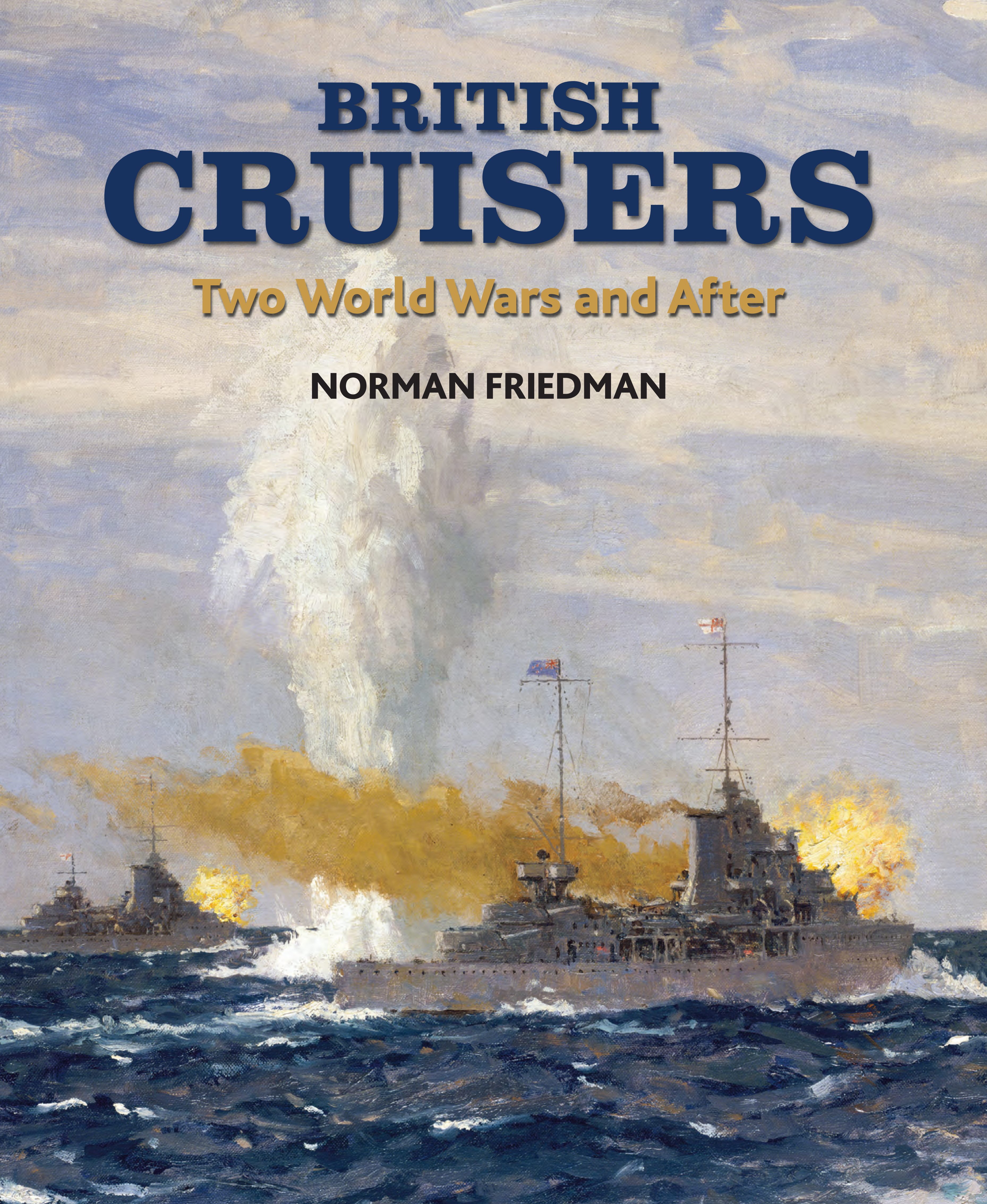
BRITISH CRUISERS

Two World Wars and After

NORMAN FRIEDMAN



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Ship plans by A D Baker III, John R Dominy, Alan Raven and Paul Webb

Seaforth
PUBLISHING

Frontispiece: HMS *Dido* illustrates the configuration of her class by mid-1943, with the small lantern of the surface-search set atop the tripod foremast.
(This and all other uncredited photographs are from US official sources, by courtesy of the author)

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CONTENTS

GLOSSARY AND ABBREVIATIONS

A/S: anti-submarine
AA: anti-aircraft
ABU: automatic barrage unit
ACNS (W): Assistant Chief of the Naval Staff (Weapons)
ACNS: Assistant Chief of the Naval Staff
ADO: Air Defence Officer
ADP: Air Defence Position
ADR: Aircraft Direction Room
AIO: Action Information Organisation
AP: armour piercing
ARL: Admiralty Research Laboratory
ASW: anti-submarine warfare

BD: between decks (mounting)
BL: breech-loading (gun)
BOR: Bridge Operations Room

CDS: Comprehensive Display System
CID: Committee of Imperial Defence
C-in-C: Commander-in-Chief
CNS: Chief of the Naval Staff
CO: Commanding Officer
Commodore (T): Commodore of the Harwich Force (Commodore, later Rear Admiral, Sir Reginald Y Tyrwhitt)
COSAG: Combined Steam and Gas (turbine)
COW: Coventry Ordnance Works
CRBF: Close Range Blind Fire (system)

D of D: Director of Dockyards
D of P: Director of Plans
D of TD: Director of Torpedo Division
DA: direct attack (weapon)
DACR: direct attack close range (weapon)
DAS: Director of Anti-Submarine Warfare
DAW: Director of Naval Air Warfare
DBR: dive bomber reconnaissance (aircraft)
DCNS: Deputy Chief of the Naval Staff
DCT: director control tower
DDNC: Deputy Director of Naval Construction
DDNO: Deputy Director of Naval Ordnance
DDOD (M): Deputy Director of Operations Division (Mining)
DEE: Department/Director of Electrical Engineering
DFSL: Deputy First Sea Lord
DGD: Department/Director of Gunnery Division
DNAD: Director of Naval Air Division
DNC: Director of Naval Construction
DNE: Director of Naval Equipment (including arrangements for personnel aboard ships)
DNI: Director of Naval Intelligence
DNO: Director of Naval Ordnance
DOD: Director of Dockyards (same as D of D, above)
DPT: data link associated with CDS (*qv*)
DRC: Defence Requirements Committee
DRE: Director of Radio Equipment
DTM: Directorate of Torpedoes and Mines
DTSD: Director/Division of Training and Staff Duties (in 1945, Tactical, Torpedo, and Staff Duties; after 1945, Tactical and Staff Duties)
DTWP: Director of Tactics and Weapons Policy
DUW: Director of Underwater Weapons

ehp: effective horsepower
E-in-C: Engineer-in-Chief

F/R: fighter-reconnaissance (aircraft)
FDO: Fighter Direction Office
FKC: Fuse-Keeping Clock
FOST: Fleet Operational Support and Training (ship)
ft: foot/feet

GAP: Guided Air Projectile
GDR: Gunnery Direction Room
GDS: Gun Direction Systems

HA: high angle
HACP: High-Angle Control Position
HACS: High-Angle Control System
HADT: High-Angle Director Tower
HE: high explosive
HF/DF: High Frequency Direction-Finding
HMAS: His/Her Majesty's Australian Ship
HMCS: His/Her Majesty's Canadian Ship
HMS: His/Her Majesty's Ship
HP: high pressure

IFF: Identification Friend or Foe
in(s): inch(es)

kt(s): knot(s)
kW: kilowatts

LA: low angle
lb(s): pound(s)
LCS: Light Cruiser Squadron
LP: low pressure
LST: Landing Ship Tank

MCDP: Medium Calibre Dual Purpose (gun)
MoD: Ministry of Defence

NATO: North Atlantic Treaty Organisation
NDAC: New Design Armoured Cruiser
NID: Naval Intelligence Department
nm: nautical miles

oa: overall

PAC: Parachute and Cable (weapon)
PIL: Position In Line (rangefinder)
pp: between perpendiculars
PRO: Public Record Office
psi: pounds per square inch
PWQ Committee: Post-war Questions Committee

QF: quick-firing (gun)

RA (D): Rear Admiral (Destroyers)
RAE: Royal Aircraft Establishment, Farnborough
RAF: Royal Air Force
RCO: Radar Control Office
RDF: Radio Direction-Finding (i.e. radar)
RPC: remote power control
rpm: revolutions per minute

S of C: Superintendant of Charts
S/R: spotter-reconnaissance (aircraft)
SAP: Semi-Armour Piercing
shp: shaft horsepower
STAAG: Stabilised Tachymetric Anti-Aircraft Gun
STD: Simple Tachymetric Director

TIR: Target Indication Room
TIU: Target Indication Unit
TOM: Tachymetric One-Man (director)
TSR: torpedo spotter reconnaissance (aircraft)

UP: Unrotated Projectile (rocket)
USS: United States Ship

VCNS: Vice Chief of the Naval Staff

W/T: wireless telegraphy, i.e. radio
WA: warning air (radar)
wl: waterline
WS: warning surface (radar)

YARD: Yarrow-Admiralty Research Department
yd(s): yard(s)
YEAD: Yarrow-English Electric Admiralty Development

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Above all I thank my wife Rhea, who has lived with this project and its forebears for many years, from the 1970s, when she first encouraged me to take vacation time to visit and revisit the Draught Room at the National Maritime Museum. She is a large part of how and why books like this get written. I have often enjoyed (and benefited greatly from) discussing the historical and policy issues raised in this work with her. She has always been very supportive, particularly at times when projects have seemed to me to entail walking through molasses. She has helped me adopt and to continue using photography to obtain copies of crucial documents, first using a film camera and tripod and more recently using a digital one. More than any previous book of mine, this one could not have been written without the digital camera, because the volume of documents consulted has been so vast. However, the book also benefited heavily from access to a considerable library of printed material. Rhea has often joined me in hunting through bookstores, here and abroad. I cannot thank Rhea enough for her loving support.

My research on British cruisers goes back to the 1970s, when it benefited enormously from help provided by the late David Lyon, at that time in charge of the Draught Room of the National Maritime Museum. Since his time crucial National Maritime Museum collections, including the Covers and the Constructors' Notebooks, have become available to the public at the Brass Foundry out-station of that museum. For critical assistance I thank its current chief, Jeremy Michell, his assistant Andrew Choong Han Lin, and their predecessors. I have to thank a former head of the Brass Foundry, the late David R Topliss, for alerting me to the value of the Constructors' Notebooks. I am also grateful to the Brass Foundry staff for helping me gain access to the trove of Vickers design material they hold. I am grateful to the staff of the Caird Library of the National Maritime Museum for assistance with the d'Eyncourt papers, and with the d'Eyncourt design notebook I have quoted. I much appreciate the considerable assistance provided by Captain Christopher Page (recently retired) and his staff at the Royal Naval Historical Branch and the Admiralty Library (to whose librarian, Jenny Wraight, I am much indebted). I have also benefited from access to the archive of the Royal Navy Museum in Portsmouth, arranged by Ms Wraight. I am, as always, grateful to the staffs of the Public Record Office (Kew: now The [British] National Archives) and the US National Archives and Records Agency, both downtown and at College Park. Given the close association of the Royal Navy and the US Navy, the ability to cross-reference materials from both sides of the Atlantic has been extremely valuable. I benefited greatly from relevant parts of the Thurston Notebook (export designs) provided by Stephen McLaughlin. Particularly for Australian ships, I am grateful to Dr David Stevens, head of the RAN Historical Branch, and to Paul Webb. Professor C M Woolgar of Southampton University and his assistant Karen Robson provided me with a microfilm of some of the pre-1914 Battenberg papers, which provided useful hints on British cruiser policy. In addition to those named, I benefited greatly from discussions with A D Baker III, with Alan Raven and with Dr Nicholas Lambert, whose knowledge of the workings of the Admiralty during the pre-1914 and First World War eras is remarkable. I am also grateful to Dr Eric Grove, whose insights into the post-1945 Royal Navy and into British defence policy in general have proven quite helpful. I would like to thank Dr George H Elder for supplying copies of some important Royal Navy documents. I would also like to thank members of the 'Steel Navy' web discussion board for their help, particularly in elucidating the final close-range armament of HMS *Exeter*.

My friend A D Baker III produced many drawings specially for this book, and provided invaluable advice and also many photographs. My friend Alan Raven kindly produced several drawings showing British cruisers at particularly interesting times during their wartime careers, drawn for this book, as well as much valued comment, particularly on wartime alterations. Paul Webb very kindly allowed me to use several of his drawings, and also provided important information and photographs. John R Dominy allowed me to use several of his drawings, all of which were based on official plans. Mr Baker in turn thanks several friends for their own assistance in his work: Robin Bursell, John Lambert, Darius Lipinski, Miles McLaughlin, Alan Raven, Paul Webb and the staff of the Brass Foundry, which holds plans on which many of the drawings were partly based (the list of those who helped Mr Baker suggests how much more his plans entail than simply tracing and simplifying the large originals in the National Maritime Museum).

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Although I greatly appreciate all the help given me, I am of course responsible for the contents of this book, including any errors.

CHAPTER 1
INTRODUCTION

It is difficult to define a cruiser in a way which embraces all the ships described in this book. The name implies a ship capable of cruising independently on a foreign station, which in the age of steam machinery entailed an ability to make running repairs far from home, as well as a long radius of action. Behind this name was the idea that the cruiser was smaller or more weakly armed than a battleship, yet still protected against enemy fire to some extent. The second, but not quite the first, attribute can be associated with the fast cruisers built during the First World War, which were to a considerable extent super-destroyers (which is why the big 'Tribal' class destroyers were candidate replacements in the 1930s). Although they were initially called armoured cruisers, I have not included the first battlecruisers; they are more closely associated with the last generation of large armoured cruisers, which I hope to describe in a later volume. I have included cruiser minelayers, and I have also included the escort cruisers and command cruisers (culminating in the *Invincible* class) of the 1960s and 1970s, because they were conceived very much for possible independent operations.

This book describes the British cruisers of the radio or wireless age. Radio changed naval warfare in profound ways, and cruisers operating far from home were changed more than most kinds of ships. British cruisers had three roles. One was to protect seaborne trade against surface raiders. A second was to support the battle fleet, both as scouts and by beating off enemy torpedo attacks. A third was to maintain order in the massive British Empire. During what might be called the pre-radio age, trade protection entailed large numbers of ships, covering convoys or occupying the focal areas through which most trade passed, and through which raiders, too, would most likely pass. Trade protection by either technique required large numbers of cruisers. In the late nineteenth century, likely enemies (France, Germany, Russia) all began building large, fast armoured cruisers and protected cruisers which might attack British trade. The Royal Navy built its own numerous fleet of large cruisers – each of which cost about as much as a battleship. Cruiser-building to protect trade was ruinously expensive because so many such ships were needed to cover so much trade. In effect the Royal Navy found itself building both a battle fleet and a cruiser fleet of similar or even greater cost. The French went so far as to write about an economic war ('guerre industrielle') in which the British would be defeated by being driven bankrupt. This war was deadly because the French (and Russians, and Germans) did not have to build large numbers of cruisers, while the Royal Navy had to place equivalent ships everywhere they might appear.

Radio changed trade protection. It became possible to envisage an intelligence system using radio reports of raider attacks to track the raiders.[1] On that basis, fast cruisers could be vectored to intercept them. Although the process was imperfect, it could deal far more economically with any raiders. Initially the expectation seems to have been that fast long-range ships (battlecruisers) would be held at readiness in home waters for despatch against raiders, but by about 1910 it was clear that groups of cruisers would be held on foreign stations awaiting radioed orders. This idea, which could not be discussed publicly, made it possible to imagine protecting British trade using an affordable number of cruisers. That number in turn shaped British cruiser design during the inter-war period, when most of the ships described in this book were built or at least conceived.

Cruisers also operated with the fleet. As scouts, they were expected to find the enemy fleet (and discover its disposition, course and speed)

Throughout most of the cruiser era, Royal Navy strategists were faced with a terrible problem: they had to defend the worldwide trade of the Empire, its lifeblood, with a single mobile fleet, supplemented by cruisers on remote stations. The encouragement of the Dominion navies was a partial solution, but the cruisers built for and operated by the Dominions were lumped with those of the Royal Navy under the inter-war naval arms-limitation treaties, particularly that signed in London in 1930 (which limited overall cruiser tonnage). HMAS *Australia* is shown between the wars. The two Australian 'Counties' differed from their Royal Navy counterparts in having taller funnels. (Photo by Allan C Green via State Library of Victoria)

Above: The inter-war Royal Navy was dominated by the need to protect the seaborne trade which kept the British Empire alive. The big 'County' class cruisers were conceived largely to deter Japanese attacks on British trade by threatening Japanese trade during the weeks before the main British fleet could reach Singapore, its base for a war against Japan. The first five 'Counties' were therefore deployed to the China Fleet upon completion. HMS *Berwick* is shown in 1932, wearing tropical livery (white hull and buff funnels). Note the trolley, which indicates that she has been fitted with a catapult.

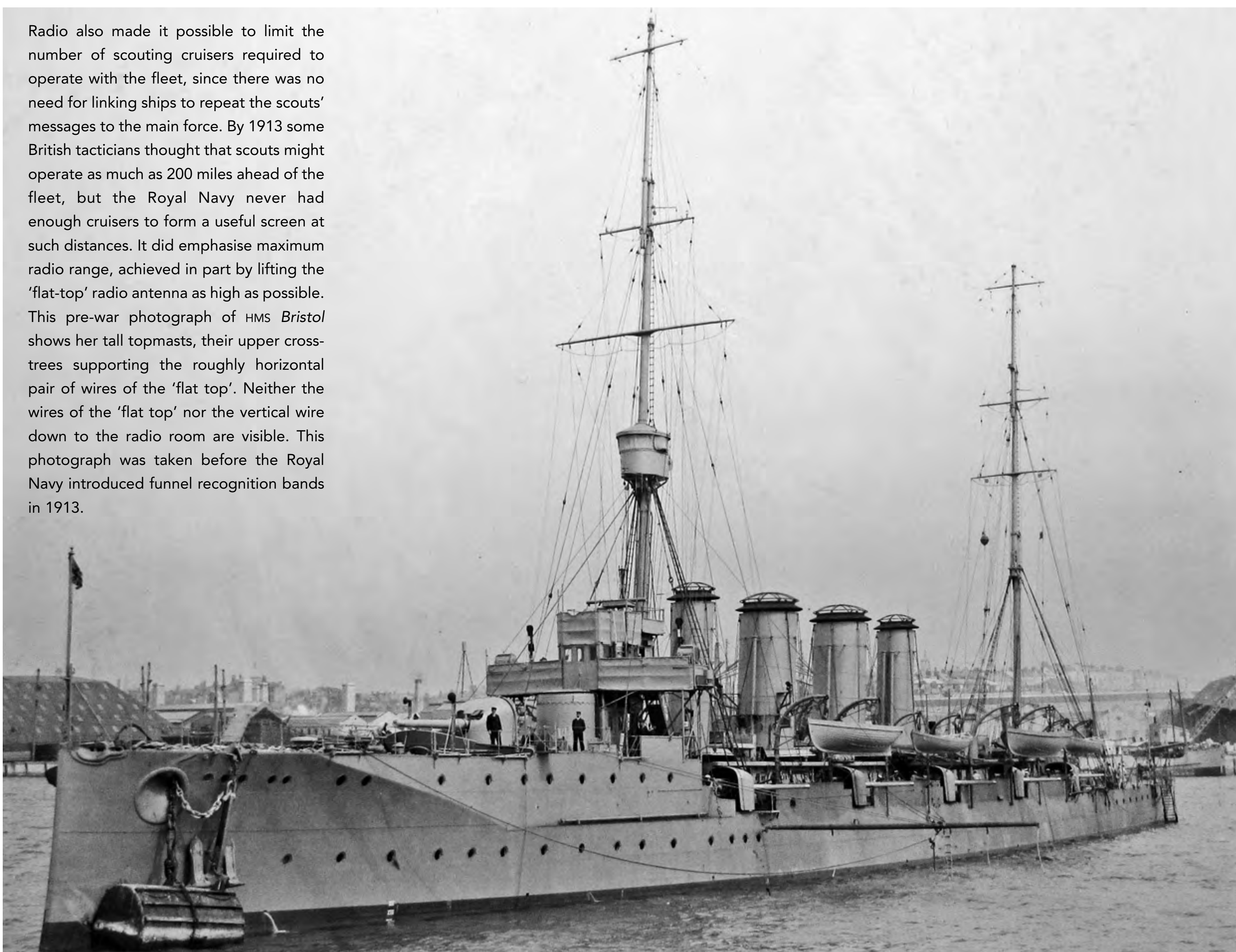
Above: HMS *Kent* emerged from a 1931 refit with a catapult, an important feature because an aircraft gave a cruiser a much better chance of detecting raiders. Within a few years the Royal Navy was intensely interested in the offensive potential of catapult aircraft, but the one shown here was limited to spotting duties. Aircraft were included in the design (the ships were completed with a foundation for a catapult) but initially were omitted to avoid exceeding the 10,000-ton Washington Treaty limit.

Above: HMS *Norfolk*, a later 'County' class cruiser, emerged from a 1937 refit with twin 4in anti-aircraft guns, part of a rearmament package proposed by the 1932 Naval Anti-Aircraft Gunnery Committee. The single centreline anti-aircraft director (aft) with which the ship was completed was replaced by a pair of such directors abreast the bridge. Other improvements were a pair of octuple pompoms, the most powerful existing light anti-aircraft weapons, abeam the after superstructure, and a pair of the new quadruple 0.5in machine guns on platforms abeam the gap between the first and second funnels. The inter-war Royal Navy invested more in anti-aircraft firepower than any other, and was air-conscious to the point that additional deck armour for capital ships was justified as a defence against bombing. The 4in gun was particularly important because it was assumed that enemy bombers would attack from medium altitude, hence could be engaged at a considerable distance and their formations broken up. Unfortunately the Royal Navy opted too soon for a fire-control system which depended on the controlling officer's estimate of the speed of the approaching aircraft. Just before the Second World War the Director of Naval Ordnance wrote that this had been the wrong choice; he was about to test a tachymetric (speed-measuring) system (which, probably unknown to him, the US Navy already used). He expected the new system to enter service in 1941. The ship's DF array is just visible near the juncture between the foremast and its topmast, just below the crow's-nest.

Right: Radio made it possible for the Royal Navy to set up a global ocean-surveillance system and to vector cruisers to hunt down surface raiders, something inconceivable before about 1908. In 1909 the Admiralty sought to convince the Dominions to create fleets which could secure Empire trade outside European waters. Only Australia and New Zealand responded, and only Australia created a full 'fleet unit'. When war came in 1914, HMAS *Sydney*, shown, participated in the hunt for the German raider *Emden*. The extent of the force required seems to have been an unpleasant surprise, and it inspired the post-war idea that British raiding cruisers could tie down significant Japanese forces. *Sydney* is shown pre-war; note the identifying funnel bands standard in the Royal Navy. (RAN Historical Branch)

while screening their own fleet from enemy discovery. If the British fleet was blockading an enemy port, British cruisers would operate off that port to raise the alarm when the enemy fleet sortied. To be viable, fleet scouts had to be powerful enough to survive in the face of the enemy's most powerful cruisers. In a pre-radio age, these scouts had to be backed by ships linking them to the main fleet, each within visual signalling range. With the advent of radio, the scouts could operate much further afield (a discussion in 1913 of fleet organisation mentioned scouts as much as 200 miles ahead) and the numbers in the cruiser force could be reduced dramatically. That became evident in post-First World War discussions of the number of cruisers the Royal Navy required.

In addition to their scouting role, the cruisers operating ahead of or with the fleet were expected to shield it from enemy torpedo craft. Before about 1910, the British expected the Germans to send out their destroyers (which they called seagoing torpedo boats) in hunting groups,



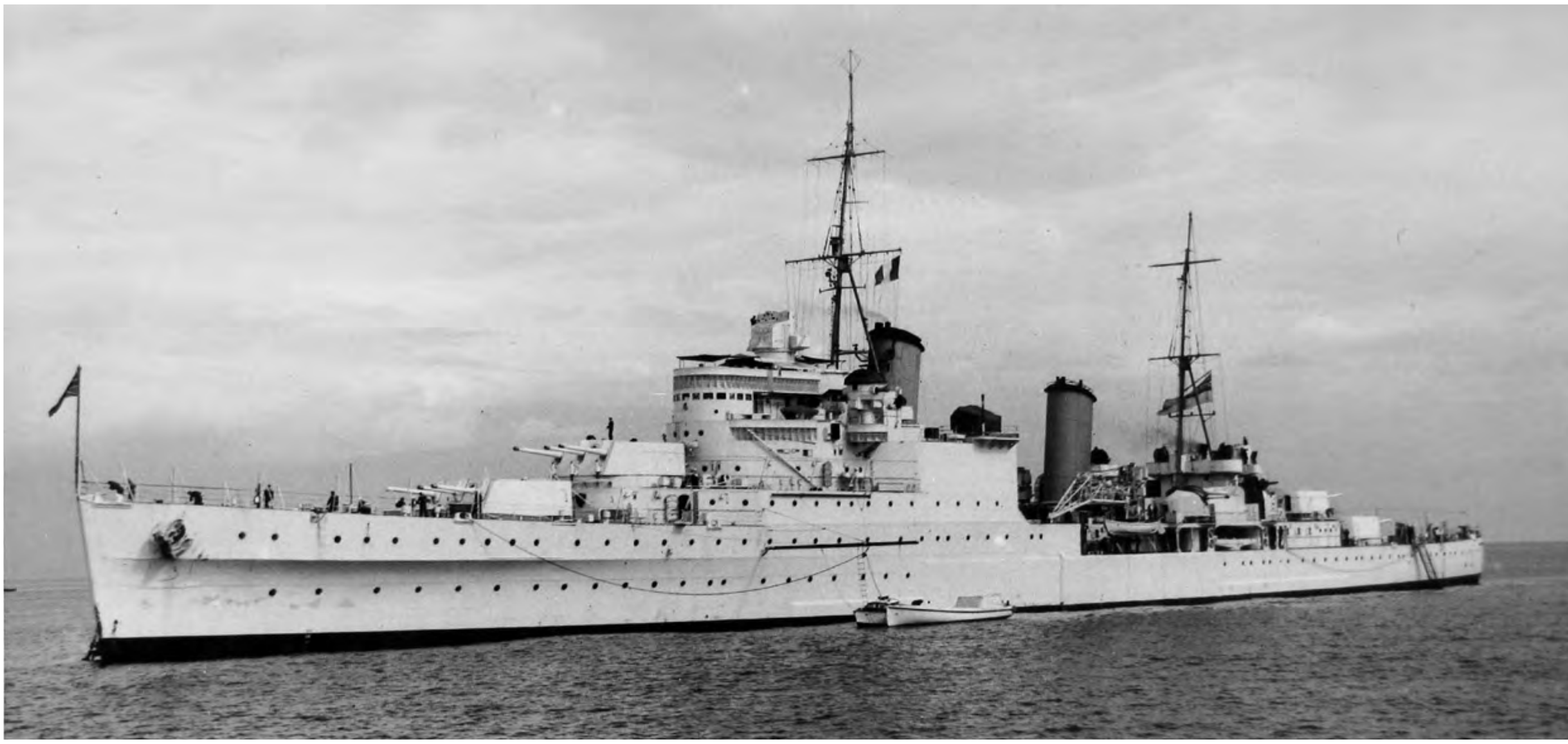
Radio also made it possible to limit the number of scouting cruisers required to operate with the fleet, since there was no need for linking ships to repeat the scouts' messages to the main force. By 1913 some British tacticians thought that scouts might operate as much as 200 miles ahead of the fleet, but the Royal Navy never had enough cruisers to form a useful screen at such distances. It did emphasise maximum radio range, achieved in part by lifting the 'flat-top' radio antenna as high as possible. This pre-war photograph of HMS *Bristol* shows her tall topmasts, their upper cross-trees supporting the roughly horizontal pair of wires of the 'flat top'. Neither the wires of the 'flat top' nor the vertical wire down to the radio room are visible. This photograph was taken before the Royal Navy introduced funnel recognition bands in 1913.

Above: Radio made it possible to so reduce the number of scouts in the fleet that other cruisers could be assigned to beat off enemy destroyer attacks. After the First World War the ideal Royal Navy cruiser squadron consisted of five ships. By the early 1920s it was assumed that the battle fleet would have a two-squadron scouting line and two more squadrons to deal with enemy torpedo attacks, and to back up attacks by British destroyers. The seventy-cruiser force advocated from about 1924 on consisted mainly of ships assigned to trade protection, either as deterrents or to run down raiders based on ocean surveillance. The *Arethusa*s (of 1913) and later small cruisers were conceived mainly as destroyer-killers. Later classes were given heavy torpedo batteries because, in attacking the enemy's destroyer force, they might find themselves in position to fire torpedoes at the enemy main body. HMS *Danae*, shown in 1930, was a mature example of this kind of cruiser, mounting four triple torpedo tubes – twice the battery of a destroyer, or a full destroyer battery on each side (she could not have mounted centreline tubes, hence could not use all of her tubes on either side). The main post-war modification was the addition of three 4in anti-aircraft guns, two abeam her funnels and one abaft No. 5 gun.

Below: The need for numbers of cruisers, mainly for trade protection, was a consuming requirement in inter-war British thinking. The Royal Navy pursued arms-control treaties to reduce cruiser size, hence cost, and its designers sought the minimum acceptable cruiser design. This ideal was reached in the *Arethusa* class. HMS *Galatea* is shown at Malta in April 1937, wearing neutrality stripes on 'B' turret to avoid attack during the Spanish Civil War. She had not yet been upgraded with twin rather than single 4in anti-aircraft guns. (Fahey Collection of the US Naval Institute)

so British anti-destroyer tactics were to blockade German torpedo boat bases using flotillas of destroyers stiffened by cruisers. About 1910 it was accepted that the Germans would take their destroyers to sea with their battle fleet, and the cruiser anti-destroyer (and pro-destroyer) roles with the fleet became important; the *Arethusa*s and their successors were built for this purpose.

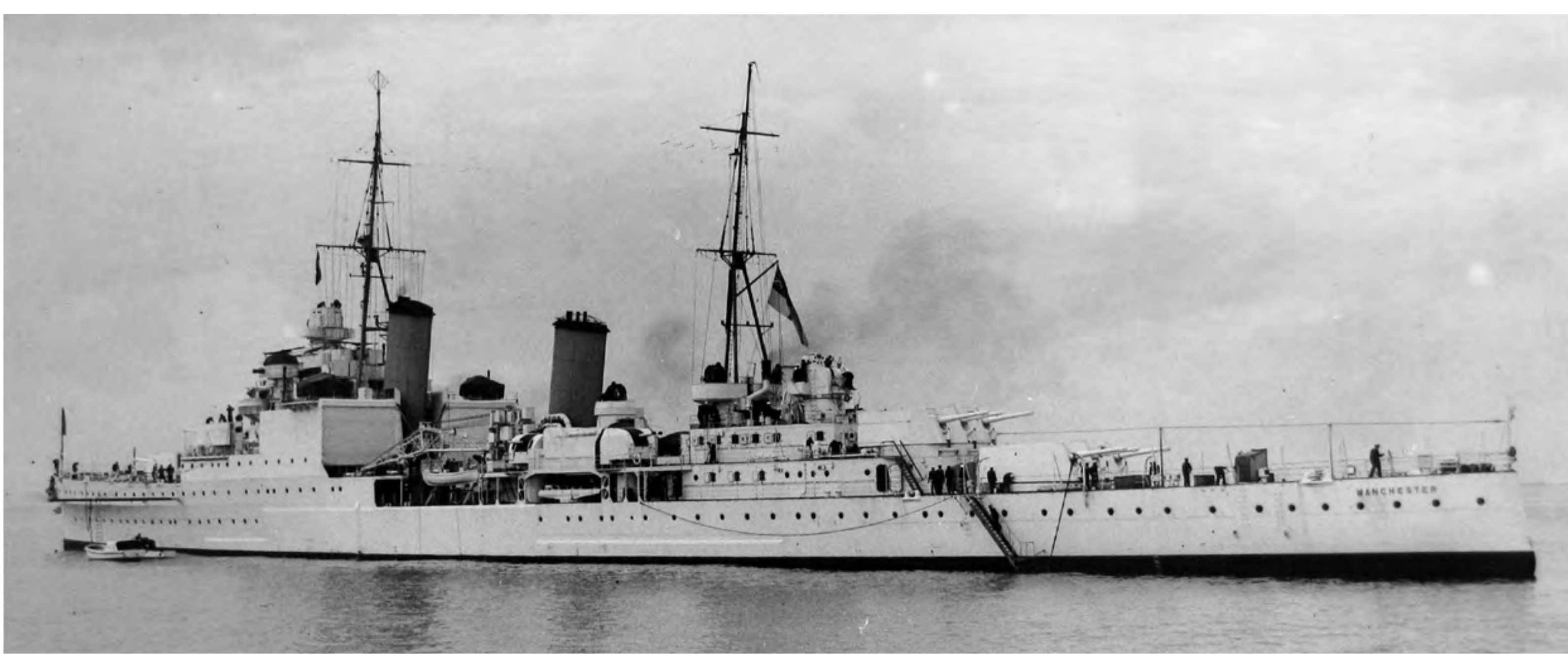
The third important cruiser role was protecting the Empire. It was complex partly because shadowing the formal British Empire was an informal one, consisting of close trading partners whose governments tended to benefit from British sea dominance. This informal empire was closely connected to the trading operations of the City of London, the financial centre of the United Kingdom and, before the First World War, the single most important financial centre in the world. The City financed world trade, and it well understood that free trade (free, for example, from anti-trade warfare) was key to British prosperity. It was understood that governments would favour Britain and the City if they understood that British sea dominance helped protect them. China, for example, was part of the informal empire, which explains why the Royal Navy maintained a large and expensive China Fleet through the inter-war period, far larger than the Asiatic fleet or squadron of any other European power. The extent of British investment helps explain why Japanese expansion into China in the 1930s was so threatening to the British. The informal empire seems to have been well understood in the British government, but rarely (if ever) explicitly discussed; it has surfaced in historical discussions only in recent years.[2] Yet the requirements of informal empire had profound implications for the British cruiser fleet. A cruiser was a particularly good package for colonial warfare: she combined a powerful gun armament with a substantial landing force of Marines and with command and control. In 1927, for example, HMS *Enterprise* and her Marines saved Kuwait from a Saudi attack. Kuwait was part of the informal empire, with a British resident, but was by no means a colony (a British amphibious carrier saved Kuwait again in 1961, this time from Iraqi attack). The great convulsion in the British cruiser force just prior to the beginning of this book



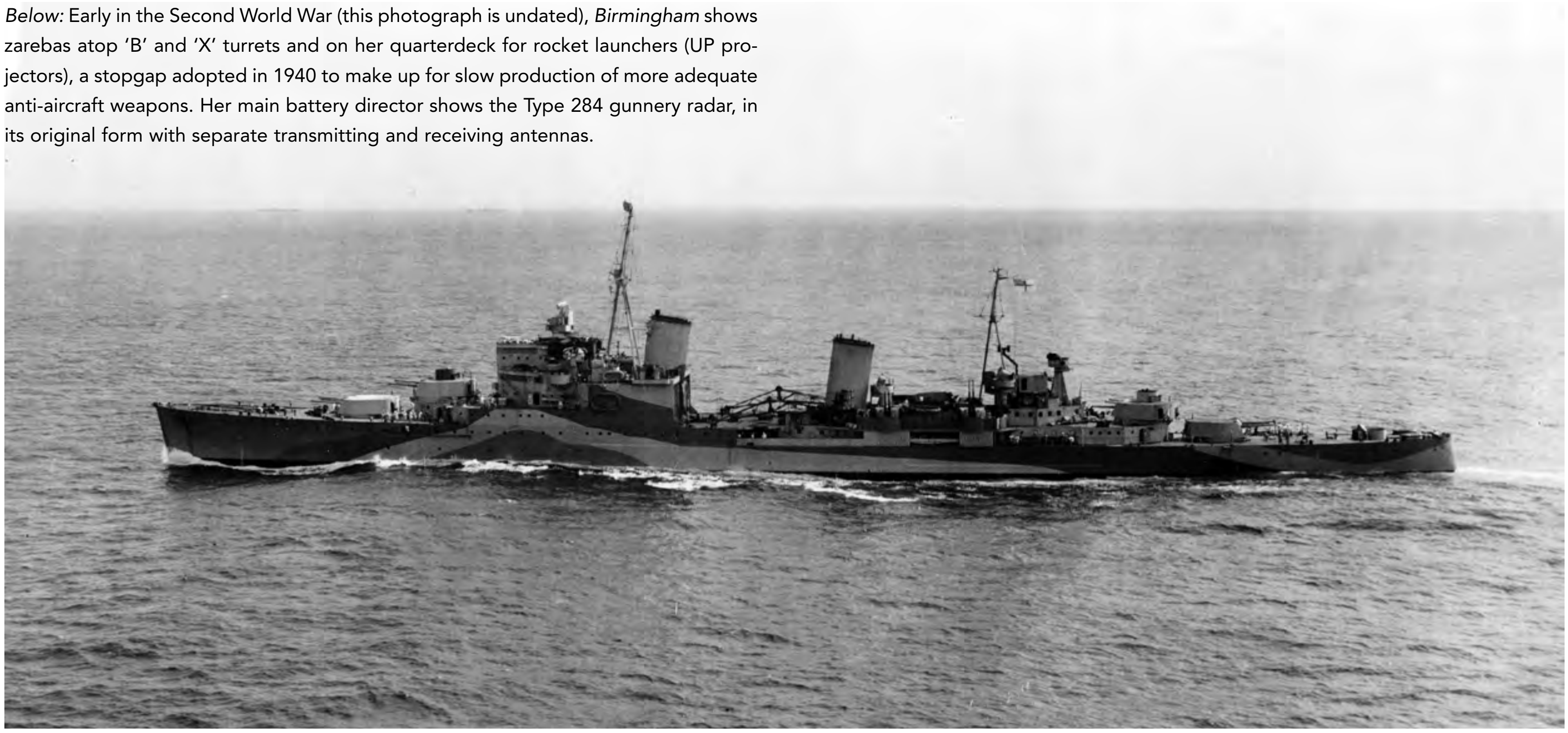
was the elimination of many small cruising craft on empire-protecting foreign stations, because neither the Foreign Office nor the Colonial Office was willing to pay for them, and in view of the new concept of trade protection they lacked a purely naval role. A few such craft (not true cruisers) survived, and an attempt to replace them, described in this book, failed just prior to the First World War because the demands of the main fleet were too insistent (the inter-war sloops, which are not described in this book, were the true successors to these small cruisers).

Informal empire could be expected to work as long as prospective partners could realistically expect Britain, which generally meant the Royal Navy, to help protect them. When someone wrote that 'trade follows the flag', what was often meant was that a country shielded by the Royal Navy would feel inclined to support that protection by

Above and below: British cruiser designers consistently sought to minimise the size, which they associated with the cost, of their ships. They therefore designed for minimum tonnage (weight-critical design practices), often not estimating the need for length or for space until late in the design process. That was possible because very experienced designers could estimate the needs of conventional designs. Unfortunately the situation changed quickly just before and during the Second World War, with dramatically increased needs not only for topweight (to accommodate radars and anti-aircraft guns) but also for internal space and for additional electric power. HMS *Manchester* is shown, newly completed, in 1938. She displays the first of the electronic devices which would soon proliferate, an HF/DF loop at the head of her foremast. This sensor was relatively common in the Royal Navy by 1939, but no other navy had it. Cruisers had HF/DF in order to detect and run down raiders beyond the horizon, and probably also to assist their aircraft in homing on them.



Below: Early in the Second World War (this photograph is undated), *Birmingham* shows zarebas atop 'B' and 'X' turrets and on her quarterdeck for rocket launchers (UP projectors), a stopgap adopted in 1940 to make up for slow production of more adequate anti-aircraft weapons. Her main battery director shows the Type 284 gunnery radar, in its original form with separate transmitting and receiving antennas.



buying British, and by using British banks to float its loans. In a sense informal empire justified the cruiser squadrons maintained on foreign stations between the two World Wars. The stations were revived after the Second World War, but could not be maintained for long, as the war had destroyed too much of the British economy.

The Royal Navy ships in this book were designed by the Department of Naval Construction, headed by the Director of Naval Construction (DNC), who was officially adviser to the Admiralty Board on warship materiel (and as such was sometimes styled Deputy Controller). After a reorganisation in the 1960s, the design and construction organisation became the Ship Department and DNC became Director General, Ships; he figures only in the very last designs described in this book. Machinery was the responsibility of Engineer-in-Chief (E-in-C), and ordnance the Director of Naval Ordnance (DNO). During the inter-war period, as electrical machinery became more important, a separate Department of Electrical Engineering (DEE) was created. I have referred interchangeably to departments and to their chiefs. The DNC organisation designed ships up to the point at which bids could be invited, which for the purposes of this book meant to the point of mature designs. By way of contrast, E-in-C and DNO laid out specifications and evaluated designs (they also estimated weights and sizes so that DNC's designers could produce preliminary designs). DNO was responsible for fire control, but in 1941 a new Department of Gunnery and Anti-Air Warfare (DGD) was created, splitting DNO's role. There was also a separate torpedo and mine directorate (DTM). During the inter-war period an Anti-Submarine directorate, concerned with Asdic (sonar) was created, and ultimately this Director of Anti-Submarine Warfare (DAS) took over responsibility for torpedoes as well (as DTASW). Finally, between the wars a Naval Air Department (DNAD) was created; it was significant for cruiser design. Departments were reorganised after the Second World War on functional lines, creating, for example, a Director of Air Warfare (DAW) and a Director of Underwater Warfare (DUW). Neither is very important for this book. Director of Dockyards (D of D) was responsible for building and refitting ships, and provided information as to the capacity of the dockyard system.

Policy, including ship requirements, was set by the Board of Admiralty: First Sea Lord, his deputy Second Sea Lord (also responsible for personnel), Third Sea Lord (and Controller) and, at various times, Fourth Sea Lord (logistics) and Fifth Sea Lord (fleet aircraft). Before 1912 the Naval Intelligence Department (NID) functioned as both an intelligence organisation and a naval staff, evaluating various ship design issues, among other things. In 1912, as a result of controversy

Above: Photographed at Scapa Flow from USS *Wasp* on 17 May 1942, HMS *Manchester* displays the usual wartime modifications, which had to be squeezed into the ships. She had just completed a refit (18 March – 25 April 1942). Her masts carry the separate transmitting and receiving antennas of the Type 279 air-warning radar. The bridge carries the 'lantern' of the Type 273 surface-search radar, abaft the main battery director, which carries the separate transmitting and receiving antennas of a Type 284 gunnery-ranging set. Atop 'B' turret is a single Bofors gun. She had received one single Bofors and five single Oerlikons during a 16 January – 29 March 1941 refit, and another three single Oerlikons during a refit at the Philadelphia Navy Yard (23 September 1941 – 27 February 1942). Another two single Bofors were temporarily added for Operation 'Pedestal', the attempt to push a convoy through to Malta. During it she was sunk on 13 August.

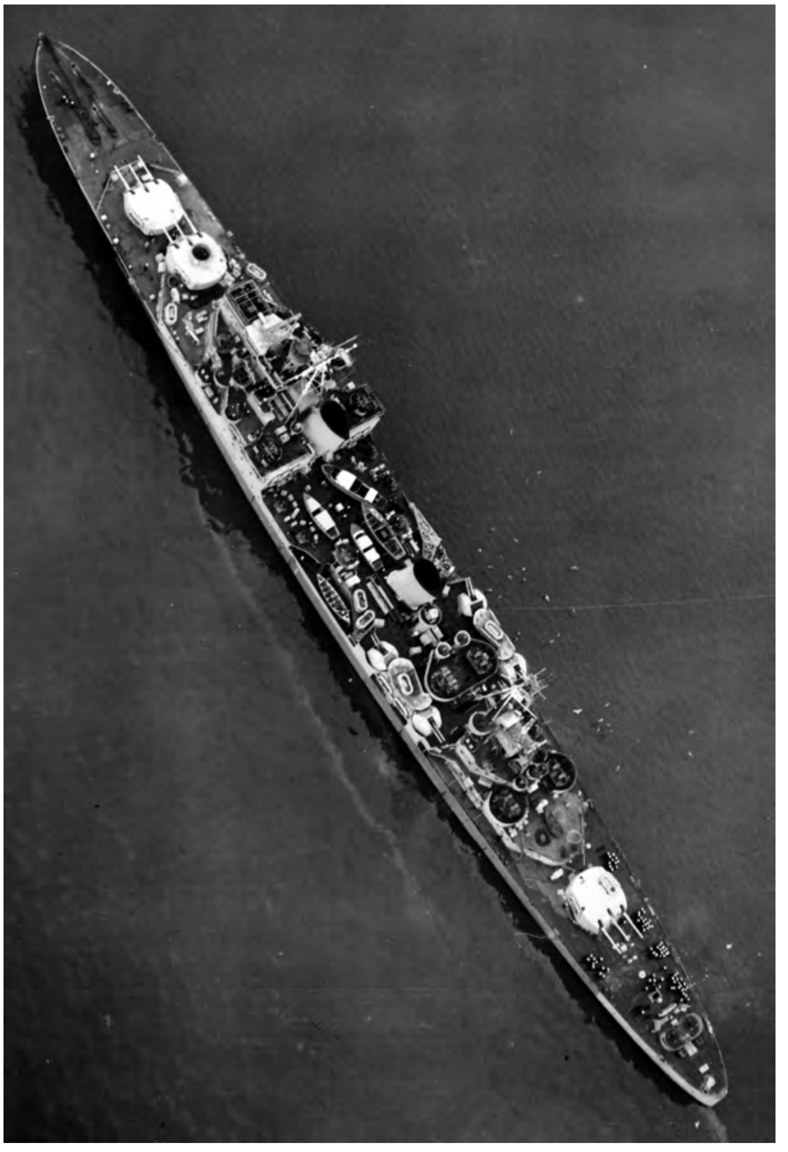
Above and below: Photographed on 15 September 1943, *Birmingham* shows further modifications. She had been fitted with gunnery (Type 284) and air-search (Type 291) radars during a 1942 refit, but during a Devonport refit (23 April 1943 – 21 August 1943) she received a large-ship air-search set (Type 281B, with a single antenna for transmitting and receiving) and a Type 273 surface-search set atop her bridge. She was torpedoed on 28 November 1943 *en route* to Alexandria, and went to the United States for a further major refit.

concerning the navy's ability to staff war plans, a new War Staff was created, taking over the staff functions of NID. The staff functions became far more important during the First World War, and in 1917 a more elaborate staff organisation was formalised. By analogy with the army's staff, the war staff was given executive rather than advisory responsibility, and First Sea Lord was made Chief of the Naval Staff, with a Deputy First Sea Lord and Deputy and Assistant Chiefs of the Naval Staff (DCNS and ACNS), each of whom was responsible for parts of the naval staff. A new Naval Artillery and Torpedoes Division was created in June 1918 to decide weapons employment policy and also to develop weapon requirements. This division was also responsible for requirements for ship protection against weapons, which is why its chief became involved in discussions of the 'E' class cruiser design. This was Captain Frederic C Dreyer, who had been Admiral Jellicoe's Grand Fleet gunnery officer. When DNO (Director of Naval Ordnance) tried to shut down his new department, Dreyer argued successfully that DNO was far too involved with details to develop overall policy. In 1920 the new department was split into a Gunnery Department and a Torpedo Department; Dreyer became the first director of the Gunnery Department (DGD). A Training and Staff Duties Division (DTSD) was created in June 1918, initially to help organise the staff and also to consider conditions of entry into the Royal Navy; by way of contrast, the equivalent army organisation developed Staff Requirements, in effect deciding how new technology should be used to meet tactical and strategic needs. In 1918 the existence of numerous technical departments made such a development impossible, although to some extent Captain Dreyer's division filled them. A further reorganisation in 1920 made DCNS responsible for strategic policy and ACNS for tactical policy (including ship and weapon development); the office of Deputy First Sea Lord lapsed. On this basis ACNS was given a Tactical Section (he also had the Air Section).

By this time there was intense pressure to cut the staff as part of the post-war pruning of Royal Navy overheads. For example, DNO continued to see DGD as an unnecessary rival, and there was also a proposal to eliminate DTSD, among other divisions. For a time the new staff organisation survived due to memories of wartime disasters suffered because of inadequate staff work. In a further reorganisation in December 1928, the gunnery division was incorporated into DTSD, and the torpedo division into the tactical division (formerly the tactical section). Until 1939, Staff Requirements, at least for ships, were formulated by the Tactical Division. At that time it was folded into DTSD, which thereby gained full co-ordinating (never exclusive) responsibility for Staff Requirements. Note that these requirements were always a matter of discussion for all interested departments and divisions.[3]

First Sea Lord wore three hats. He was operational chief of the navy, a role made more important in the Second World War because he and his Admiralty staff had access to the ocean surveillance picture created on the basis of code-breaking and other sources of intelligence. He was also head of the Naval Staff, and he was also responsible for many decisions concerning materiel. In 1942 a new office of Deputy First Sea Lord (sometimes styled DFSL) created mainly to handle materiel. He was assisted by a new Assistant Chief of the Naval Staff (Weapons) (ACNS(W)); DFSL and ACNS(W) headed a new Future Building Committee, which largely but not completely shaped wartime ship policy. A Vice Chief of Naval Staff (VCNS) was also created. The Future Building Committee was considered successful. After 1945 it was succeeded by a Fleet Requirements Committee and a Ship Characteristics Committee, both of which were involved in the last cruiser designs.

Until the end of the First World War, Controller or, sometimes, First



Above: By late 1943, drastic changes were needed to free topweight and space for further additions, particularly for more close-range weapons. HMS *Birmingham* is shown on 23 November 1944 at Hampton Roads after a refit in the United States (Norfolk Navy Yard, July 1944 – 28 November 1944), her 'X' turret having been removed. She retained the two quadruple pompoms atop her former hangar, but the refit added four quadruple Bofors aft plus five single and two twin Oerlikons. She already had two single Oerlikons (seven fitted during a Simonstown refit, 5 March 1942 – 1 April 1942, but five removed during the next refit) and eight twin Oerlikons (added during a Devonport refit, 23 April 1943 – 21 August 1943). Note the short depth-charge track right aft, a standard installation on board British cruisers from the First World War onwards.

Lord or First Sea Lord asked DNC for a sketch design to meet a very simple requirement, most of what would later figure in Staff Requirements being understood as conforming to standard practice. Later Controller generally formulated an initial set of requirements, DNC producing sketch designs to see what was practicable. Formal Staff Requirements typically reflected one such sketch design, although at times more general ones were formulated. Also, once formulated, Staff Requirements were debated within the Admiralty, as is evident in some of the cases described in this book. Controller was thus usually the key figure in defining what a cruiser should be, although he did not always succeed. The most obvious example is Rear Admiral Reginald Henderson's failure in 1936 to convince the Board to adopt a ship armed entirely with 5.25in guns as the 8,000-ton cruiser (the *Fiji*s had 6in guns). The only case in which a DNC took the initiative seems to have been the big cruiser eventually built as the *Hawkins* class. It may have been significant that the DNC involved, Sir Eustace Tennyson d'Eyncourt, came from a major private yard with its own design capacity (Armstrong) rather than from the ranks of the Royal Corps of Naval Constructors. All other DNCs rose through the ranks.

Many of the Controllers represented here later became First Sea Lords, and as such sometimes revived initiatives they had started as Controllers. The controversy over the internal arrangements of the rebuilt 'County' class is a case in point.

The Ministry of Defence (MoD) was created in 1940, but it had little effect on the Royal Navy before its minister Duncan Sandys conducted the 1956 Defence Review. Formal service unification came in 1959, and the Board of Admiralty was formally abolished in 1964 (it continued as a lower-level organisation). Ministry of Defence committees, such as the all-service Operational Requirements Committee, increasingly reviewed navy projects. These changes are peripheral to nearly all the ships described in this book, the only exceptions being the escort cruiser and its successor the command cruiser.

Given the set of Constructors' Notebooks preserved in the National Maritime Museum's Brass Foundry, plus the Ship Covers and papers in the Public Record Office, it has been possible to reconstruct (apparently) virtually all British cruiser designs prepared between 1920 and the last missile cruiser in 1956.[4] The Notebooks, particularly those left by Sir Charles S Lillicrap (head of the cruiser section in the late 1930s, and later DNC) provide insight into the way in which designs were prepared. The key design tool was the summary weight breakdown typically included in the Legend, the summary of ship characteristics presented to decision-makers. Typically the designer began with a target weight and with demands for particular armament, protection and speed. He could calculate (or estimate) armament weight, and therefore the weight of 'general equipment', which depended mainly on personnel and their stores. Displacement suggested overall dimensions, based on previous cruiser practice. Again, based on existing cruiser designs, the designer could estimate how much power was needed. E-in-C could estimate both machinery weight and the dimensions of the machinery box. The constructor could add up what he had and subtract from the total allowable displacement to give available protection weight. For much of the period covered by this book, protection meant a belt and deck over the machinery plus boxes covering magazines and (with reduced thickness) shell rooms. Hence machinery box dimensions gave armour weight or, for a given weight, available thickness. If the combination did not work, the constructor modified dimensions and tried again. Notebooks suggest that a few combinations of dimensions gave a practicable combination, on the basis of which more detailed work began.

The great strength of this technique was that, in the hands of an experienced designer like Lillicrap, it very quickly provided the basis for a cruiser design. It ruled out impractical alternatives. The weakness of the technique was that it did not explicitly account for ship volume. Experience was key, because a designer had a feel for what was wanted. Moreover, as long as ship designs were broadly similar, it was unlikely that a hull of reasonable size would fail to accommodate what was needed along the centreline of the ship: machinery and turrets (superstructure generally fit above a machinery box of reasonable size). If the ship seemed likely to be somewhat tight, the initial designer might add 10 or 20ft to its length, as a surrogate for adding deck space. This practice was unavoidable, because it was difficult at best to estimate deck areas and hence available space. That was done once overall dimensions and weights had been estimated, but it entailed far too much calculation for alternative layouts to be worked out.

Given experience and a long line of ships similarly arranged, designers generally found it unnecessary to work out the lengthwise arrangement of spaces. For cruisers the one exception, until 1939, seems to have been the unconventional aircraft-aft design investigated by Lillicrap late in 1936. However, lengthwise space analysis seems to have been the rule from 1939 on; it was certainly done for the wartime heavy cruiser designs.

British design practices worked because DNC split his organisation into sections, one of which specialised in cruisers (to some extent one might define a British cruiser as a ship designed by the cruiser section). Specialisation is obvious in the Constructors' Notebooks, which rarely show designs of multiple types (except as constructors moved from section to section). Those in the section worked on preliminary and detailed designs, and they also became aware of how the ships they designed performed. By way of contrast, the US Bureau of Construction and Repair was organised according to stages of design, the Preliminary Design section working on all types of ships (submarine design was somewhat more specialised). Contract Design, for example, was a separate organisation. In 1918 Stanley V Goodall, a British constructor (later DNC) seconded to the US organisation, delivered a lecture in which he argued that the British split according to type of ship made for better awareness of overall design issues.

The split by ship type encouraged a section to develop a style of design with implicit emphases. British designers favoured the tightest possible designs, with limited stretch for in-service modification. That became evident during the First World War, when, for example, extra generator power was wanted for more powerful searchlights. Early post-1918 designs, such as the 'County' class, seem to have had more stretch in them, but later inter-war designs were certainly quite tight. The *Fiji* class suffered particularly because they entered service just as major additions, such as radar and many more close-range anti-aircraft guns, were wanted. British cruisers designed after the First World War also seem to have suffered because E-in-C was more conservative than his foreign counterparts. Early reports of Italian practice seemed to justify his relatively bulky boilers and heavy turbines, but US designers produced roomier ships, probably because they had lighter and more compact machinery. During the Second World War DNC was forced to defend his design practices as British officers saw and admired many US designs. The British cruisers designed (but not built) late in the war were far larger than their predecessors, to an extent which shocked many of those defining requirements. The shock of growth was worsened because ships came to be described by their deep load rather than standard displacements, the difference amounting to several thousand tons in a large ship.

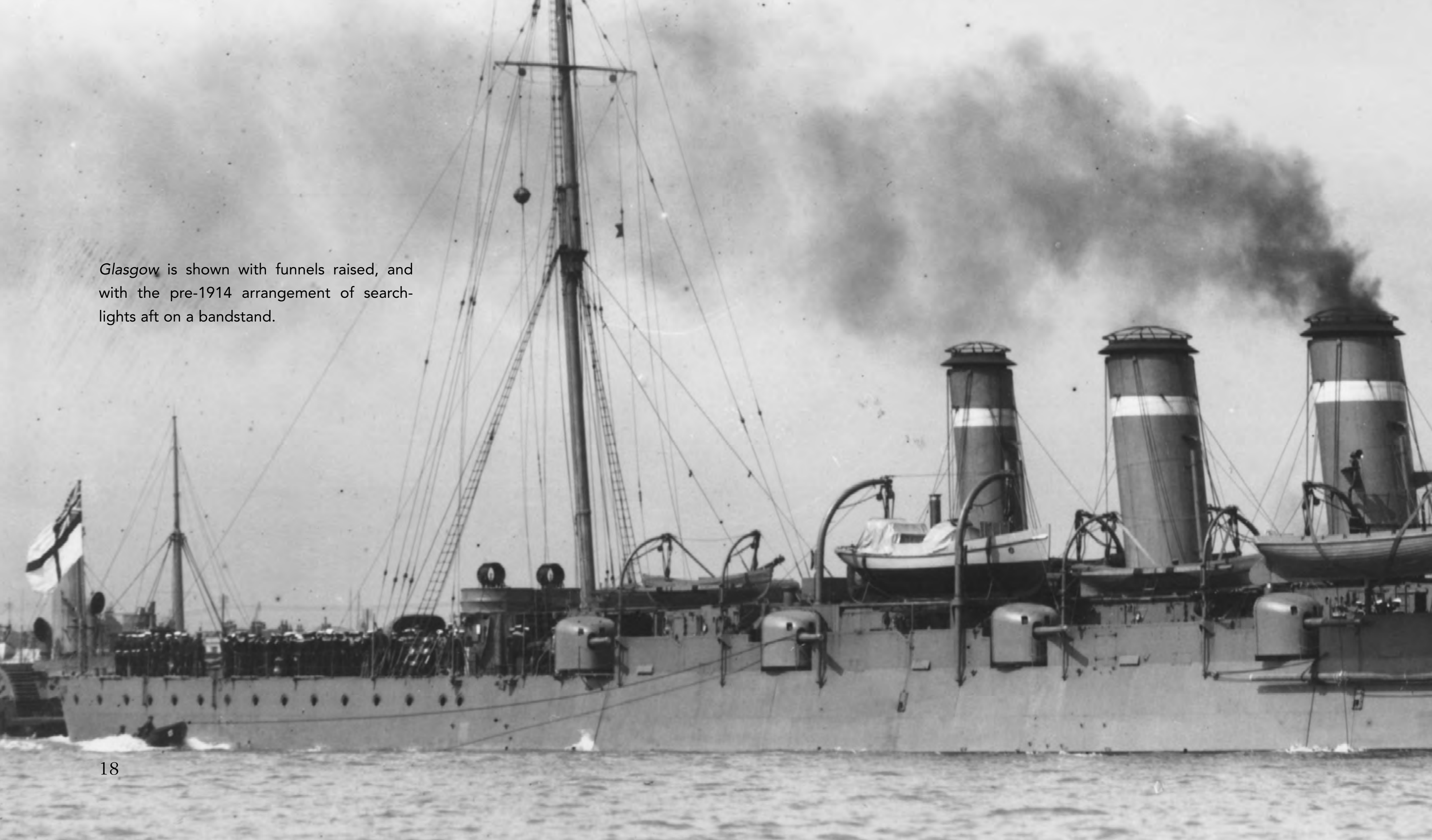
Opposite above and below: Off Guantánamo Bay on 17 November 1952, *Sheffield* shows relatively simple post-war modifications, in which light anti-aircraft weapons were partly standardised. At this time the ship had four twin 40mm and six single power-worked Bofors guns; she retained her original pair of quadruple pompoms. She had the standard end-of-war radar suite: Type 281B on the mainmast, Type 293 (target indication) on the foremast, Type 277 (surface search and limited height-finding) on a lattice tower before the foremast, Type 274 on the main battery director, and Type 285 on each of the 4in directors abeam and abaft the bridge. (US Navy photos courtesy of Rick E Davis)

CHAPTER 2
PROTECTING TRADE

When Admiral Fisher took office as First Sea Lord in 1904, the British cruiser fleet included large armoured cruisers intended to work with the battle fleet or to deal with large enemy raiders, medium cruisers for trade protection and station work, and smaller cruisers intended for purposes ranging from Empire defence to linking scouts with the main fleet. Radio obviated many such functions, so that Fisher envisaged a fleet in which battlecruisers would scout and perhaps also form part of a battle line. Through 1909 the only cruisers he built were intended either as destroyer leaders (for independent flotilla operations blockading German destroyer bases) and as scouts for coastal defence destroyers. Because of their destroyer functions, these ships have been dealt within a previous volume devoted to British destroyers.

The *Bristol* class

Work on a 'new *Boadicea*' began late in 1907, six such ships being planned for the 1908/9 programme, including one to be built at the Royal Dockyard, Pembroke.[1] HMS *Boadicea* was essentially a destroyer leader, but the new cruiser was much more powerful. The principal role was understood to be to meet the new German Third Class Cruisers. That meant a variety of roles. For the fleet, it meant backing up blockading destroyers against a stronger German cruiser threat. Earlier, slower German cruisers would have been ineffective against fast British destroyers, but the newer ones could run down the British destroyers. It also meant trade protection, as the German ships could operate against British trade from the German colonies. During the First World War



Glasgow is shown with funnels raised, and with the pre-1914 arrangement of searchlights aft on a bandstand.

several of them did just that, *Emden* and *Königsberg* becoming famous in that role. Probably the ships involved were the first German turbine cruisers, the prototype *Stettin* and then *Dresden* and *Emden*, all armed with ten 4.1in/40 guns, displacing around 3,300–3,600 metric tons. Design speed was 23–24kts, increasing to 25.5–26kts in the next (*Kolberg*) class. Initial instructions (2 November 1907) were to design a 4,000-tonner capable of 25kts, armed with twelve 4in guns, with 50 per cent more fuel (coal and oil) than a *Boadicea* (the latest Scout), with a protective deck but no side armour, and with four months' stores. There was no apparent interest in higher speed to overmatch the latest German cruisers. DNC could meet these requirements on the desired displacement, with the same protection as *Boadicea* (½in deck throughout with 1in slopes over the machinery, and a 4in conning tower).[2] The Board provisionally approved the 410-foot version of the 4,000-tonner, but DNC asked for more options with thicker armour decks: (A) with 1in flat and 1½in slope only over machinery and magazines (4,150 tons) and (B) with 1in flat and 2in slopes (4,300 tons). A detailed drawing showed a 420ft (pp) x 44ft x 14ft 9in ship (4,300 tons). The design showed two 4in guns side by side at each end plus three in the waist on each side, blocked from firing across the ship by the boiler casing. The new ships were rated as Second Class Protected Cruisers because they were powerful enough to fight the last British cruisers with that rating, the *Diana* class. These ships were too big to build at Pembroke (a ship had to be docked within six months of launching, and the yard had no dock large enough), so in January 1908 it was decided that one of the six 1908/9 cruisers would be a smaller repeat *Boadicea*, the others being built at private yards.

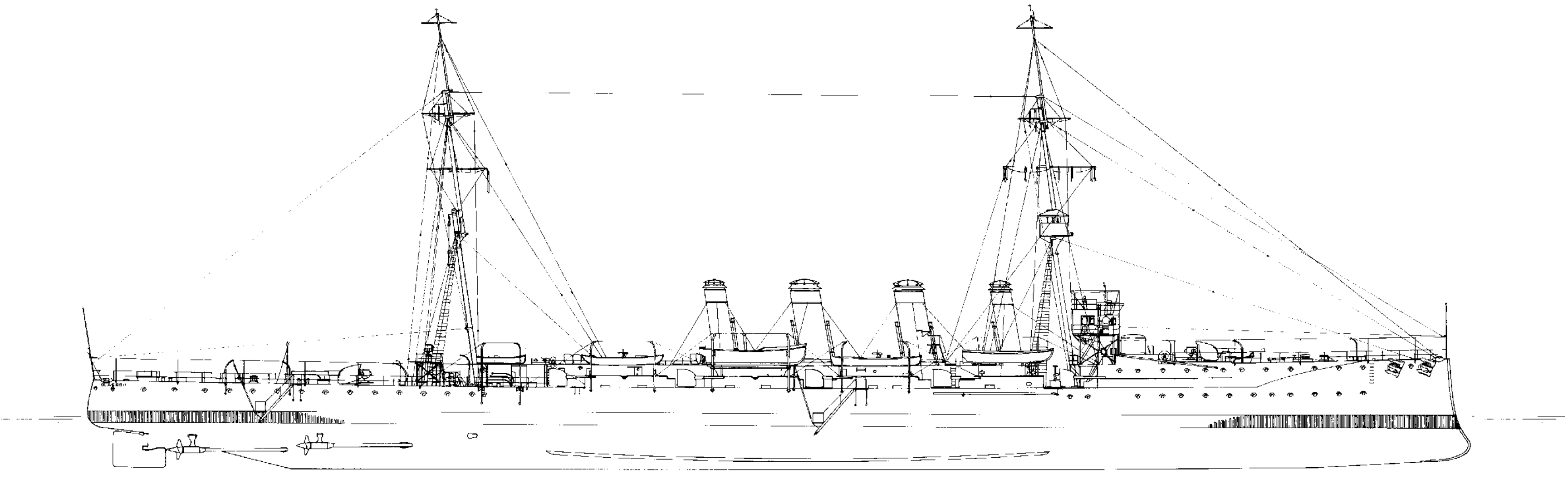
HMS *Newcastle* shows the effect of short funnels in this 19 August 1910 photograph.

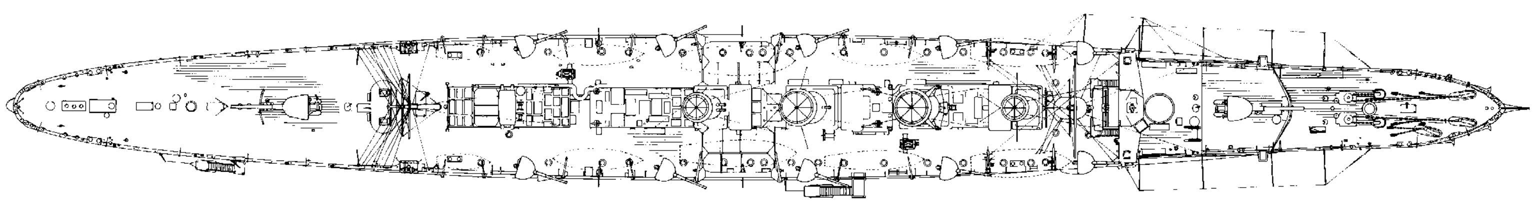
It was proposed to replace the deck tubes with a submerged torpedo room.[3] That in turn cleared deck space for another two 4in guns, for a total of fourteen. These changes were decided early in January 1908. DNC sketched a 4,600-tonner with the desired heavier armour (1in flat, 2in slope), the larger gun battery, and the submerged tubes.

Controller considered a 4in battery on a ship this size weak; for a few more tons she could have 6in guns at the ends plus the eight broadside 4in. The 6in was considered the natural gun for a relatively small cruiser, because it was the largest whose shell could be handled by a single man, hence the largest which did not require a powered hoist and elaborate loading arrangements.[4] That also made the 6in the natural armament of armed merchant ships and other raiders which could be commissioned in significant numbers in wartime.

In mid-January DNC ordered Legends prepared for this alternative, as well as for four 6in (guns paired alongside each other at the ends) and four 4in, and for six 6in and eight 12pdrs (3in guns: 6in paired at the ends, with another pair of 6in guns, one on each side abaft the break of the forecastle, and the 12pdrs on the broadside abaft them).[5] Although on 18 January the Board approved the version with single 6in at the ends (4,400 tons), Controller asked DNC to work out a slightly larger ship with two more waist 4in guns and a protected ammunition supply (3in tubes at the ends and in the waist). DNC thought that would add about 250 tons.[6] In addition to the 6in and 4in guns, the ship was to be armed with a Maxim machine gun (later increased to four).

On 17 February Controller told DNC (Philip Watts) to pursue this 4,650-ton design. On 13 May he added that all of the guns should protected with 3in shields (in previous designs the guns were not protected at all); estimated displacement rose to 4,700 tons. Further



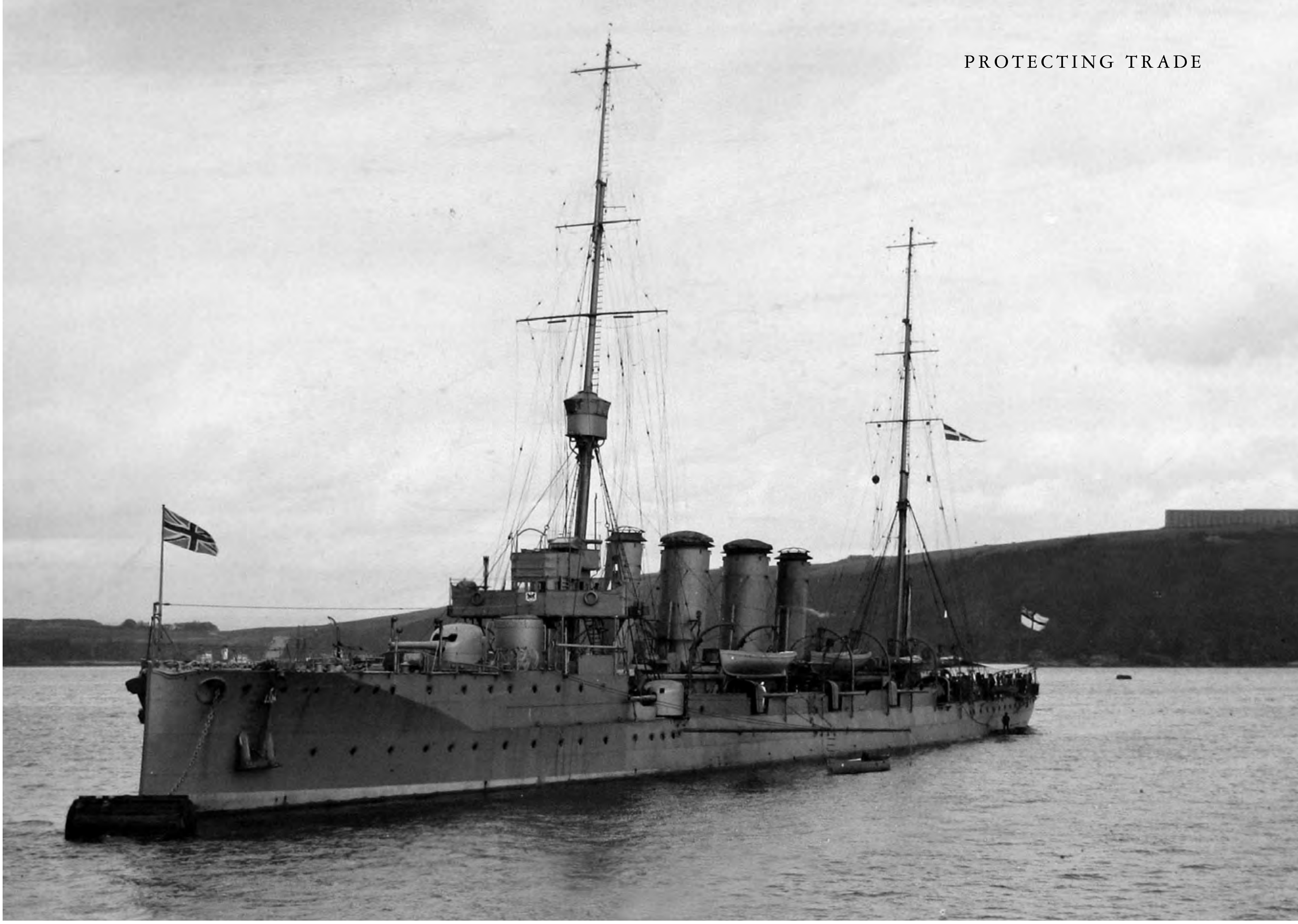


Above: Glasgow was a *Bristol* class cruiser. The 18in underwater broadside tubes were mounted well aft, abreast the mainmast, the starboard tube being mounted forward of the port tube. The elevation drawing was simplified somewhat by excluding the radio aerial rig, two multi-strand arrays rigged from the upper yards. It also omits the extensive coaling rig. The poles extending horizontally from the sides of the forecastle (and on the port side abreast the sick bay) supported 'sun screens'. When not in use they were stowed beneath the 35ft steam cutter. The two 16ft dinghies were stowed atop the 35ft cutter when the ship was at sea. The main changes during the First World War were slight enlargement of the fire-control platform (but the pole foremast was retained) and the addition of one 3in anti-aircraft gun. Several ships of this class had their main topmasts removed in wartime. In addition to the usual small arms for shore parties, the ship had fifty cutlasses stowed in the overhead of the passageway abreast the captain's cabin. (A D Baker III)

proposed detail changes would add another 120 tons. They included installing a 9ft rangefinder in a control position at the head of the foremast (with the guns having follow-the-pointer sights), fitting the 6in guns to have 1° rather than ½° depression; fitting the after 4in guns so that they could fire right aft; mounting four machine guns (Maxims) instead of one; adding a second searchlight (projector) on the after platform or engine room hatch; adding a 6ft screen (with open ports) between the upper deck guns, and across the deck in wake of the engine hatch; and installing magazine cooling (already provided in the *Boadicea* class). These changes would require another foot of beam. Watt particularly disliked the proposed screen, which he considered a possible shell trap which increased target area. The weight involved could be used instead to thicken the conning tower from 4in to 6in and also to thicken the deck over the steering gear from ¾in to 1½in. In rough weather the screens could trap water and this topweight would menace the ship. The screens were approved as a means of protecting guns on the off-side of the ship from the blast of guns when trained well off the beam; the gunnery school (HMS *Excellent*) estimated that without them the maximum training arc for broadside guns would be only 45°. Ultimately the conning tower was thickened to 6in. It was decided to save money by making the protective deck of nickel steel rather than non-cemented armour, experiments having shown no advantage for the latter.

Right: The *Bristol* class had funnels raised to reduce smoking; this also improved boiler draught. HMS *Gloucester* is shown shortly before the First World War, with identifying funnel bands. Note the marked difference between the large 6in guns at the ends and the broadside 4in guns. The objects visible on the compass platform are an open chart table and a rangefinder.

Watts considered the ships better subdivided than most unarmoured ships, and pointed out that all the main hold bulkheads were unpierced. Machinery spaces were redesigned between July and September 1908 for better subdivision. The engine space was divided into five compartments, three side by side forward of two spaces. The centre one of the three side by side contained the turbines driving the inner shafts, the turbines driving the outer shafts being in the two outer spaces. The other two compartments housed pumps and condensers. This arrangement protected the ship more than in the past against being disabled by a single shell penetrating the machinery spaces. The 'tween deck spaces above the armoured deck was much more subdivided than in the past, making it less likely that the ship would lose stability or buoyancy due



Above: HMS *Gloucester* was one of the initial group of 'Town' class cruisers designed partly to protect British trade, a reversion to an earlier cruiser function. She is shown as completed, with short funnels which smoked her bridge.

to riddling of her side. Of forty-one separate watertight compartments between the upper and protective decks, twenty were coal bunkers, three were offices and officers' cabins, six were crew accommodation, and twelve were washplaces, store rooms, etc. DNC argued that although any unarmoured ship was more vulnerable to loss of stability, he had considerably reduced that risk. By late September, weight saving in the detailed design had made it possible to increase conning tower protection from 4in to 6in, and to provide 2in over the steering gear.

The version with two 6in and ten 4in guns was reported to the Board as the 'New 2nd class Protected Cruiser', the Legend dated 30 May 1908 and submitted in June 1908. The new ship followed *Boadicea* in having engine rooms arranged so that either could operate if the other were bilged.[7] A different arrangement was being considered to this end. Required speed was 25kts, roughly that of a battlecruiser. At the outset, the Board clearly called for range, since it asked for 50 per cent more fuel (coal and oil) capacity than that of the earlier ship (about two and a quarter that of *Amethyst*, the last conventional small cruiser, and nearly four times that of the destroyer-leading Scouts). Compared to *Boadicea*, the new ship was given a block of coal stowage forward of the machinery, for extra protection. Similarly, her torpedo tubes were placed below the waterline, where they were considered protected, rather than unprotected above water. Gun armament was changed from an all-4in battery (and only six guns), suited to fighting or supporting destroyers, to a pair of 6in guns at the ends plus ten 4in guns along the sides. In contrast to *Boadicea*, all the guns were shielded. The new ship was far larger, 4,800 tons rather than 3,300 tons. As the designation applied, protection was limited to an armour deck. The Board approved this design on 7 July 1908.

Five of these *Bristol* class were built under the 1908/9 programme. They and their immediate successors were called the 'Town' class. Approval (on 16 January 1908) was subject to the demand that the cost of one repeat *Boadicea* and five of the new cruisers should not exceed that estimated for six improved *Boadicea*s. Estimated cost was £415,000, but shipbuilding conditions were bad, so builders bid low. These and the later versions of the design all had twelve boilers in three boiler rooms with four funnels, the middle pair being wider because they combined the uptakes from the after end of one boiler room with those from the fore end of the adjacent one. Each set of uptakes served two boilers set side by side, the stoking space in each boiler room being between two rows of boilers. Thus the foremost funnel was at the forward bulkhead of No. 1 boiler room, the aftermost at the after bulkhead of No. 3 boiler room. One of the five ships, HMS *Bristol*, had two-shaft Brown-Curtis turbines instead of the four-shaft Parsons turbines in the others. She had two engine rooms in tandem, each containing one turbine with its condenser on the other side of a longitudinal bulkhead (these bulkheads were on alternating sides, to suit the turbines driving the port and starboard shafts).

The *Dartmouth* class

The following year the Board asked that the 4in guns be replaced with 6in, for a uniform battery of 6in. On 28 January Controller asked for ships with six or eight guns, equipped as private ships or flagships, all of which were to have 21in rather than 18in torpedo tubes if possible. The eight-gun alternative was chosen; estimated displacement was 4,950 tons. Blast screens would be omitted. Legends submitted on 3 February showed a 430ft, 4,990-ton ship or a similarly-armed 440ft, 5,280-ton flagship; 22,000shp engines would drive each at 24.75kts. Watts proposed reducing fuel at deep load to 1,450 tons to compensate for extra armament weight (150 tons) without enlarging the ship. In each case armament included two submerged tubes for short 21in torpedoes. To get enough breadth for them, the tubes were moved to forward of the forward boiler room, the lower athwartships coal block (for protection) being eliminated. Watts considered the new cruisers the smallest which could accommodate the new torpedoes.

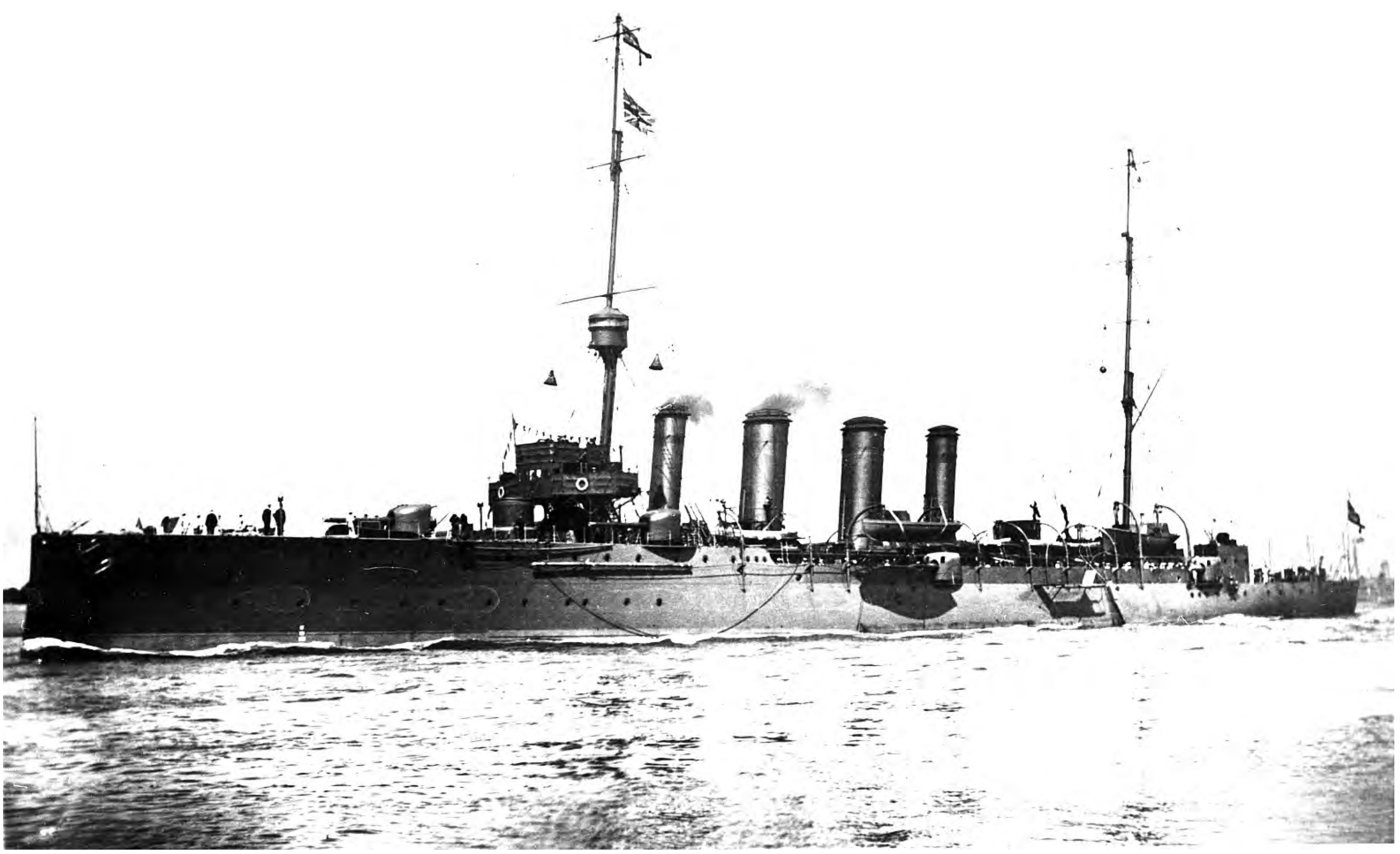
As the forward broadside 6in guns might be affected by spray, Watts relocated them to the lengthened forecastle. All three forecastle guns could fire right ahead, and the three after guns could fire right astern; the broadside was five 6in. More boilers (an additional boiler room) would be needed. In redesigning the ship, Watts lengthened the forecastle to provide sufficient space for all officer cabins, the lower deck being left clear for the crew. However, the Board had recently called for sufficient space for 15 per cent supernumeraries, and Watts wanted to know what complement he should allow for. In an accompanying note, Watts pointed out that to maintain the existing speed of 25kts, it would be necessary to add at least 400 to 600 tons. Alternatively, it would be far less expensive to retain the existing machinery and accept the loss of perhaps a quarter-knot. This might be no more than a nominal sacrifice, as many turbine ships were exceeding their rated horsepower and speed on trials (the state of turbine design was primitive, and reliable instruments, such as dynamometers, to measure output did not exist).

Controller proposed in mid-April that the eight-gun design be adopted for the 1909/10 ships. They would be fitted as flagships, accommodation being provided under an extended forecastle. Bunker capacity would be reduced by 150 tons as weight compensation. As Watts had recommended, the machinery would be unchanged, the slight loss of speed being accepted.

The completed design was submitted on 30 July 1909 and approved by the Board that day; Watts hoped to have building drawings ready for bidders by the end of August. Protection matched that of the *Bristol* class. Due to the loss of the lower coal block, fuel capacity was reduced from 1,600 tons to 1,500 tons, but 'this is still a very large fuel supply for this class of vessel'. Length was the same as that of the *Bristol* (430ft), but beam increased from 47ft to 48½ft and draft increased by 3in. At this stage displacement was given as 5,250 tons. On the basis of the cost estimate for the *Bristol*s, Watt estimated that the new ships would cost £440,000, but shipbuilding conditions were still poor and he expected some reduction (though not as much as for the *Bristol*s).

Four of these *Dartmouth*-class cruisers were built. As in the previous

The *Weymouth* class introduced an all-6in main battery. *Weymouth* is shown. Note her pronounced tumblehome in the waist.

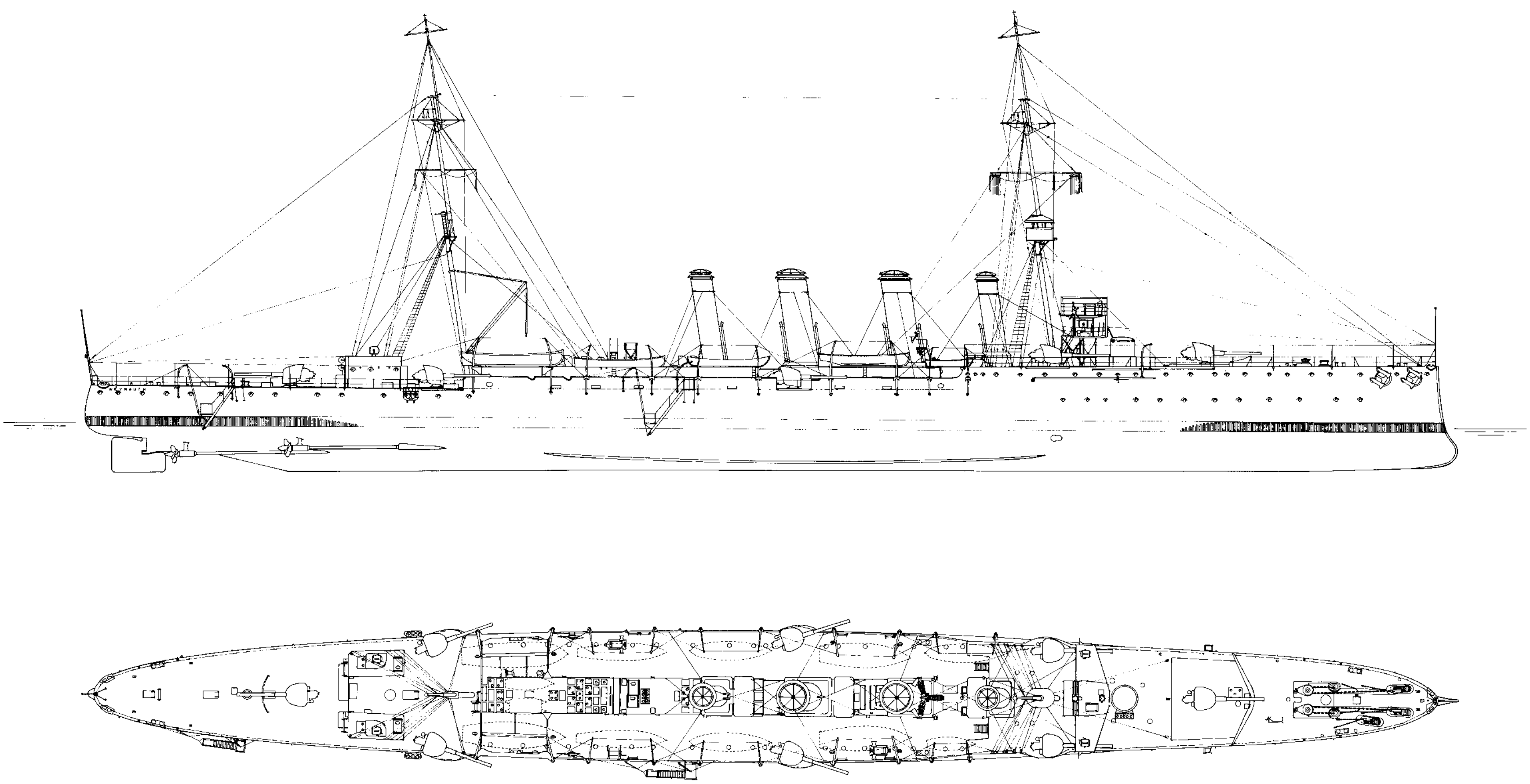


class, one ship (HMS *Yarmouth*) had two-shaft Brown-Curtis rather than four-shaft Parsons turbines. Although turbines were rated at 22,000shp, they often developed much more: three ships developed nearly 24,000shp, and *Falmouth* developed 27,900shp and attained 26.8kts. *Yarmouth* trials showed that on two shafts she had about the same performance as a four-shaft ship. Ships turned out lighter than expected: against the Legend figure of 5,250 tons, *Falmouth* displaced 5,040 tons, *Weymouth* 5,044 tons and *Dartmouth* 5,076 tons, with similar savings at deep load.

While these designs were being prepared, the British government was negotiating with major colonial governments in hopes that they would help provide naval forces for Imperial defence.[8] The British government would much have preferred that the colonies contribute to an Empire Fleet, but the Australian and Canadian governments held out for their own navies. The Admiralty pressed for each major unit in the Empire to create a 'fleet unit' which could help protect imperial trade, but which could also be combined with other fleet units to create a fleet for distant areas, i.e. for operations in the Pacific. It argued that the local defence forces the Dominions (particularly Australia) contemplated would provide only a very limited degree of mutual defence, because they could never affect the main threat of commerce raiding (the Australians originally contemplated a cruiser squadron to deal with raiders, backed by local defences). The fleet unit envisaged by the Admiralty comprised a battlecruiser, three *Bristol*-class cruisers, six destroyers, three submarines, and necessary supporting auxiliaries. At a meeting on 10 August 1909 Admiral Fisher explained the Empire or Pacific Fleet concept, and also argued that the core of any fleet unit had to be the battlecruiser, as without her the lesser units could not be very effective against a commerce raider. Ultimately only Australia bought a fleet unit.

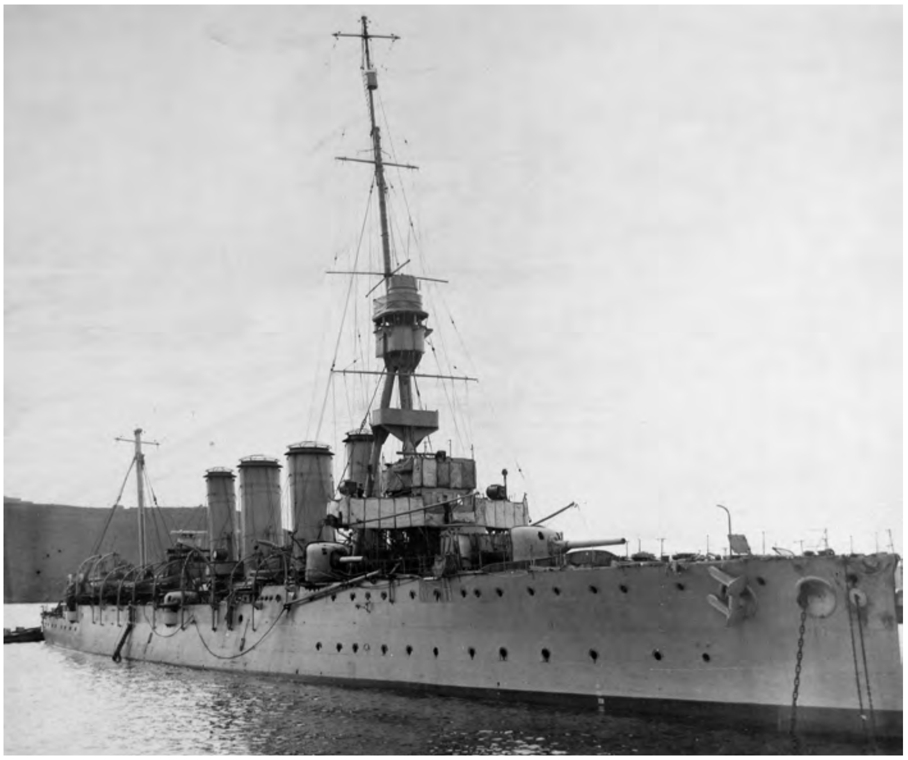
No one explained how the battlecruiser and the cruisers would work together against commerce raiders, perhaps because it was so bound up with Admiral Fisher's intelligence-based scheme of operations. It is, however, reasonable to imagine that by 1909 he had accepted that a scouting line would be far more likely to find a raider than a single ship, the light cruisers detecting a powerful raider and falling back on the battlecruiser so that she could deal with it. The Australians opted for

HMS *Weymouth* is shown as built. This drawing omits the two eight-strand radio antennas slung between the upper yards. When coaling, the ship rigged a horizontal cable between the funnels and the masts to support coal-bag handling. When preparing for battle, additional stays could be rigged to support the foremast. Yards are omitted in this drawing to make it possible to indicate the complexity of the standing rigging for the masts. The two cruciform devices carried in cage racks on either side of the mainmast were quick-release lifesaving buoys provided with electric lights. During the First World War the foremast was altered to a tripod to support an enlarged fire-control top (ca. 1917). One 3in anti-aircraft gun was added in 1915 between the second and third funnels, a second being added on the quarterdeck in 1918, at which time the main topmast was struck. A flying-off platform was erected forward of the bridge in 1918 and removed in 1919. During a 1924–5 refit the compass platform (from which the ship was conned) was enlarged and extended forward, and the gun control platform equipped with a 'gun direction tower' atop an enlarged fire-control platform. *Weymouth* and her sisters retained their conning towers throughout their careers. Broader and slightly longer bilge keels were fitted at some point during the First World War. (A D Baker III)

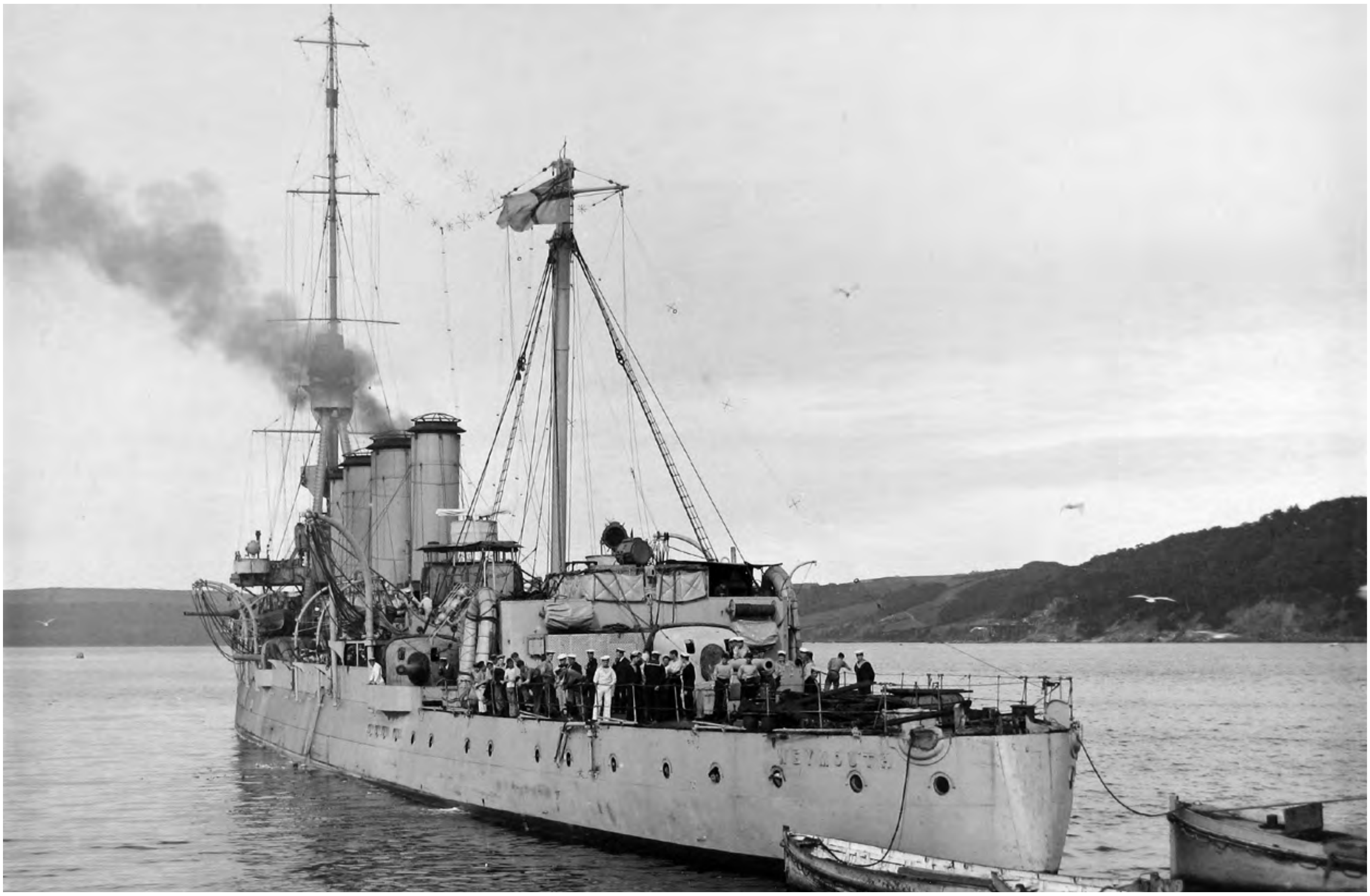


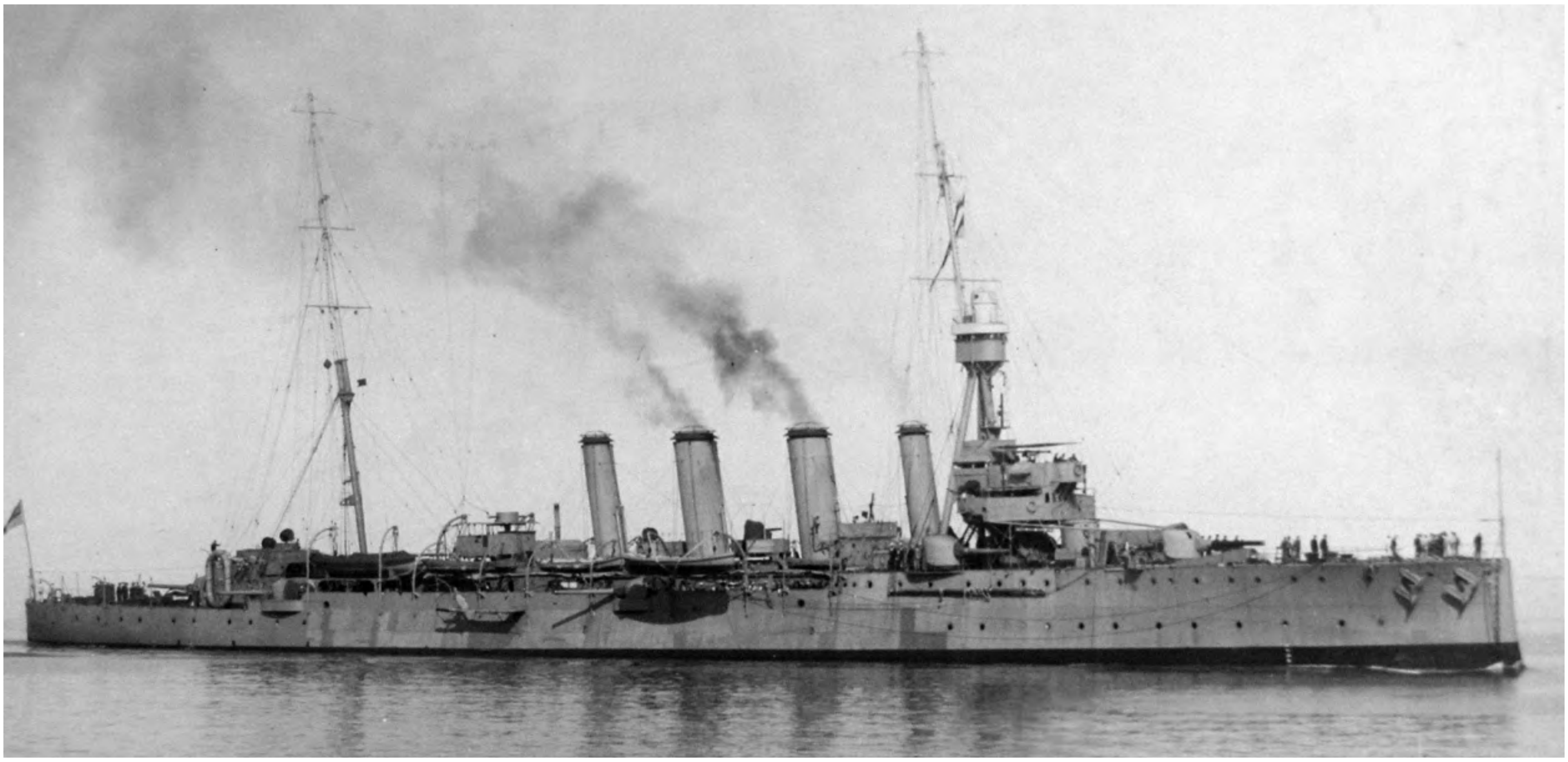
'Improved *Bristol*s,' which meant modified versions of the later *Chatham* class. Initially they hoped to complete all three by August 1912, which was when the *Weymouth*s were to be completed for the Royal Navy. Then the Australians decided to build two ships in the United Kingdom and the third in Australia, accepting the delay in order to develop their own industry.

The Canadians considered two alternatives: four improved *Bristol*s, a *Boadicea* and six destroyers; or three improved *Bristol*s and four destroyers. The Admiralty agreed to provide all possible assistance (April 1910), and the relevant specifications and drawings were provided in February 1911. Then the project died.



Right and below: Weymouth is shown in wartime, before the flying-off platform was fitted, with her mainmast cut down. These photographs were probably taken in 1917, after the tripod had been mounted but before the flying-off platform was added. *Weymouth* and *Dartmouth* had an additional 3in anti-aircraft gun on the quarterdeck, but it is not visible here. *Weymouth* served in the Mediterranean in 1915–16, when her mainmast was cut down, then with the Grand Fleet in 1916–17, then back in the Mediterranean in 1917–18, serving as flagship of the 8th Light Cruiser Squadron.



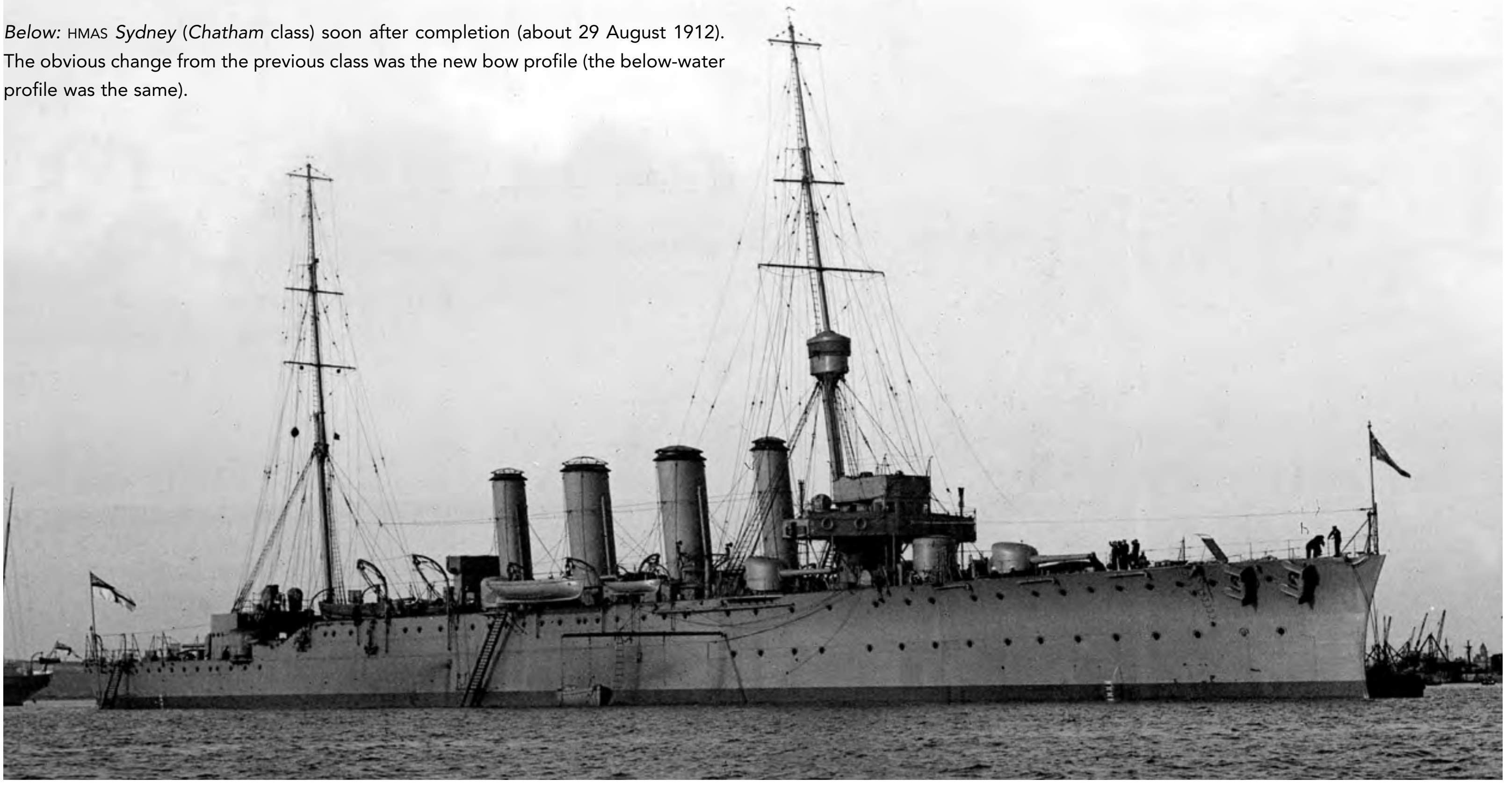


Above and below: Weymouth is shown in Malta in 1920, having been refitted in 1919–20 after having been torpedoed by the Austrian submarine *U-28* off Durazzo on 2 October 1918. During this refit her mainmast was restored to its previous height, presumably to provide her with increased radio range. The platform below the spotting top was for searchlights.

The *Chatham* class

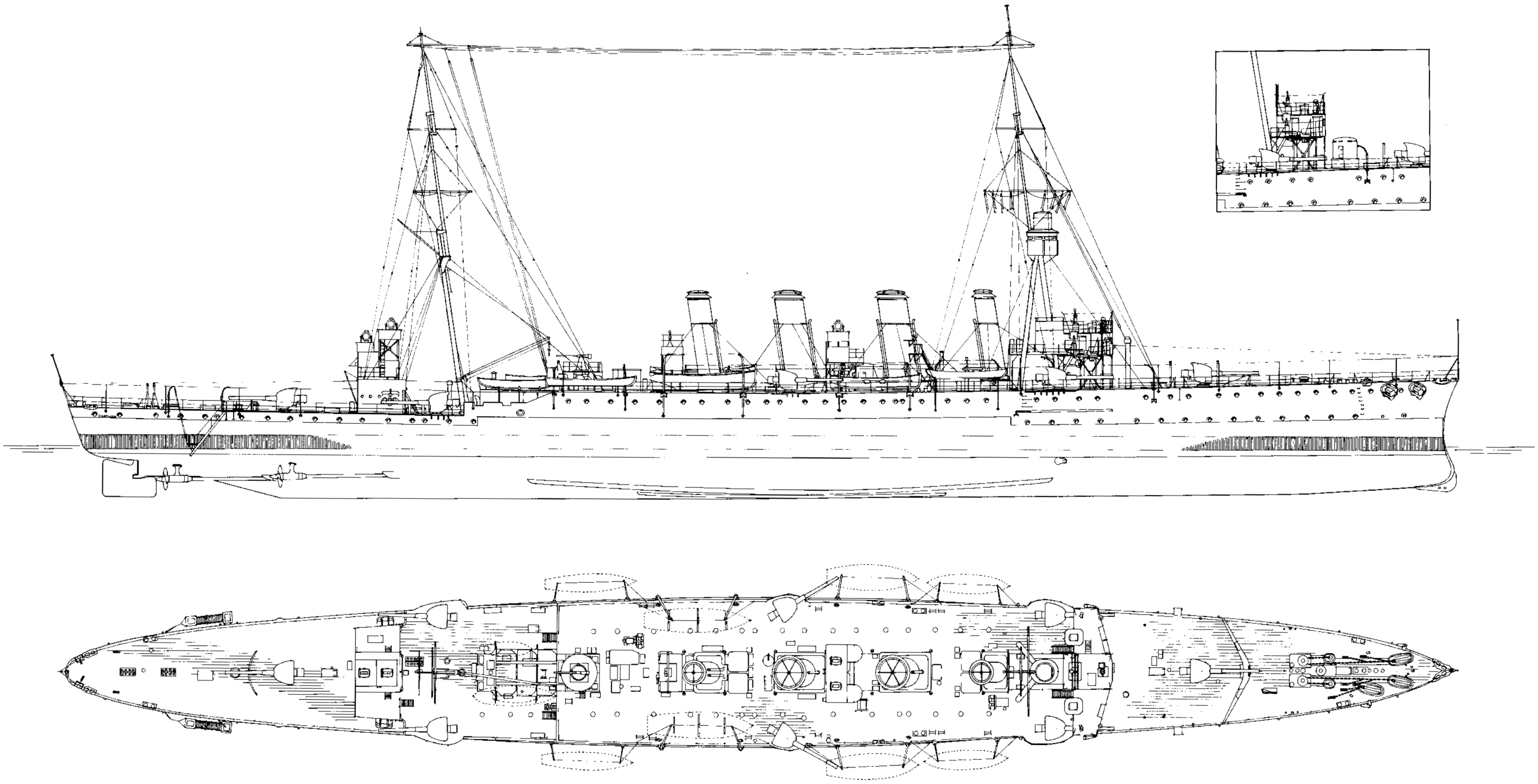
On 6 August 1909, while bidders' packages for the 1909/10 cruisers were being prepared, Controller issued instructions for the 1910/11 ships. He wanted them to have a main deck if possible (i.e. to be flush-decked) and to be good seakeepers without adding much size. Improved seakeeping was later explicitly connected with trade protection in distant seas. As in the previous year, horsepower should not be increased (speed should not fall below 23kts). The ships would not be fitted as flagships, and bunker capacity (i.e. range) should not be reduced. Displacement should not exceed 5,500 tons, and cost should not exceed £350,000. DNC pointed out in November that to hold down size he wanted to stay fairly close to the *Bristol* design. A flush-decked cruiser would come close to the old *Challenger*, but enlarged to provide 23kts or more. He offered designs for a ship with a forecastle deck extending for two-thirds of her length, carrying all but the after three 6in guns, and serving as the boat deck (to avoid a raised superstructure whose topweight would require increased beam). Armament, bunker capacity

Below: HMAS *Sydney* (*Chatham* class) soon after completion (about 29 August 1912). The obvious change from the previous class was the new bow profile (the below-water profile was the same).



Below: HMAS *Melbourne* displays standard First World War modifications, including a flying-off platform forward (in *Melbourne* and *Sydney*, but not in *Brisbane*), a tripod foremast topped by a director, and a long-base rangefinder abaft the fourth funnel. This undated photograph must have been taken soon after the war, since the flying-off platform (and conning tower) were removed when the ship returned to Australia. As completed, the ship had two 3pdr guns on quarterdeck level abaft the break of the forecastle, but by this time they had been raised to forecastle deck level. The search-lights amidships and aft were enlarged to 36in diameter.

Below: HMAS *Melbourne* is shown late in 1921, the flying-off platform and the conning tower beneath it having been removed. The 3in anti-aircraft gun in its bandstand is visible just abaft the long-base rangefinder, and the two 3pdrs are visible near the break of the forecastle. (Photo by Allan C Green via State Library of Victoria)



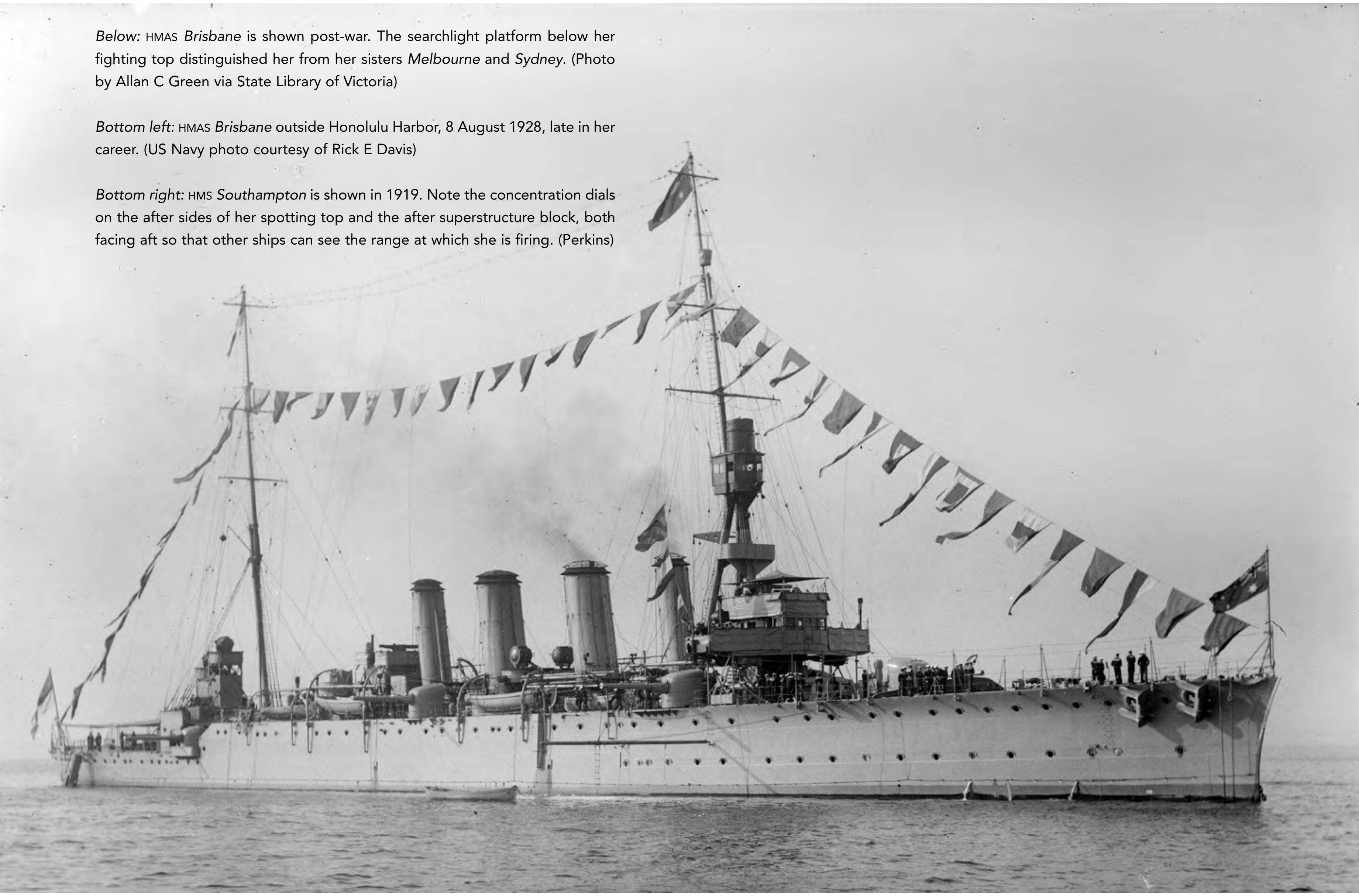
HMS *Chatham* is shown as fitted in January 1921 (the scrap elevation view shows her bridge and conning tower before the 1916 modification when she was given a tripod foremast to support an enlarged fire-control top forward). The director tower atop the fire-control top was added in 1920 when she was refitted to serve as flagship of the New Zealand Division of the Royal Navy (11 September 1920 through 1924). The after searchlight tower and the searchlight platform between the second and third funnels were added during a 1916 refit, and in 1917–18 a flying-off platform was erected forward of the bridge (removed 1919, when the ship went into reserve). Also in 1916 the bridge was extended aft to provide an admiral's sea cabin abaft the pilothouse, and a 24in searchlight was added on the centreline abaft the new cabin. The 3in gun was added in 1915. Four single Hotchkiss 3pdr QF guns were removed during the 1920 refit, when a portion of the after coal stowage was converted to additional oil fuel stowage. Also removed in 1920 were the ship's mine countermeasures paravanes and their handling gear. The accommodation ladder position amidships for non-rated personnel was moved to the port side aft. (A D Baker III)

and speed would match those of the *Bristol* and the subsequent class; estimated speed (with the same machinery) was 24.75kts. Alternative sketch designs showed officers' accommodation forward, as in the previous cruisers, or aft (Commodore (T) was reporting on his experience in HMS *Boadicea*, which had her officers forward). DNC favoured the *Boadicea* arrangement. DNC thought he could meet the cost limit.

The designs submitted in November were labelled 'New Colonial Cruiser', suggesting a ship intended to operate on a foreign station. Sketches embodying various modifications were dated 20 December 1909. They included a watch cabin with a sleeping berth on the bridge.

The experimental firing against HMS *Edinburgh* demonstrated 'once again' the value of thin armour against high-explosive (HE) shell, which were expected to be the main means of attack against unarmoured or lightly-armoured ships. The firing also showed the value of an armoured deck, a somewhat unexpected outcome since there had been no tests against armoured decks for many years. Well after this firing a target was used to compare the value of side and deck armour against 6in shells. This later experiment showed that side armour was much more valuable against HE shells, and that against powder-filled shells side armour gave no great advantage but was no disadvantage. Since almost all foreign navies had adopted HE shells, the HE experiments had priority. Watts therefore proposed developing the 1910/11 design on these lines, the planned ships for colonial navies (Australia and Canada) being of the same type.

It was then pointed out to DNC that by reducing the first and upper decks to 15lbs (⅜in), the ship could be given side armour, extending up from the lower edge of the protective deck to the edge of the upper deck over the length of the machinery, and from the protective deck to 3ft below the upper deck at the ends. On 5,300 tons the ship could have 1¾in side armour, and on 5,400 tons she could have 2¼in, for total thicknesses (including shell plating) of 2¾in and 3in respectively (and 2in and 2½in at the ends). The displacement thus far put forward was 5,400 tons, but 5,300 tons was probably better for structural arrangement. Asked what thickness he could provide if the protective deck was thickened from ⅜in to ¾in, DNC offered 2¾in rather than 3in, and 1¾in at the ends instead of 2in. Yet another possibility (considered in February 1910) was to thicken the lower deck only abaft the forecastle (adding 30 tons); ½in would be removed over the same length on the side. Watts liked the idea, because it would provide more protection where it was needed, further forward. The design finally submitted on 12 April 1910 showed a 3in belt extending to the upper deck over the whole length of the machinery spaces, with a 2½in belt forward to 3ft below the waterline, and a 2in belt aft instead of a thick protective deck. The lower deck would now be ⅛in thick, increased to ¾in abaft the engines, and to 1½in over the steering gear. In a history of recent British cruiser design of October 1918, DNC pointed out that the change to a thin belt had been of considerable wartime value. It led directly to the



Below: HMAS *Brisbane* is shown post-war. The searchlight platform below her fighting top distinguished her from her sisters *Melbourne* and *Sydney*. (Photo by Allan C Green via State Library of Victoria)

Bottom left: HMAS *Brisbane* outside Honolulu Harbor, 8 August 1928, late in her career. (US Navy photo courtesy of Rick E Davis)

Bottom right: HMS *Southampton* is shown in 1919. Note the concentration dials on the after sides of her spotting top and the after superstructure block, both facing aft so that other ships can see the range at which she is firing. (Perkins)

use of the side armour as part of the hull strength of the later small light cruisers of the *Arethusa* class.

Length between perpendiculars matched that of the earlier classes (430ft), but these ships had the above-water part of their bow raked rather than ram-form, retaining the below-water bulb (not really a ram). Displacement was 5,400 tons, a growth of about 150 tons compared to the earlier ship. Fuel matched that in the *Weymouth* class (650/1,500 tons), and rated speed was 24.75kts with power increased to 25,000shp.

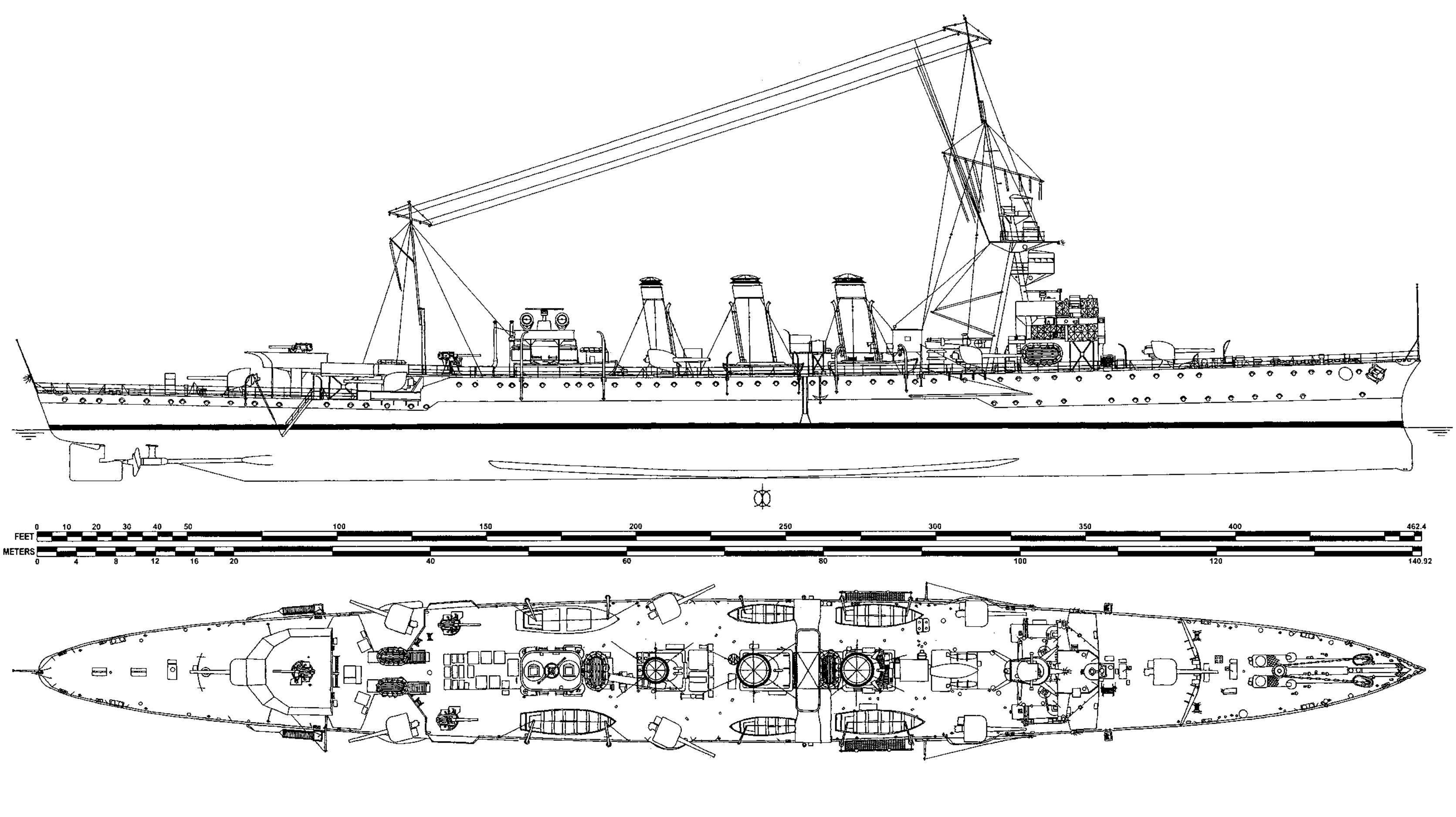
The Royal Navy received three of these *Chatham* class cruisers; three more were built for the Royal Australian Navy (*Sydney*, *Melbourne* and *Brisbane*). Of the British ships, *Southampton* had Brown-Curtis turbines driving twin screws, the others Parsons driving quadruple screws. Of the three Australian ships, the last was built locally, at Cockatoo Dockyard. Construction was delayed by the late arrival of material from England.

The *Birmingham* class

Three more ships were included in the 1911/12 programme (*Birmingham* class). They were very similar to the *Chatham*s, but with nine rather than eight 6in guns (two guns on the forecastle side by side instead of one on the centreline, but a single gun aft on the centreline as in the earlier class). These ships introduced a new shorter, hence more easily manoeuvred, 6in gun (45-calibre Mk XII rather than 50-calibre Mk XI). The gun mounting also offered greater elevation. All had quadruple screws and were rated at 25,000shp. The Australians bought a fourth ship, which they built in Australia as HMAS *Adelaide*. Her hull and machinery were all made in Australia, the armament being imported from the United Kingdom.

In 1914 DNC wired the Australian government proposing a new design, the *Brisbane* design being four years old. *Brisbane* had eight 6in guns with 3in shields, but the newer *Birmingham* had nine, and the new light cruisers (*Arethusa* and *Calliope* classes) had spray shields rather than heavier protection to their guns.[9] Six 36in searchlights should replace the four 24in of the earlier design. Fire control and torpedo air compressor arrangements should be modernised (the earlier design lacked both a fire control platform aft and a gyro adjusting room for torpedoes, and its compressor produced 2,600psi rather than 3,000psi air). The outer thickness of the side armour should be worked longitudinally rather than vertically. The steering gear should be covered by a curved (turtle) deck rather than by a flat deck plus side armour. Parsons reaction turbines (four shafts) should give way to Parsons impulse turbines on two shafts with geared cruising turbines, and twelve boilers all burning coal or oil should give way to six dual-fuel boilers and four oil-burning boilers (in fact the ship had twelve boilers, like earlier 'Town' class cruisers).[10] There should be two sets rather than one of magazine cooling machinery. Fuel should be changed from 1,240 tons of coal and 260 tons of oil to 750 tons of coal and 600 tons of oil. This would meet Commonwealth requirements, but the change probably reflected both the greater efficiency of oil burning and the greater efficiency of geared cruising turbines. In view of experience, the captain's accommodation should be moved from right aft on the lower deck to further forward on the upper deck. Wooden lower masts should give way to steel ones which could carry searchlights. Overall, space and weight for machinery and fuel would be traded for equipment and armament. Displacement and form would roughly match those of *Brisbane*, but internal arrangements would be quite different.[11]

The 'Towns' were the last classic cruisers the Royal Navy built before



HMAS *Adelaide* in March 1939 after conversion to oil-burning. (Paul Webb) the end of the First World War, in the sense that they were intended for long-range independent deployment. During the war they served as the Grand Fleet's scouts, in the 'A-K Line' deployed ahead of the battleships. This scouting line became a fixed feature of post-First World War Royal Navy fleet formation. These large cruisers were succeeded by a series of much smaller cruisers best described as super-destroyers (with armour) or destroyer-killers.

Top left and right: HMS *Nottingham* (*Birmingham* class) is shown soon after completion. Note the paired forecastle 6in guns and the searchlight platform above the bridge.

Below: HMS *Lowestoft* was unique in the Royal Navy *Birmingham* class in being completed with a tripod. A similar mast was fitted to HMS *Birmingham* in 1916–17, but *Nottingham* was probably lost (19 August 1916) unmodified. All three were given 3in (20 cwt) anti-aircraft guns, abaft the after funnel, in 1915. Neither surviving ship was fitted with a flying-off platform.

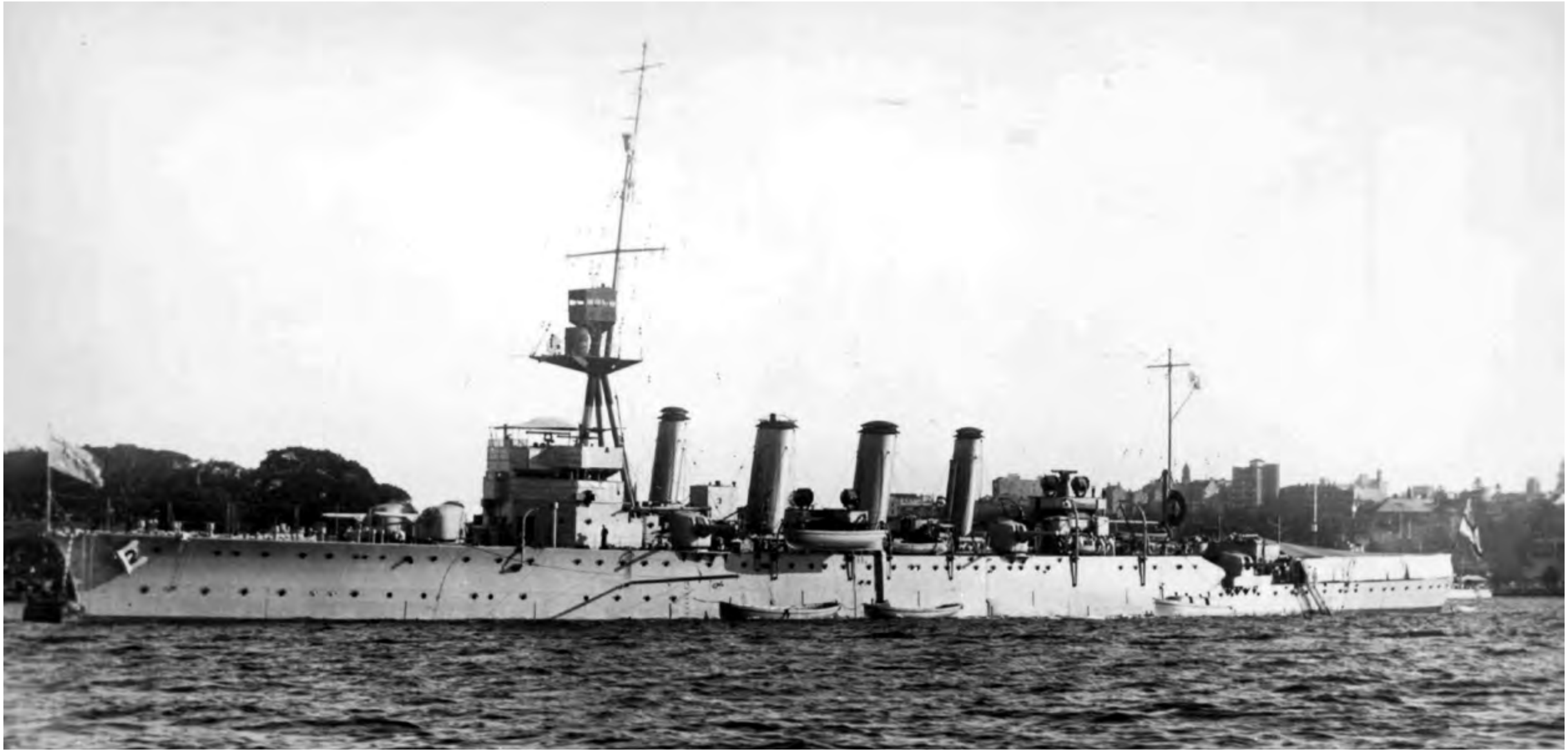
HMAS *Adelaide*

As the Australians prepared to lay down their fourth cruiser in August 1915, Controller asked for armament alternatives using 9.2in and 7.5in guns. Controller thought, in view of 'recent trend of opinion' (presumably in connection with discussions of what became the *Hawkins* class) that the main alternatives (with the same weight as nine 6in) were three 7.5in and two 9.2in, of which the last could probably be ruled out. Controller asked DNC what four or five 7.5in guns would require, in terms of greater displacement, assuming all guns on the centreline and 300 rounds per gun (rather than 150), as the ships would probably fight at long range, with great waste of ammunition. DNC prepared tracings of both alternatives. A ship mounting four 7.5in guns would probably displace 1,100 tons more and would probably need another 2,500shp (but it seemed that no extra machinery weight would be involved). Adding another 7.5in gun would add another 460 tons, much of it for additional hull (240 tons). The four-gun ship would probably be 450ft long (vs 430ft for *Birmingham*), and the five-gun ship 465ft long. On 27,500shp both the enlarged ships would make 25.5kts. DNC's very rough sketches showed single mounts in 'A' and 'B' and 'X' and 'Y' positions. A fifth gun would have been worked in at the after end of the forecastle at roughly the same height as 'X' gun, which was on a free-standing barbette. Nothing came of this exercise, but in effect this was the first approach to what became the 'Improved *Birmingham*' or *Hawkins* class. The most striking difference from the *Hawkins* was the use of enclosed gunhouses (as in the B designs described below) rather than open shields. The Australian designs also offered considerably lower speed.

The Australian design was updated as she was being designed, so that in effect she reflected ongoing changes in British cruiser design practice. In June 1915 Controller decided that she would have a tripod mast and director control, then being fitted to new British cruisers, and he asked DNO to decide whether her 6in guns should have the 30° elevation then being used. It was clear that if the ship was to be laid down, as desired, in August 1915, she could not embody an entirely new design, but would have to be largely a repeat *Birmingham* brought up to date. Her hull could be modified to provide more oil fuel, director fire-control and the new way of working in side armour (which would be HT steel instead of the nickel steel used in *Birmingham*). As completed, *Adelaide* had the tripod foremast, with spotting top and director, added to British cruisers in wartime. E-in-C thought that the new boilers would provide full power using Australian coal. Machinery repeated that of HMS *Lowestoft*, except for some auxiliaries, the middle (of three) boiler rooms burning oil only. During design, the two coal-burning boiler rooms were lengthened (total 4ft), adding 20 tons. The ship had to be lengthened slightly, as machinery could not be shifted aft, and any shift forward would cause a trim by the bow. Coal was omitted from the upper bunkers over the after engine room and from the lower bunkers abreast the middle boiler room, stowage being provided for 860 tons (instead of 1,155 tons in *Birmingham*) and for 500 tons of oil (instead of 236 tons).[12] These were not quite the figures initially suggested. A 3in high-angle (HA) gun was added on the deckhouse aft, its magazine displacing the spirit room aft. The after control platform was enlarged to take a rangefinder, a provision made to fit the standard compass on the roof of the control platform.[13] Late in November 1915 DNC estimated that the new Australian cruiser *Adelaide* would displace 5,557 tons, compared to 5,441.8 tons for *Lowestoft*.

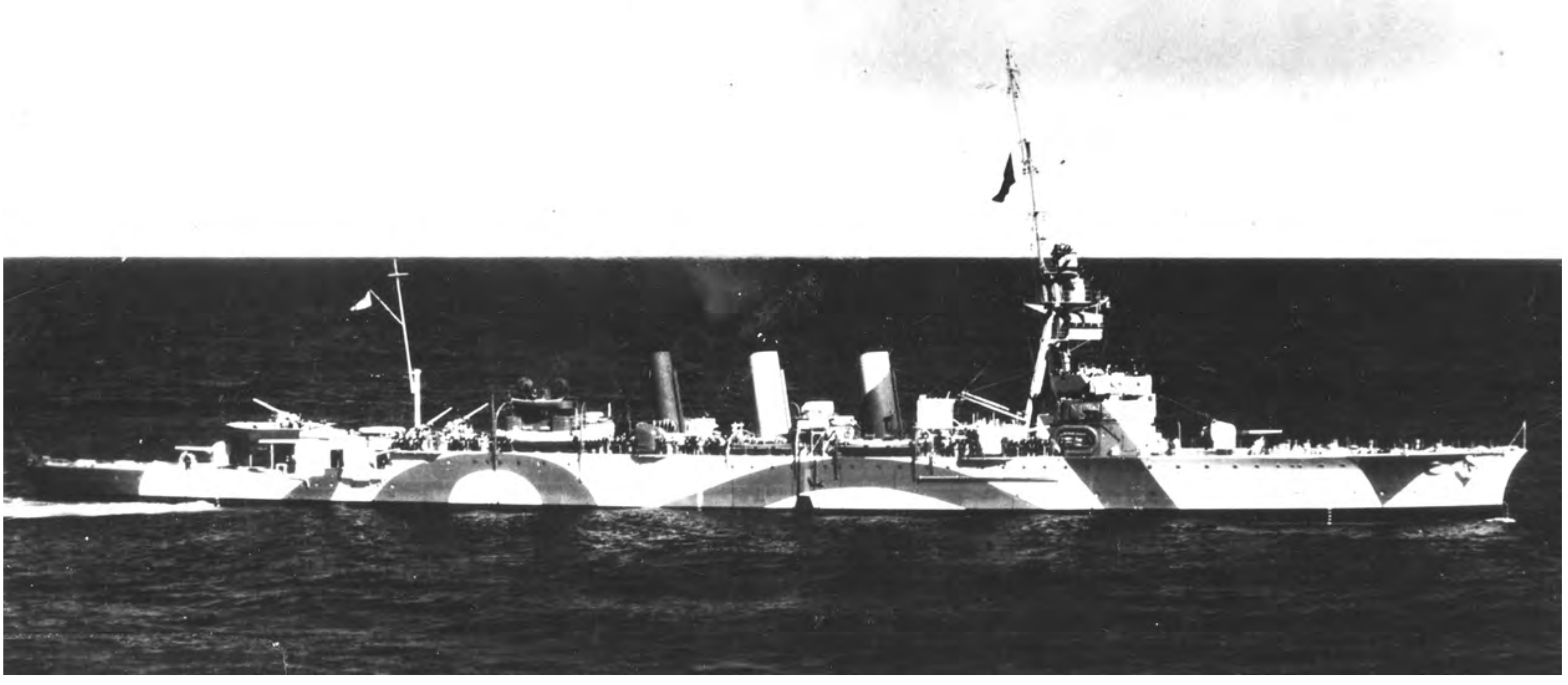
Adelaide was completed in 1922, and in November 1923 the Australian Naval Board decided to modernise her to burn oil fuel only, to have her guns on the centreline, and to have central storekeeping. By this time the Australians planned to build new oil-burning cruisers in the United Kingdom. Converting *Adelaide* during her planned visit to England would give Australia an all-oil burning squadron by 1931

HMAS *Adelaide*, the modified *Birmingham*, as completed, with a new-type bridge and a short mainmast. Unlike earlier cruisers, she carried her director below and before her spotting top, rather than atop it. Note the concentration dials on foremast and aft. Near-sisters *Birmingham* and *Lowestoft* also had their bridges rebuilt, but they carried their directors atop their spotting tops, with a searchlight platform below the spotting top.



Above: HMAS *Adelaide*, by then the last remaining British Commonwealth cruiser of pre-1914 design, as modernised in 1938–9 at Cockatoo Island. Her foremast has been rearranged to give her an HA director at its top, the 6in spotting top being brought lower down (the 6in director was not moved). Three 4in anti-aircraft guns were added, one on the centreline to superfire over the after 6in gun, and two at the after end of the forecastle. One of the two forecastle 6in guns was landed. The ship was converted to all-oil fuel, the two forward boilers and the forefunnel being removed. The sheet-anchor was removed, its hawse-pipe plated over. *Adelaide* recommissioned in this form on 13 March 1939, but the next month was laid up, her crew earmarked for the new cruiser *Perth*. She recommissioned in September 1939. (Photo by Allan C Green via State Library of Victoria)

Below: *Adelaide* at sea in wartime, before her 1942–3 Sydney refit, and before she was fitted with radars. She still had her original curved gun shields.



instead of by 1937, as originally planned. The Australians proposed replacing the existing twelve boilers with four larger ones. She would save considerably on complement during her remaining lifetime of fourteen years. The result would be more compact machinery spaces and reduced number and spacing of funnels. The Australians suggested that her armament could be rearranged on the centreline. The Australians hoped that the Admiralty could arrange favourable terms to justify having the work done away from Australia.

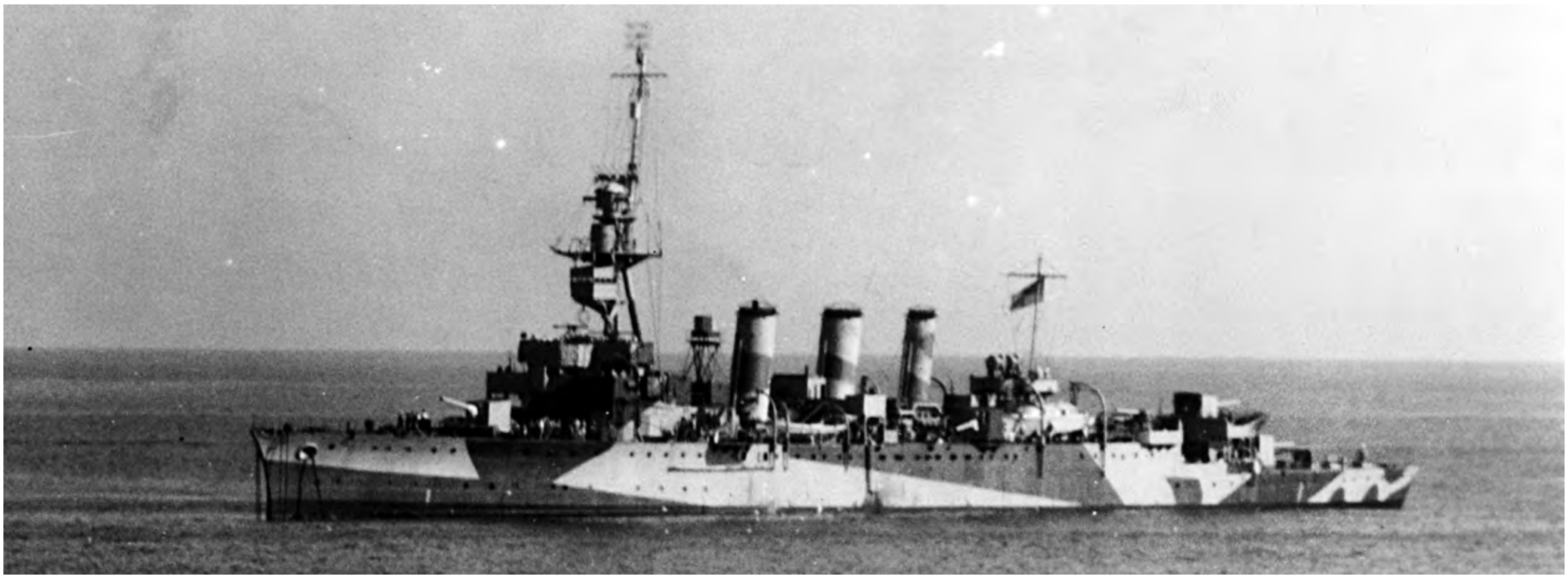
A slightly later proposed modernisation would retain six oil-burning boilers, the two end funnels being eliminated and the remaining uptakes trunked into one broad funnel and one narrow one. Armament would be reduced to six 6in guns arranged roughly as on a 'D' class cruiser, three guns being landed. To allow for the superfiring gun forward, the bridge would be rebuilt roughly as on a 'D' class cruiser, cruiser-type remote control and plotting arrangements being installed. The foremast would not be altered. The foremost 6in gun would have to be moved forward (further forward than in a 'D' class cruiser). It had recently been decided to strengthen the anti-aircraft armament of light cruisers, so the single 3in HA gun would be replaced by a pair of 4in HA guns amidships on the forecastle deck, with two 2pdr pompoms (singles) forward (as in the 'D' class). The 6in magazines would remain as before. The ship would carry eight torpedoes for her two submerged tubes.

Before this modernisation could be carried out, DNC produced a series of alternative schemes in which an aircraft catapult was placed between the new (fatter) after funnel and the searchlight platform, the former No. 1 and No. 4 funnels being eliminated (as before). The seaplane crane was stepped at the searchlight platform. The fatter after funnel was moved somewhat abaft of the original position of No. 3 funnel. In the simplest version, two 4in HA guns would have been mounted on the centreline, one in place of the forefunnel and one on a platform abaft the two after wing 6in guns. The single 6in guns and the bridge would not have been moved. In a more elaborate alternative scheme, 6in guns would have been mounted where the two 4in were, two forward wing 6in being landed; the two 4in guns would have been on a searchlight platform between the two remaining funnels. That would have given a broadside of six guns, compared to the original five. In a third scheme, a 6in gun was placed in a superfiring position forward (as in the original DNC scheme), and the two 4in HA guns were in the waist to either side of the gap between the funnels. A more elaborate version had a modified bridge and two 6in guns in the waist (total of seven), the 4in HA guns being to either side of the gap between the funnels (or, alternatively, on the searchlight platform). A final version retained the two waist 6in aft, but had the superfiring gun forward and the gun in place of No. 1 funnel. This one was unique in having the catapult aft, at the break of the forecastle deck abaft the two remaining broadside guns. DNC's sketches were dated 8 July 1926.

The project was evaluated at an Admiralty conference in December 1926. A key point was that the ship, which was slow by current standards, would be used in wartime for trade protection. Conversion to oil fuel made good economic sense. Moving guns to the centreline did not, because it did not add appreciably to the ship's fighting ability. However, a catapult and aircraft would be very valuable. The best position would be between the after funnel and the after control position (searchlight platform). It would also pay to modernise the ship's W/T systems, including installation of radio direction-finding. Late in 1927 the Australians decided to limit themselves to a conversion to oil burning, and even to retain the two forward boilers which had been earmarked for removal. Oil would replace coal previously stored in upper bunkers, these spaces becoming peace tanks.

Even this was not done; *Adelaide* was not modernised until 1938–9, when the two forward coal-burning boilers and the forefunnel were removed. The torpedo tubes were landed, the gun armament modified (the two side-by-side 6in forward replaced by one gun on the centreline and three 4in anti-aircraft [two in sided in the waist, a third superfiring over the after 6in gun] added, plus four 3pdr and eight Lewis guns), and fire controls rearranged. During 1942–3 the two waist 6in guns were replaced by four depth-charge throwers, one 6in replacing the 4in anti-aircraft gun superfiring over the after 6in (for a total of seven such guns). All 6in were fitted with new square shields. The two 4in in the waist remained, and the ship had six Oerlikons (she retained the Lewis guns).

Adelaide as seen from USS *Saratoga* on 28 April 1944. Note the new-type squared-off 6in shields. She had a mix of US and British radars: a US SC at the foretop for air search, but a British Type 272 in its flat-sided 'lantern' on the lattice tower forward of her forefunnel, and Type 285 atop the HA director. She had six Oerlikons: two in the flat-sided extensions to her bridge structure, two abeam the middle funnel, and two at the after end of the searchlight platform near the stub mainmast. The four depth-charge throwers were mounted, two on either side, behind the bulwark abaft the break of the forecastle. The major modifications were carried out during a 1942–3 refit at Sydney.



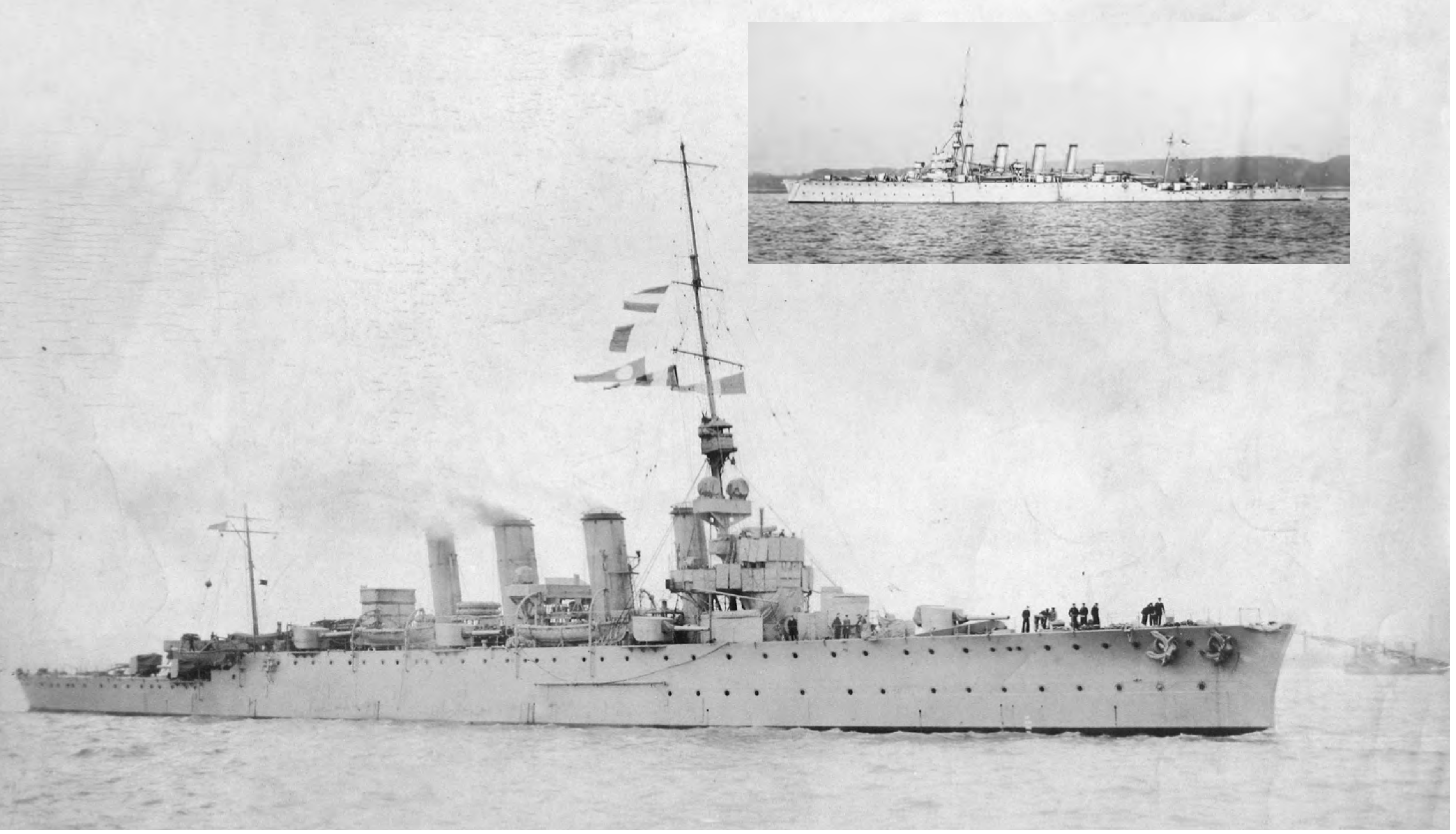
The *Chester* class

When war broke out in 1914, Cammell Laird was building two comparable cruisers for the Greek Navy. They were taken over in 1915 as *Birkenhead* and *Chester*. They resembled the *Chatham* class, but introduced a new 5.5in gun, which figured in some other British warships, including HMS *Hood* and the aircraft carrier *Hermes*. It was probably chosen for compatibility with the 5.5in secondary battery planned for the French *Bretagne* class battleship Greece was then planning to buy. These ships had ten 5.5in guns (two abreast at the bow, two on the centreline in tandem aft) and had a six-gun broadside. Like the 'Towns,' they burned coal and oil. Four shaft Parsons direct-drive turbines produced 25,000shp (25kts). *Chester* was modified while under construction to burn oil fuel only, for 31,000shp (26.5kts).

The Spanish cruiser *Reina Victoria Eugenia* is generally described as nearly an improved *Birmingham*. She was almost certainly a Vickers design.[14] Vickers also designed the next Spanish cruiser class (*Mendez Nunez*).[15]

Below and inset: HMS *Chester* was one of two cruisers under construction for Greece in 1914, taken over in 1915 for the Royal Navy. They were built by the Coventry Syndicate, intended to compete with Vickers and Armstrong by linking an armaments firm (Coventry Ordnance Works) with three shipbuilders and steel makers (Cammell Laird, John Brown, and Fairfield). Unlike the very similar *Birmingham*s, she did not have paired guns on her forecastle. These ships also had differently-shaped gun shields. *Birkenhead* could be distinguished by her vertical mainmast. Note the bandstand (for a light anti-aircraft gun) before the bridge in the later photograph, which shows the 3in anti-aircraft gun aft, just abaft the after two waist guns. The ships were built with platforms, between the after pair of broadside guns and the aftermost 5.5in gun, for two 3in HA guns, but they were not available, and 3pdrs were mounted instead. *Chester* was unique among the 'Towns' in having all-oil-fired boilers; the others had mixed firing. The two ex-Greek ships could easily be distinguished from the other 'Towns' by their short mainmasts, only half the height of their foremasts.

Below: HMS *Birkenhead* in 1919, shows wartime modifications: a tripod foremast with a director atop the enlarged spotting top, a flying-off platform (with, unusually, wind protection for the aircraft), concentration dials, and large searchlights. Note the vertical mainmast.



The 'Atlantic Cruiser'

In 1912 the new DNC Sir Eustace Tennyson d'Eyncourt drew the Board's attention to the need to replace the large armoured cruisers then employed on foreign stations. At this time British policy was to match German cruisers on a two-for-one basis. The 1912 German Naval Law called for the construction of ten cruisers specifically for foreign service by 1920. If the Royal Navy built twenty such ships, it could have five each on the China, East Indies and Cape Stations, with five to spare for the West Indies or elsewhere as required.[16] Chief of War Plans Captain Ballard also pointed out that the Germans planned to equip ten of their largest and fastest merchant ships as armed merchant cruisers in wartime, probably for distant service (given their large coal capacity).

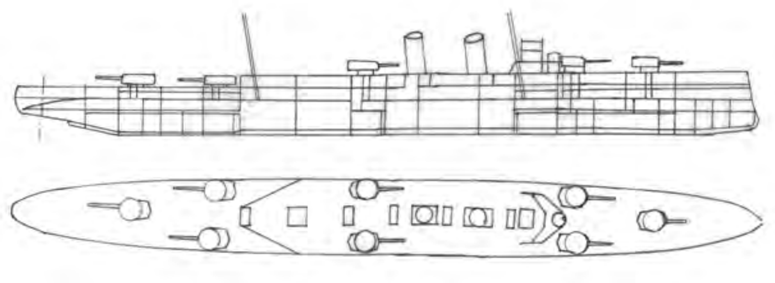
The 2 July 1913 report on the design of a new large cruiser (B3) was labelled (probably by Third Sea Lord) 'this design was got out as the result of rumours that the new German protected cruisers would be armed with guns of at least 6.9in (*sic*) calibre (probably larger). The First Lord [Winston Churchill] was anxious to have a design ready in case these rumours were true.' The ship was described as a Light Cruiser for Atlantic Service. The ship was armed with eight 7.5in guns. DNC pointed out that this was much more powerful than that of any foreign cruiser. He held down cost by limiting displacement to 7,500 tons, on which he was unable to provide more than 4in of belt armour amidships (3in at the ends) with a 3in upper strake amidships. To achieve the desired speed (26kts) on moderate power (as on the new light cruisers, but using heavier machinery for greater reliability), he had to make the ship rather long (500ft); he also gave the ship relatively deep draft (20ft mean) for good seakeeping performance. Unlike existing cruisers, this one would have mounted her heavy guns in turrets: single ones at the ends, and the others in single turrets paired port and starboard. She would have had two underwater torpedo rooms (two tubes each), forward and abaft her machinery spaces.[17]

Third Lord was impressed by her power and good freeboard – 'compared with the County class, it is remarkable what a powerful ship she would be for her size'. He also noted that if the existing 6in gun were retained, there would be little scope for improvement over the current *Birmingham*, although greater length and oil fuel might add another knot and perhaps two more 6in guns or two more torpedo tubes could be mounted.

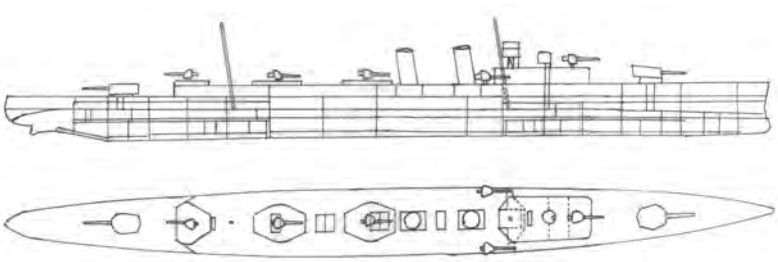
Churchill was unhappy with the size and cost of the ship; on 4 August he wrote to First Sea Lord that 'I question whether it does not go beyond anything required by German cruiser construction. I do not like the expression "for Atlantic service."' He asked DNC for a second design for comparison: smaller (6,500 tons) but faster (27.5kts on oil fuel), so in August DNC offered B4. It retained the end 7.5in guns but substituted six 6in for the rest: two in 'B' and 'X' positions, two abreast the bridge, and two on the centreline abaft the funnels. Length was 510ft to achieve the desired speed on the limited power. Alternatively, a 7,000-tonner could burn coal and oil as in the *Birmingham* class. Given the lower energy content of coal, she was larger (7,000 tons) and slower (26.5kts). As desired, the new design was expected to be considerably less expensive (£550,000 rather than £700,000, in each case exclusive of guns; the mixed-fuel ship would cost £590,000).

Nothing happened for the moment, presumably because the new destroyer-killer (see the next chapter) was more urgently wanted, but design work was approved. In concept, the big cruiser became the basis for the *Hawkins* class built during the First World War, the justification for which was almost exactly what DNC had written a few years earlier. Despite the German Fleet Law, the two for one policy was applied to produce the small fleet cruisers described in the next chapter.

There was also interest in a new low-performance 'colonial' cruiser, in effect the ancestor of the inter-war sloops.[18] It died because British finances were badly strained simply to match German cruiser construction as desired. If the colonial cruiser was included in the two-for-one numbers, it detracted from effective British cruiser strength. If it was counted outside those numbers (which might be difficult to explain to Parliament), it stretched the badly extended budget. In 1912 the financial problem was bad enough that First Lord Winston Churchill was interested in an arms control agreement with the Germans, who were also in considerable trouble (but it could not be negotiated).



Above: Design B3. The first sketch design (July 1913) showed a 7,400-tonner (500ft x 52ft x 20ft) with 26ft freeboard forward, armed with eight single 7.5in guns, four HA guns and four submerged torpedo tubes. A 30,000shp powerplant would have driven her at 26kts, and she would have burned only oil. Like later British First World War cruisers, she had only side armour, in this case 4in and 3in amidships. B3 was this size, with the same armament of eight 7.5in in single turrets – not the open mountings of the later *Hawkins* class, in effect continuations of this theme. The three boiler rooms were separated from two engine rooms by oil fuel stowage. (Norman Friedman)

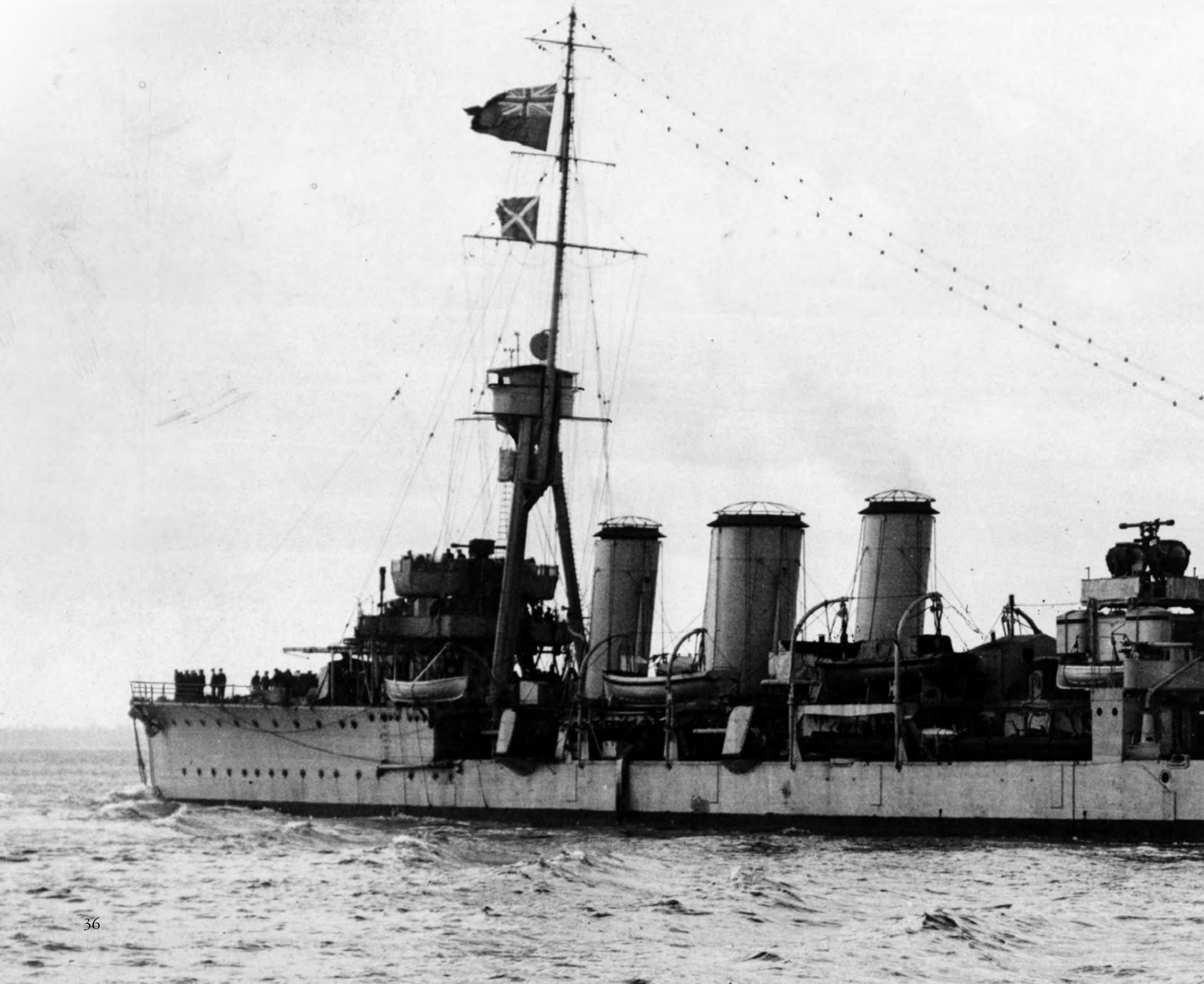


Above: Design B4 (August 1913). This version of the Atlantic cruiser was somewhat smaller (6,500 tons, 510ft x 53ft x 17ft 6in), armed with two 7.5in guns in turrets (like an armoured cruiser) and six open shielded 6in guns, like a light cruiser. Armour matched that of B3. B4 would make 27.5kts on oil fuel. An alternative version burning coal and oil would be larger (7,000 tons, 510ft x 54ft x 17ft 6in) and slower (26.5kts on 28,000shp). As in B3, each 7.5in gun would have 150 rounds, and each 6in would have 200, plus 300 per HA gun. (Norman Friedman)

CHAPTER 3
DESTROYER-KILLERS

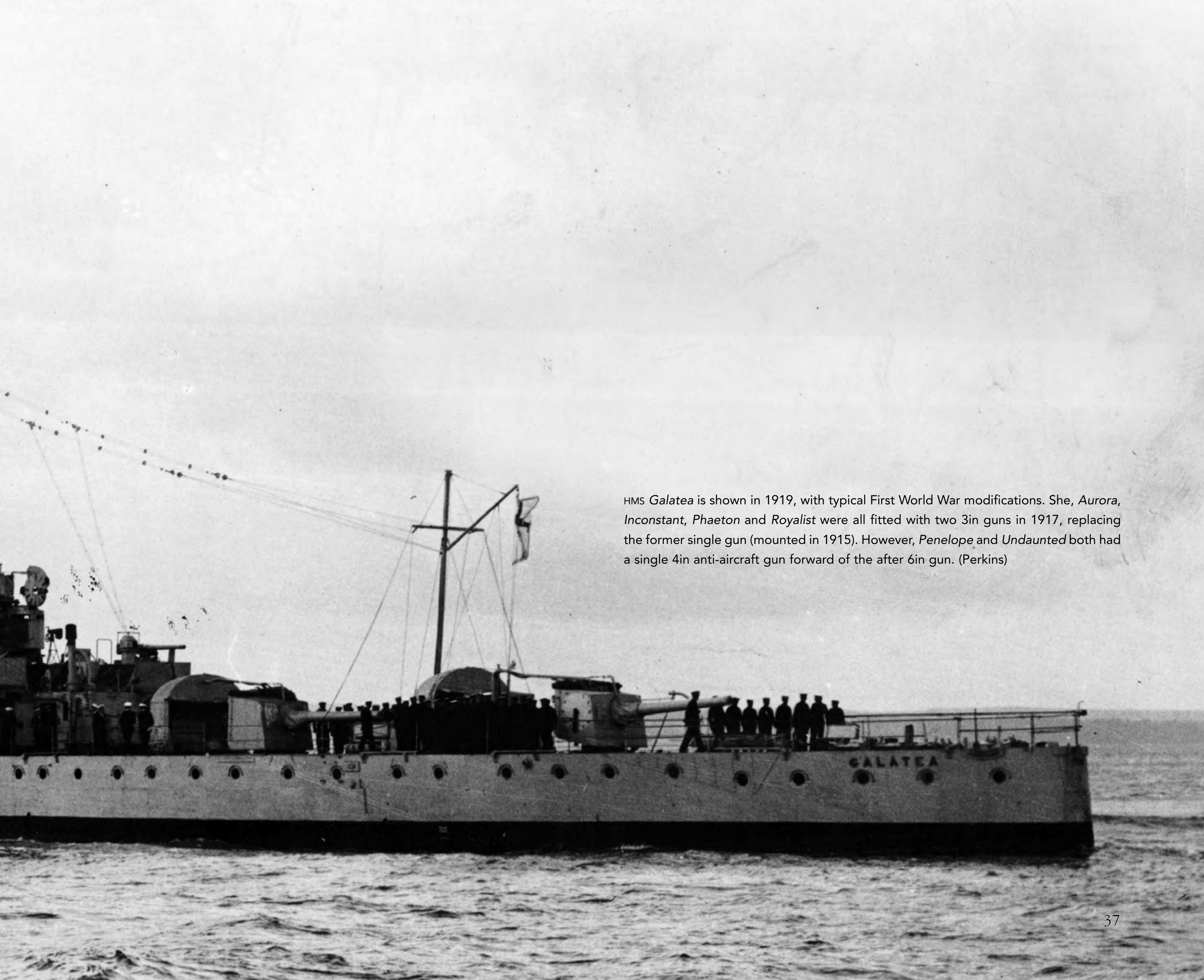
The *Arethusa* class

In about 1907 the Germans became interested in taking destroyers to sea to support their battle fleet, but by this time the Royal Navy considered destroyers operating in direct support of the battle fleet a danger both to themselves and to the capital ships. This departure from what had become standard practice in the Mediterranean Fleet can probably be traced to increasing gunnery range, which made it far more difficult to insure against friendly-fire accidents. As Mediterranean Fleet commander, Admiral Sir John Fisher had in effect invented tactics in which British destroyers worked directly with the fleet, but as First Sea Lord he abandoned them in favour of distant blockade of German destroyer bases coupled with the use of destroyer flotillas for home defence. He became less and less convinced that the battle fleet could

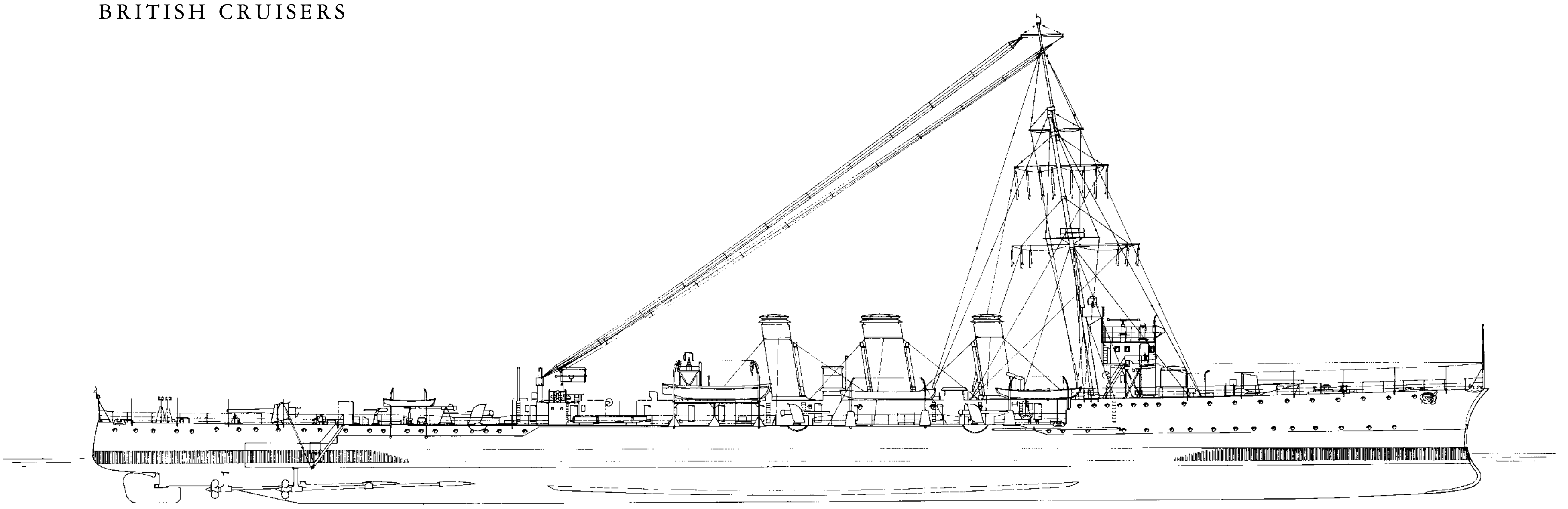


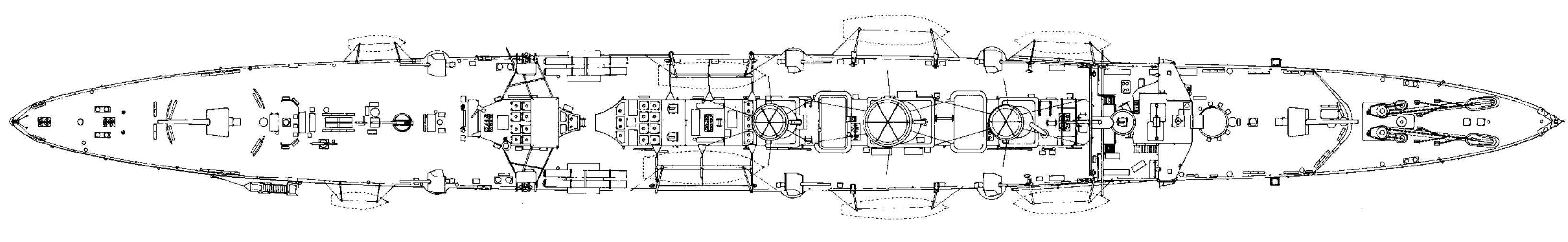
operate effectively in the North Sea, to the extent that he preferred to buy battlecruisers, which had an important trade-protection role in distant waters. This was by no means a widely-held view. When Fisher's successor as Mediterranean commander, Admiral Sir Charles Beresford, took over the Channel Fleet, he objected to Fisher's centralisation of torpedo craft command, arguing that he had to have destroyers as part of his fleet. Beresford went so far as to conduct exercises in 1908 to demonstrate that without them he could not fight a fleet with its own integral destroyer force. The Admiralty staff (i.e. Fisher) dismissed his account of the exercises with the bald statement that the Germans, like the British, would be operating their destroyers separately from the fleet. This claim may have been mirror-imaging, or part of Fisher's ongoing war with Beresford. To some extent, also, Fisher's belief that neither battle fleet could survive in a narrow sea in the face of masses of torpedo craft, including submarines, rendered such exercises pointless.

Once Fisher left the Admiralty in January 1910, battle fleet operations in the North Sea were taken far more seriously. Admiral William H May conducted exercises to examine the consequences of the newly-perceived German practice of operating destroyers with their fleet. Having completed the experiments early in 1911, May concluded that light cruisers were the appropriate counter to German fleet destroyers. In the blockade role destroyers were necessary, because they needed the speed to run down German destroyers as they appeared. They were poor gun platforms, but they would have time to sink the German ships as they ran with them, but when trying to deal with German destroyers rushing the British battle line, they would not have enough time to make up for their poor gun platform characteristics. This conclusion seems not to have had an immediate impact. First Sea Lord Sir Arthur K Wilson apparently planned to attack the German destroyers and submarines in their ports (later tacticians would call this 'attack at source') because he doubted that any form of blockade would succeed. He seems not to have accepted the new view of how the Germans would use their



HMS *Galatea* is shown in 1919, with typical First World War modifications. She, *Aurora*, *Inconstant*, *Phaeton* and *Royalist* were all fitted with two 3in guns in 1917, replacing the former single gun (mounted in 1915). However, *Penelope* and *Undaunted* both had a single 4in anti-aircraft gun forward of the after 6in gun. (Perkins)



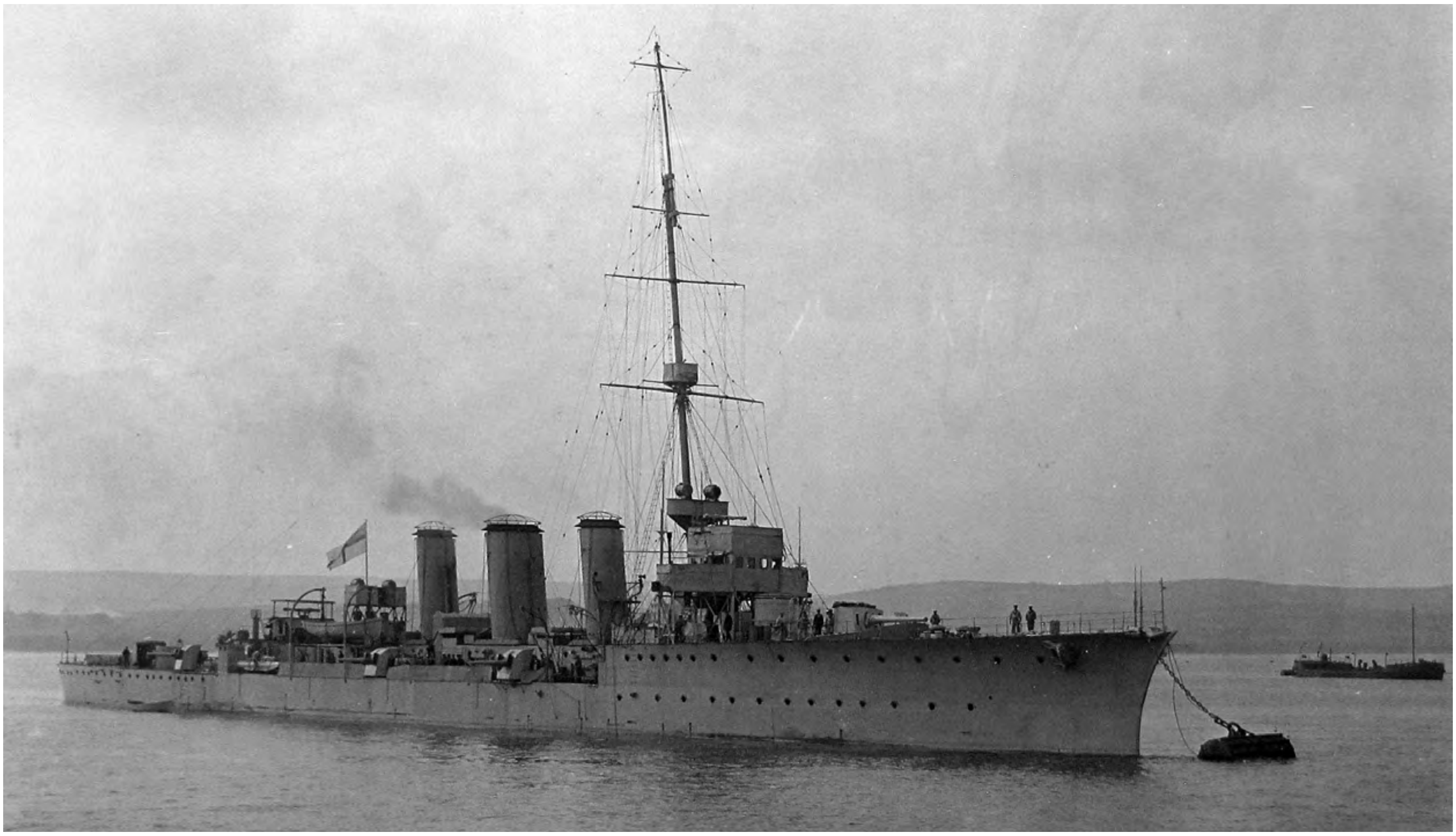


HMS *Arethusa* as in March 1914. The forecastle and upper (main) deck were planked, as was the bridge, but the deckhouse amidships (in effect the boiler casing) had steel decking. A reload torpedo magazine was located on the first platform deck, the reloading hatch being just abaft the aftermost deckhouse (six reloads could be carried). Torpedoes were reloaded via overhead travelling lift gear fitted between the centreline deckhouse sides and the officers' and warrant officers' washroom deckhouse. Folding platforms outboard the 4in mounts were removed during 1915. Surviving ships had two more twin torpedo tubes added during 1917. In 1918 conning towers were removed and a third 6in gun replaced the two after 4in guns. The foremast was given tripod legs to support a fire-control top, and a flying-off platform mounted forward of the bridge. Four of the surviving ships (*Galatea*, *Phaeton*, *Royalist* and *Undaunted*) could tow kite balloons. In 1918 all were fitted to lay mines. (A D Baker III)

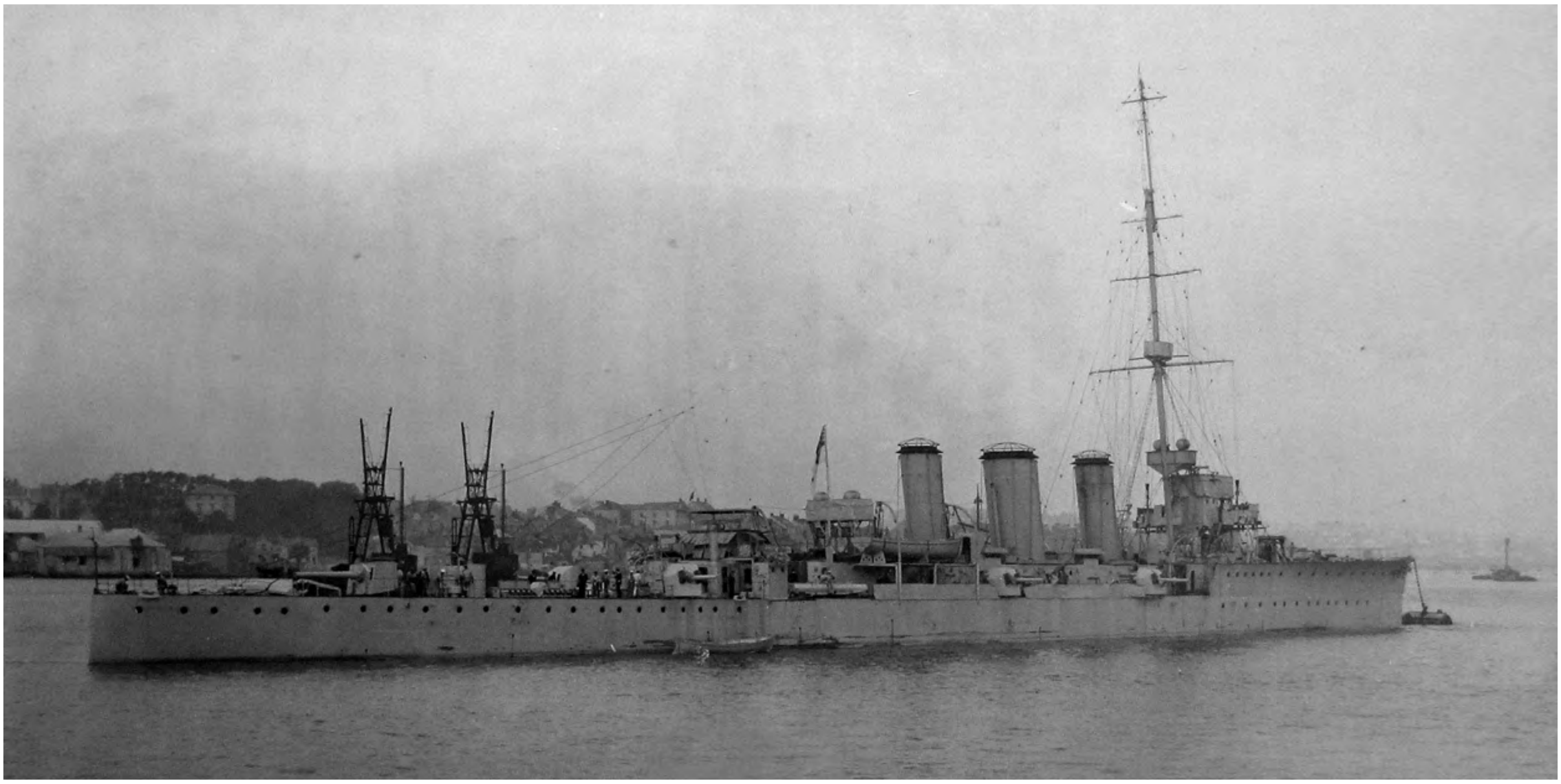
destroyer force. Wilson described his war plan at an informal meeting in 1911 in Whitehall Gardens, called because war seemed imminent due to the Agadir crisis. A horrified Prime Minister Asquith decided that Wilson was a fool (he had failed adequately to explain his reasoning), and appointed Winston Churchill First Lord of the Admiralty (roughly equivalent to a US Secretary of the Navy) to push the Royal Navy towards saner operating concepts.

Churchill had no naval experience whatever, but he was nominally responsible for the main features of the ships of the 1912/13 programme, including the *Queen Elizabeth* class battleships and the *Arethusa* class cruisers. It is not clear who advised Churchill, but he was close to the former First Sea Lord Admiral Sir John Fisher. Both classes (and also the destroyers of this programme) emphasised speed. The new 'Town' class cruisers were not fast enough to deal with German destroyers, and so early in 1912 Churchill verbally instructed DNC Philip Watts to develop a new fast light cruiser to deal with German destroyers. The DNC Department First World War cruiser history, dated October 1918, attributes the new ship to the considerable interest aroused in the autumn of 1911 by the new Italian cruiser *Quarto*, which achieved 28kts although she was about the same size as the earlier British *Boadicea* (25kts). In effect *Quarto* demonstrated that a small ship could combine the performance of new seagoing destroyers with cruiser protection and firepower, something not previous achieved. It was also reported that the newest German cruisers (the *Breslau* class) were faster than British light cruisers, and better protected, though not as well armed. It appeared that these fast new cruisers achieved their speed by using oil fuel and by adopting faster-running machinery closer to destroyer standards. The *Arethusa* Cover does not mention any of this.

The Cover is marked 'New *Fearless*', so presumably it was conceived as an upgraded version of that ship, which in turn had been (in effect) a destroyer leader. An initial sketch submitted on 10 January 1912 showed a 3,500-tonner (30kts) protected with 2in side armour over the machinery spaces, 410ft x 42ft, carrying 300/800 tons of fuel. She was about the size of the earlier cruiser *Active*. Armament was two 6in guns, four 12pdrs, four machine guns (Maxims) and two 21in torpedo tubes, whose total weight was the same as the armament weight of the *Active*. DNO preferred 4in guns to 12pdrs (the same shift was occurring in contemporary British destroyers), and wanted two more torpedo tubes. DNC submitted the resulting revised design on 16 January, commenting that no modification would have been required had the after 6in gun been replaced by a 4in. At this stage the ship was called a Third Class Cruiser. An earlier but undated design (which survives in the Cover) had an all-4in gun armament, including two guns side by side on the forecastle and the quarterdeck (and four single 4in on each side in the waist). This sketch may merely be an updated version of HMS *Active*, which was armed with ten single 4in guns (although the sketch is not marked as



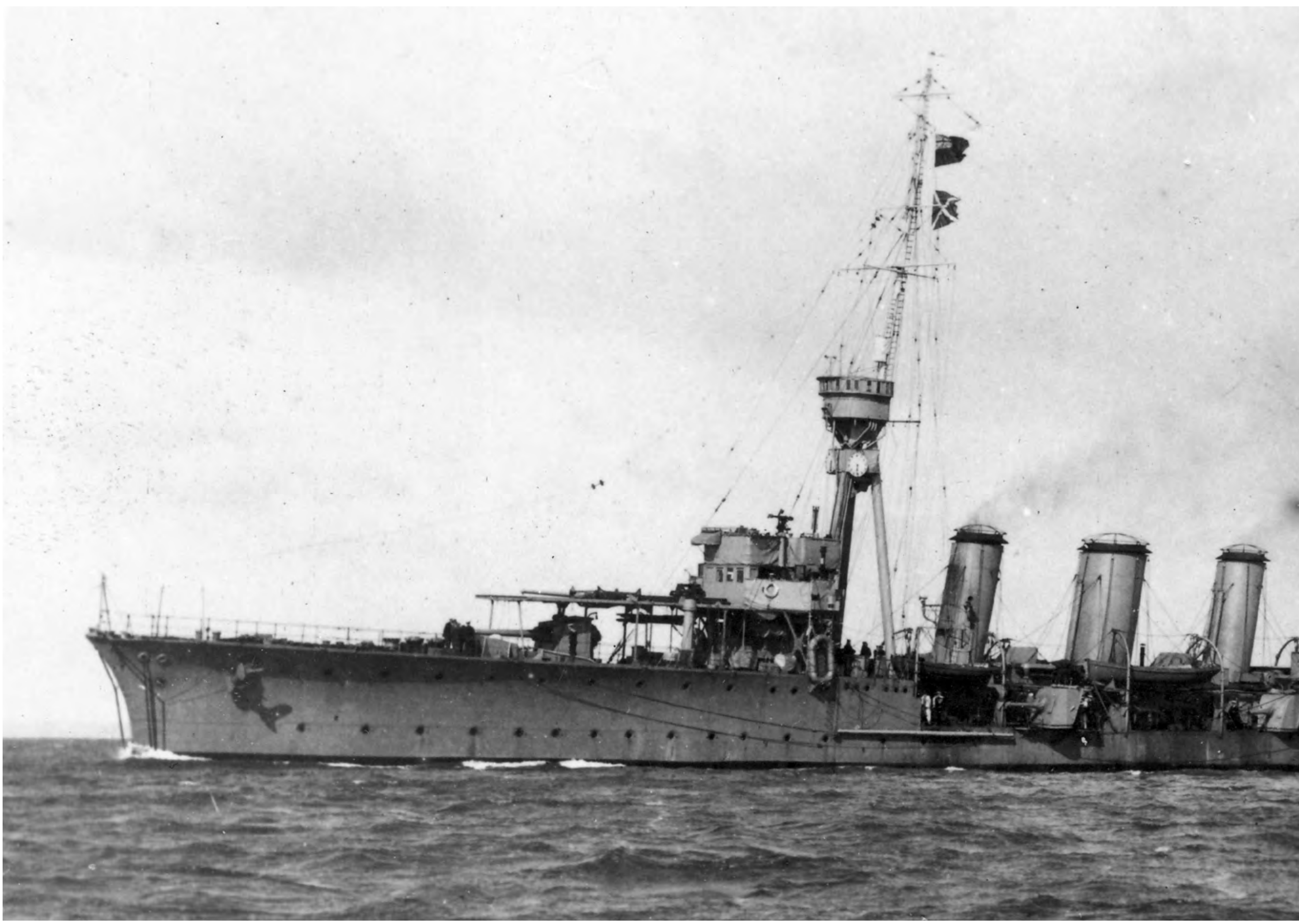
Above and below: Nearly all British First World War light cruisers were derived from the pre-war *Arethusa* class. HMS *Aurora* is shown newly completed (the towers aft were presumably temporary trials fittings). The reduction to one mast reduced radio range but it also made it more difficult for enemy ships to estimate the cruiser's course.



such). Note that *Active* lacked the side armour of the new design. The new cruiser would be longer than *Active* (410ft rather than 385ft between perpendiculars) and much faster (30kts rather than 25.3kts, on 40,000shp rather than 18,000shp).

There may have been some interest in a cruiser based on the big destroyer *Swift*; the Cover includes estimates of steaming radius for both the Super-*Active* and the Super-*Swift*. However, that comparison is the only reference to the Super-*Swift* in the Cover, and it is difficult to see a Super-*Swift* as a heavily-gunned destroyer killer. The new cruiser had far more endurance, making her much better suited to operating as an integral part of a battle fleet (4,400nm at 15kts compared to 2,400nm at 16kts). Because direct-drive turbines offered poor efficiency at low speeds, the ships had cruising turbines. Turbines were rated at 7,500shp each, with 10,000shp overload rating for a short time (at 650rpm). Boiler pressure was 235psi. The engines were in two engine rooms, and the eight boilers in two boiler rooms. All had Parsons Impulse-Reaction turbines except for *Arethusa* and *Undaunted*, which had Brown-Curtis. As in a destroyer, the uptakes from the after boilers in the forward room and from the forward boilers in the after room were trunked together to form a fatter second funnel between two narrower ones. Late in the design process it was decided to rake the mast and funnels because the mast did not support a boat derrick, hence did not have to be vertical. While the ships were being built, it was pointed out that the high power (10,000shp per shaft) would probably necessitate experiments with alternative propellers, but that proved impossible due to the outbreak of war, and the ships actually made 18.5 to 29kts.[1]

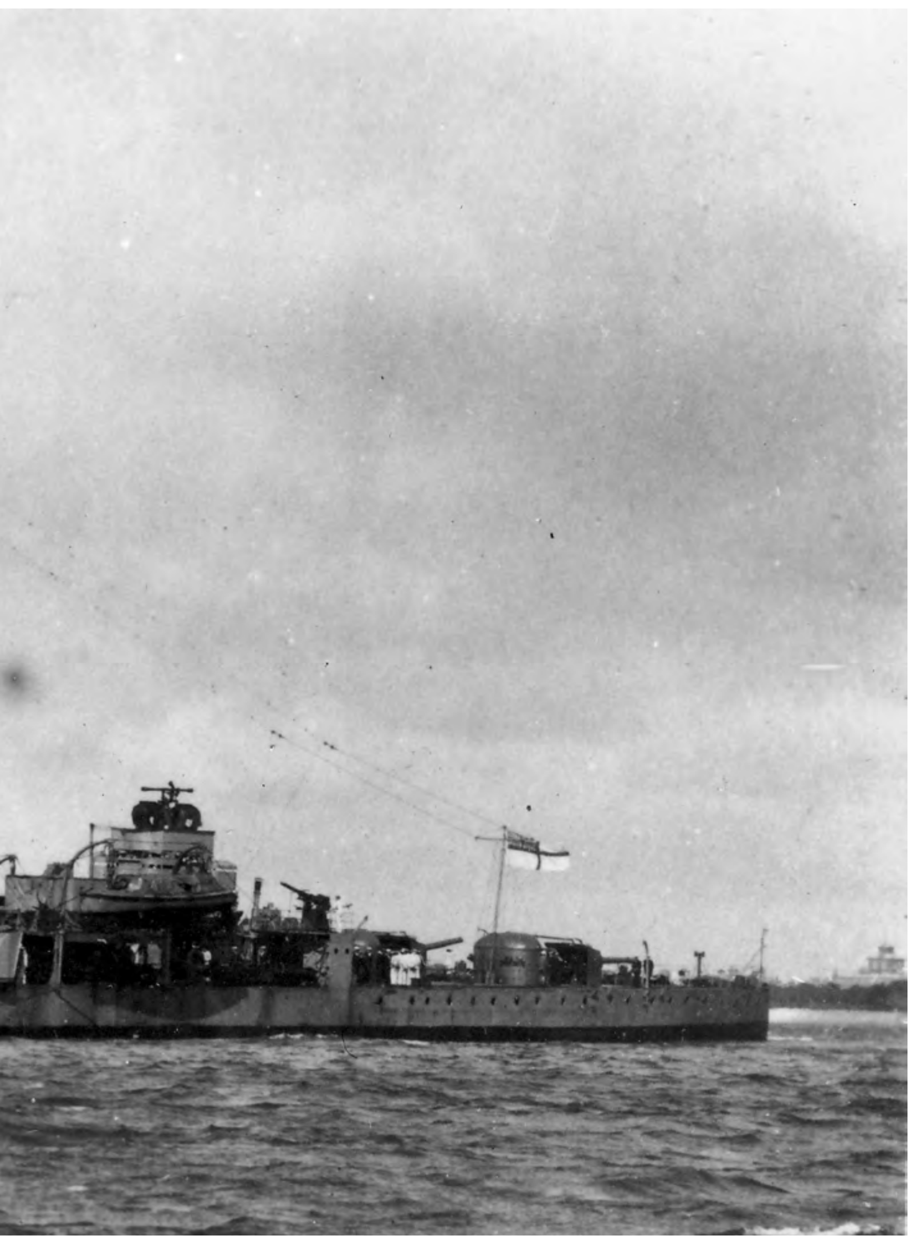
An internal DNC memo dated 29 February 1912 instructed the DNC staff to push the 'New *Active*' design as quickly as possible, with an armament, if possible, of twelve 4in guns – which might be difficult to fit in. Submerged torpedo tubes should be adopted to leave more space (for the guns) on the upper deck. Space was a problem because, DNC wrote, 'it is inexpedient to lengthen ship'. A sketch design for the all-4in ship was submitted in March 1912. In March the First Sea Lord asked for alternative ten- and eight-gun arrangements. DNC pointed out that weight saved that way could go into side armour over the machinery: an extra quarter-inch with ten guns, an extra ½in with eight guns. One of the ten-gun arrangement showed the two after guns *en echelon*, well separated lengthwise, to give a six- rather than five-gun



broadside (as in the twelve-gun ship). One of the eight-gun arrangements showed single centreline 4in guns at the ends, to give the same broadside as a ten-gun ship with paired guns fore and aft. The result might seem comparable to *Active*, but a March 1912 note on complement observed that the earlier ship provided enough crews only to man one broadside or the other, whereas the new cruiser would have enough to man all her guns simultaneously – which would make sense, as she would be engaging German destroyers rushing past her to attack the British battle line. In addition, it appeared that she would be armed with faster-firing QF (quick-firing, i.e. fixed ammunition) rather than breech-loading (BL, i.e. separate ammunition) 4in guns (but ammunition allowance per gun, 250 rounds, would not change).

To save hull weight, the armour was incorporated into the hull strength, a 2in outer layer covering the 1in hull plates, which had not been done in the 'Town' class. To this end strakes were worked longitudinally rather than vertically; there was later some fear that hits would break up the sandwich of armour involved. Total thickness was 3in over the machinery (and fuel tanks) amidships. That was quite respectable. After her action with *Emden*, the Captain of HMAS *Sydney* wrote that his 2in side armour had proven very valuable, since it defeated the standard German cruiser gun (4.1in) at 8,000yds, and probably at much shorter ranges. Fortunately the German shells rarely burst (had they done so, the ship's fore and aft controls would have been put out of action in the first few minutes). They also fell steeply enough not to ricochet. The Captain concluded that at least one control position should be behind armour. He rejected the existing conning tower.

DNC planned to extend side armour to the ends (1¼in thick); Churchill preferred protective decks at the ends. However, the extended side plating was important for structural strength; more structure would be needed to make up for the discontinuities at the ends of the belt. The weight saving was vital if the ship was to make the desired speed. Also, First Lord's preferred armour decks would complicate internal arrangements in a ship in which space was at a premium. DNC suggested a compromise, extending the belt armour about 60ft fore and aft of the machinery spaces (but to reduced height). That would provide 2in sides instead of the earlier 1½in sides, and a 1in arched deck over the steering flat instead of the previous quarter-inch deck. The extended belt would cover the lower conning tower, magazines, and shell rooms. The original 1½in plating was extended all the way to the bow, but 2in plating was extended only 30ft further aft and to a reduced height. All of that would cost about 40 tons, but about 20 tons would be gained back by eliminating the 1½in side over the steering compartment. Other detail cuts might save another 10 tons (for example, the lower conning tower side could be cut by an inch since it would be behind thicker armour). The new arrangement had the additional virtue of improving internal arrangements. Churchill approved. Ultimately ships had 1in to 1½in additional armour forward of their machinery, extending from 3ft below the upper deck to 2ft 6in below the load waterline. Aft of the machinery spaces they had 1½in extra armour back to the rudder head, from 3ft below the upper deck (cut down to 5ft 6in aft) down to 2ft 6in below load waterline. Hull plating itself was 1in to ½in thick. The machinery was protected from aft by a 1in after bulkhead, presumably to resist the fire of a pursuing enemy cruiser. *Arethusa* had a 6in conning tower with a 4in tube, ultimately replaced by a 3in conning tower with a 2in tube in these ships. The Legend showed no protective deck other than plating over the steering gear (side and deck were considered equivalent to 1½in). The continuous part of the upper deck was 1in thick for strength rather than for protection. Its role was made clear when the Captain of *Arethusa* (lead ship of the 1912/13 cruiser class) complained after the Heligoland Bight battle (28 August 1914) that parts of the superstructure acted as a shell trap, and that therefore the forecastle should have 1in armour to protect spaces below from fragments, but that would have added too much weight. Much of the lower deck had to be cut away to accommodate the large boilers. Because the ships burned oil to achieve their desired high speed, they lacked the coal bunkers whose bulkheads transversely stiffened earlier ships. It therefore became important to stiffen the ships transversely around their boiler rooms, by continuing the deep web frames in the machinery spaces above the lower deck. The structural arrangement incidentally doomed the idea of lower-deck torpedo tubes, because they entailed cutting the ship's side just where the heavy plating was. Moreover, there would be insufficient deck height to handle torpedoes freely, and tubes set low in the ship's side



HMS *Royalist* shows typical First World War modifications: a flying-off platform, the conning tower removed, a tripod foremast with a spotting top (but no heavy director; these ships had limited reserves of stability), a 3in anti-aircraft gun aft (actually one of two, to either side). One pair of 4in guns was replaced by a 6in gun on the centreline, forward of the after conning tower (barely visible here). The two pairs of deck torpedo tubes are not visible. (E Hopkins of Southsea courtesy of Josef Straczek) would fire their weapons directly into the waves created by the ship at high speed. The combined structural and protective arrangements became standard for the First World War British light cruisers derived from the *Arethusa* class.

Estimates of the required complement showed that the ship was not large enough to accommodate it; manning the guns and the submerged torpedo tubes was apparently the problem. In April, Churchill proposed to solve the problem by cutting to ten guns, with crews for seven of them (saving thirty men) and by adopting deck torpedo tubes, which saved another three men. However, the twelve-gun alternative was chosen by the Board, with QF guns of higher velocity than those being adopted for destroyers (45 calibres rather than 40 calibres). In May 1912 the Board sought to solve the weight problem by limiting each gun to 140 rounds, rather than the 250 earlier envisaged. That still left the space problem.

The Board approved the design on 7 July 1912 (DNC submitted it on 1 July). This version showed ten 4in QF guns and two upper-deck single 21in torpedo tubes; it is not clear when the Board reversed itself and approved a ten-gun armament. The Legend showed 200 rounds per gun.

Endurance was clearly considered important, because in the submission to the Board Watts pointed out that the ship could make 5,000–5,500nm by running on two shafts and trailing the other two. Estimated radius with four shafts on line was 4,000nm. In Legend or trial condition, ships carried 300 tons of oil fuel. Deeply loaded they carried 800 tons, including 140 tons in peace tanks (so called because, being above the waterline, they could not be filled in wartime). Later the total was given as 810 tons, a great deal for a 3,500-ton ship. As more and more topweight was added in wartime, stability in the light condition became less and less satisfactory – but it was possible to remedy that by flooding empty fuel tanks with sea water. Arrangements to this end were ordered in August 1916. DNC considered this modification a prerequisite for many newly-required improvements, including a tripod mast for fire control. The 1912/13 programme included eight ships of this *Arethusa* class.[2]

About November 1912 the First Lord (Churchill) decided to substitute single 6in guns for the paired (abreast) 4in guns at the ends of the ship, despite the considerable modifications involved; for example, the conning tower and bridges had to be raised about 3½ft to avoid gun smoke interference with the rangefinder on the bridge roof, and the funnels had to be raised similarly. The ships were given additional flare (to reduce wetness on the forecastle) and high spray shields fitted to reduce spray over the forward guns. The ships had already been ordered, so this change was hardly inexpensive. The rapidly-fired 4in gun was considered ideal as a destroyer-killer, but the 6in was wanted to deal with enemy cruisers which might support destroyer attacks.[3] The change left the ships with two 6in and six 4in, the latter in the waist at upper deck level.

There was, however, a problem: the ships were lively, and the 6in gun, which was manually trained and laid, was heavy. In 1913 trials on board HMS *Falmouth*, which was larger and hence not as lively as an *Arethusa*, showed that the existing 6in mounting could not be laid and trained quickly enough to deal with the motion of the ship. The metacentric height (in deep condition) in the new ships was therefore deliberately reduced. (and a squarer-section hull and deep bilge keels also adopted, to reduce motion). Goodall wrote that these changes could be made without detriment to stability because of the shift from coal and oil to oil fuel only, since in the deep condition the centre of gravity of the fuel was low rather than high. Much the same thing was done at this time in the design of the 'R' class battleships.[4] Coventry Ordnance Works (COW) proposed a power-worked solution. The alternatives were the Vickers experimental N mount and the existing P.VI pedestal mounting. The Vickers mount seemed most promising.

Ships had little or no centralised fire control, which made sense for a ship expected to engage several destroyers more or less simultaneously. The anti-destroyer guns were grouped for a degree of control, and the ship had two standard 9ft rangefinders. After she destroyed the German raider *Emden* in 1914, HMAS *Sydney* turned in a report that the rangefinders became useless once fire was opened, hence that the new technique of 'rangefinder control' was out of the question.

In March 1913 DNC was told to work out how to replace the two single deck torpedo tubes with twin tubes.[5] It would not be very expensive, but the ships had already expended their Board margins (for growth during construction), and the 5 tons involved might turn out to be the last straw. If it could not be accepted for the *Arethusa*s, surely it should be accepted for the 1913/14 ships. The First Sea Lord accepted the loss of speed. He could imagine occasions when 'these very fast ships could make night torpedo attacks on a battle squadron or division, which could not be avoided or resisted and which probably would not mean much risk to the smaller vessels'. The new cruisers were in effect super-destroyers, intended both to kill destroyers and to conduct their own torpedo attacks. The Royal Navy seems to have been unique at this time in seeing its light cruisers as torpedo craft. The idea apparently lapsed for a time, but it certainly returned strongly during the First World War.

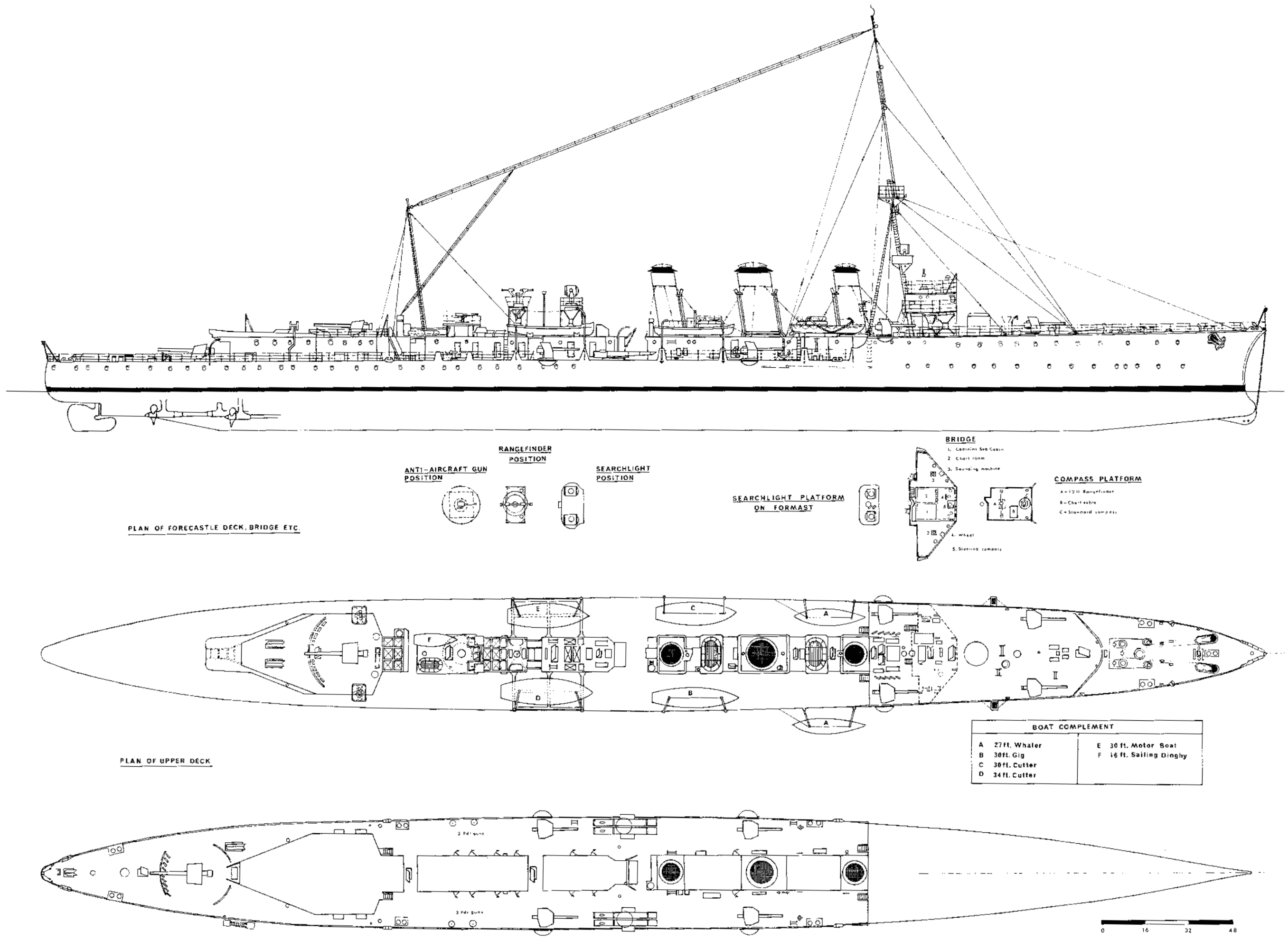
Finally, in 1913 installation of single 3in HA (high angle, i.e. anti-aircraft) guns was proposed for light cruisers. It was not approved until 1916. *Galatea* was completed with one 6pdr, *Inconstant* and *Phaeton* with one 3pdr, and *Undaunted* with one 1½pdr. The ships were completed with a single 0.303in Maxim (Vickers) machine gun, which was also standard in contemporary destroyers.

The first three ships entered service soon after war broke out in 1914. The broadside positions of the 4in guns were so wet that, at least in HMS *Aurora*, they were nearly useless. The ship's captain interpreted his experience to mean that 4in guns were useless compared to 6in, but it seems fairer to say that low-lying guns necessarily nearly at the edge of the deck were much wetter than guns on the centreline. The position nearly at the deck-edge had other unfortunate consequences. Layers and trainers had to be strapped into their seats, because on some bearings they were actually over the sea. Shells striking the belt armour created splinters which, on one occasion on board HMS *Arethusa* in 1914, killed a gunlayer.[6] DNO suggested building a light sponson under the guns. Although DNC protested that it would create more spray, it was added.

The *Caroline* or *Calliope* class

Eight more ships, slightly modified, were ordered under the 1913/14 programme as the *Calliope* class (later called the *Caroline* class). Compared to the *Arethusa* class, these ships had two more 4in guns. Two 4in were abreast forward of the bridge instead of a 6in gun; the two 6in were superimposed aft in 'X' and 'Y' positions. This unusual arrangement seems to have reflected the destroyer-killer logic: the ships would chase destroyers, against which their rapidly-firing (actually QF) 4in guns were their main weapons. Having four of them on the forecastle would provide more fire in the desired direction, and these guns would be dry in almost any weather. The 6in guns were intended to be used against enemy cruisers chasing the destroyer-killer. The ships were designed at about the same time that trials showed that existing 6in guns were unlikely to be very effective from such lively platforms.[7] According to the DNC First World War cruiser history, an alternative

HMS *Caroline* as completed in 1914, with four single 4in guns forward and two 6in aft, plus deck torpedo tubes as in *Arethusa*. (John R Dominy)



Caroline and *Carysfort*. *Caroline* is shown as in May 1917. *Carysfort* is shown as partially re-armed in 1918, with additional torpedo tubes in place of one of her waist 4in guns. Note her covered fire-control top, with (empty) searchlight platform below it, and the semaphore on the signal platform on her bridge structure. (John R Dominy)