping out of ships at sea. When the ships employed for this purpose, have arrived at their destined station, they traverse the sea backward and forward under an easy sail, and within a limited space, conjectured to be nearly in the track of their expected adversaries.”^{lxxxvii}

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