1 Building the battlefleets

The Battle of Jutland, fought on 31 May and 1 June 1916, was the only action in World War I between the massed fleets of Great Britain and Germany. The two fleets had been built during the naval competition between the two countries that is often known as the 'dreadnought race'. But, though the dreadnought battleships and battlecruisers were the most striking elements of the two fleets, the competition also extended to the other warships types – particularly light cruisers and destroyers – that, by 1916, had been integrated into these 'grand battlefleets'.[1] This introductory chapter traces the course of this Anglo-German competition from its beginning in the 'predreadnought' era to the eve of the battle itself, focussing on three specific aspects: first, the numbers of vessels of the four types (and also submarines) that were authorised and built under each yearly programme; second, the fluctuations in the British margin of numerical superiority; and, third, the technical characteristics of the warships constructed by the rival navies. All three aspects are summarised in the tables accompanying the text. To allow ready comparisons, the tables are organised by programme years (in both Britain and Germany extending from April of one year to March of the next), with completions as well as authorisations being counted in each programme year.[2]

After the passing of the Naval Defence Act of 1889,[3] the first two ships of the *Majestic* class, authorised as part of the programme for the financial year 1893–94, established the characteristics of the British battleships for the next ten years: a primary armament of four 12in guns in two centre-line turrets, a secondary broadside battery of twelve 6in, an anti-torpedo-boat armament of 12pdr guns and, in the main, a speed of 18 knots. Up to the programme of 1900–01, twenty-nine vessels of this type had been authorised. They were followed for the next three programme years by the eight battleships of the *King Edward VII* class, which mounted 4-12in and 4-9.2in in turrets and also 10-6in and 14-12pdr. The two *Lord Nelsons* for 1904–05 reverted to three

[1] Brooks, 'Battle-Fleet Tactics', p. 183.
[2] The most comprehensive source for British and German programme years is *War Vessels and Aircraft. British and Foreign. Part II, Quarterly Return . . . October 1915*, ADM 186/15.
[3] Marder, *Anatomy*, pp. 105–7.

calibres – 4-12in, 10-9.2in in turrets and 24-12pdr. By the end of the programme year 1904–05, thirty-nine of these battleships (which would soon be known as 'predreadnoughts') had been authorised and thirty-one completed, while all thirty-nine had been completed before the end of 1908–09. From 1896, France embarked on a major programme of armoured cruiser construction; by 1906, she had laid down nineteen of these large vessels, which were faster than battleships but with thinner armour.[4] Once French intentions became clear, Britain responded decisively, as she had throughout the nineteenth century to foreign challenges;[5] beginning with the six *Cresseys* of the 1897–98 programme, thirty-five British armoured cruisers were authorised and twenty completed by the end of 1904–05 with all thirty-five in service by the end of 1908–09.

In 1890, the young Emperor Wilhelm II, who had already shown an active interest in naval affairs, dismissed Chancellor Bismarck and thereafter pursued his intent to provide Germany with a navy that matched her growing status as a world power. Between 1894–95 and 1900–01, Germany authorised the construction of five each of the *Kaiser Friedrich III* and *Wittelsbach* classes. Compared with foreign predreadnoughts (including those being built in Britain), they were as well protected while, although their turret guns were of only 24cm (9.4in) calibre, they were quick-firers (QF); they also had a heavier secondary battery of 18-15cm (5.9in). In the same period, Germany also laid down three armoured cruisers. In June 1897, Rear-Admiral Alfred Tirpitz was appointed State Secretary of the Imperial Navy Office, a post he retained for the next nineteen years. His first Navy Law of 1898 established an annual construction rate of three large ships while the Amendment (*Novelle*) of 1900 specified that in most years construction would commence of two battleships, one large cruiser, six light cruisers and one division of six torpedo boats. This programme was justified by Tirpitz's 'risk-theory' (*Risikogedanke*); this was founded on the hope that the German battlefleet, if it could be increased to two-thirds of the whole British fleet, would be strong enough to threaten Britain with the loss of the battlefleet that she would be able to deploy in home waters.[6] Alternatively expressed, Germany's aim was to reduce Britain's numerical margin in battleships to not more than 50%. Under the laws, five battleships each of the *Braunschweig* and *Deutschland* classes were authorised in the years between 1901–02 and 1905–06, together with a further five armoured cruisers. In these last two predreadnought battleship classes, the turret gun calibre was

[4] Except where stated otherwise, characteristics of British and French ships are from *CAWFS 1860–1905* and *1906–21*.
[5] A Lambert (ed.), *Steam Warship*, pp. 9 and 12. Beeler, pp. 208–9.
[6] Seligmann *et al*. (eds.), pp. 8, 67, 75–80 and 82; the editors of this invaluable compilation of primary sources for *The Naval Route to the Abyss* provide incisive introductions to each phase of the naval race. Herwig, pp. 25–8 and 32–9.

increased to 28cm (11in) (also QF) and the heavier secondary battery mounted 14-17cm (6.7in).[7] Thus between Britain and Germany, the final numerical ratios were 39:20 for predreadnoughts and 35:8 for armoured cruisers, a British margin of 164% for all heavy ships; clearly, Tirpitz's aim of a margin of no more than 50% was at best a distant prospect.

While Britain remained superior in battleships and armoured cruisers, Germany was already establishing a lead in two types of lighter vessels that would, in time, become vital components of the battlefleet – light cruisers and ocean-going destroyers. The first of the ten light cruisers of the *Gazelle* class had been designed in 1896 as a single type capable of the many duties performed by small cruisers; all but *Gazelle* herself were designed for 21½ knots. They were followed in the four years 1902–06 by seven *Bremens* and four *Königsbergs*. Britain, on the other hand, continued to lay down third-class cruisers – none were capable of more than 20 knots – until the programme years 1902–04, in which four *Gems* (22 knots, except for the 22½-knot *Amethyst*, which was turbine-powered) and eight *Scouts* were authorised (all twelve were reclassified as light cruisers in 1913). The 25-knot *Scouts* had a three-knot advantage over the contemporary *Bremens*, but their endurance was poor and in service they were used as flotilla cruisers to lead destroyers (Tables 1.1 and 1.2).[8]

The Imperial German Navy was also an innovator in surface torpedo vessels. The boats of the *S90* class were designed for a new role, to work with the fleet, and were accordingly given raised forecastles so that they could continue to operate in rough seas; forty-two were laid down between 1898 and 1905, though there was a gradual increase in displacement over this period. Their success was recognised in Britain, where the Admiralty had also accepted the need for more seaworthy destroyers. The outcome was the 25½-knot *River* class, with raised forecastles and heavier scantlings than in previous British designs; thirty-four were built in the three programmes from 1901 to 1904. In comparison with the *S90s* (which the Germans classified as large torpedo-boats rather than destroyers), the *Rivers* were bigger, nominally slower and more heavily gunned: though they carried two rather than three torpedo tubes. But, as Tables 1.3 and 1.4 show, Germany, due to her earlier start, had established a significant lead in completed destroyers that were capable of operating in the wider North Sea, either with the fleet or independently.[9]

As soon as France and America achieved some successes with submarines, the Admiralty moved decisively, in the three years 1901–04 ordering from

[7] Except where stated otherwise, characteristics of German ships are from Gröner Vol. I (surface vessels) and Vol. II (U-boats).
[8] McBride, '"Scout" Class', p. 274. Rear-Admiral J de Robeck, 'History of "Attentive" Class', 1912, in 'Flotilla Scouts, Cruisers & Depôt Ships [etc.]' in ADM 1/8273.
[9] Herwig, pp. 14–15 and 28–9. Lyon, pp. 15–16. March, pp. 72–3. *CAWFS 1860–1905*, pp. 99–100, 262 and 264–5 and *1906–21*, p. 164. Friedman, *Destroyers*, pp. 86–93.

Vickers five 'Holland' boats to a licensed American design, thirteen 'A'-class boats (still largely experimental) and then eleven of the 'B' class. Apart from *A13*, all these boats had petrol engines and, although the *B*-class were larger than contemporary designs abroad, they were best suited to coastal defence roles. In contrast, due to Tirpitz's opposition to submarine warfare, Germany's first submarine, *U1*, also of the coastal type, was not laid down until 1904; this and other early U-boats were powered by kerosene engines.[10]

Fisher's construction scheme

When Admiral Sir John Fisher became First Sea Lord on 20 October 1904, he had already assured the First Lord, Lord Selborne, that his proposals for new construction, redistributing the Fleet, scrapping ineffective ships and making more efficient use of the Navy's manpower would yield 'a great reduction in the Navy Estimates'. Construction would 'be absolutely restricted to four types of ship being all that modern fighting necessitates': battleships and armoured cruisers (both with uniform armament), large fast destroyers and submarines.[11] Fisher and the expert committee advising him considered several armaments for the new 21-knot battleship but they soon settled on all-12in. For a time, a 9.2in calibre was considered sufficient for the armoured cruiser to fight 'a similar class to herself'. But again, by December, all-12in was preferred, together with a speed of 25 knots. A Committee on Designs was then formed to produce more detailed proposals; it was they who extended Fisher's assertion that 'Battleship and Armoured Cruiser are approximating to each other' to the conclusion that her 12in armament '*makes the Armoured Cruiser all the more qualified to lie in the line of battle if required to do so*' (emphasis in original).[12]

The Committee made the momentous decision that both battleship and armoured cruiser should be powered by steam turbines. In choosing deck layouts, they decided that the battleship would have ten guns in five turrets – two wing turrets and three on the centre line giving a broadside fire of eight guns. To support the boat derrick, they stepped the battleship's single tripod mast abaft the fore funnel. As a result, the fire control top would prove unduly liable to smoke interference; fortunately, this mistake was not repeated in the two-masted armoured cruisers. The armoured cruiser would have eight guns, the two turrets amidships being arranged slightly *en échelon* between the

[10] Brown, *Grand Fleet*, pp. 78–81. Herwig, pp. 38–9. [11] Mackay, pp. 306–11.
[12] *Naval Necessities. Proposals Affecting Policy, Administrative Reform and Types of Fighting Vessel*, Admiralty, 21 October 1904 (but not printed until November), p. 62, FISR 8/4. *Report of the Committee on Designs* (London, 1905), pp. 33 and 41, FISR 8/4. Brooks, '*Dreadnought*', pp. 162–3; this section is largely based on this paper, which questions whether Fisher's dreadnought policy should be seen as 'a stroke of genius'.

second and third funnels; this permitted limited arcs (about 30°) of across-deck fire if the damage to the decks from blast was accepted. The Committee also decided that the latest 12pdr guns would be satisfactory for the anti-torpedo-boat armament, though the armoured cruisers were completed with the 4in weapons that became standard for this purpose. With space restricted in the superstructures, in both designs some of these guns were mounted without shields on the turret tops, where the gun crews were completely exposed; while shields were liable to explode any shells hitting directly, they at least provided some protection against splinters. Despite Fisher's preference for the armoured cruiser type, priority was given to building a single battleship, the *Dreadnought*, as quickly as possible under the 1905–06 programme. She was launched amid extensive publicity orchestrated by Fisher in February 1906, and commissioned in readiness for her first, experimental cruise in December 1906. The three *Invincible*-class battlecruisers (to use the term that was officially adopted in 1911) were laid down under the same programme in February–April 1906 and completed between June 1908 and March 1909.[13]

Given Britain's great preponderance in armoured cruisers and with three *Invincibles* already under construction, there was no reason to lay down any more battlecruisers in the next two programme years. But in each of these years, three dreadnought battleships were authorised, the *Bellerophon* class in 1906–07 and the similar *St Vincent* class in 1907–08. The turret layout was the same as in *Dreadnought*. But her successors had two tripod masts, the foremast being stepped ahead of the funnels and the anti-torpedo-boat guns were 4in. *Dreadnought*'s main armour belt (between the lower and middle deck) was 11in in thickness but 10in in the subsequent battleship classes with 12in guns. In all, the middle-to-main deck armour was 8in thick but the sides between the main and upper decks were unarmoured. In *Dreadnought* and the *Invincibles*, protection against underwater hits by torpedoes and mines was limited to internal longitudinal bulkheads abreast the cordite magazines and shell rooms; this arrangement was retained in all later battlecruisers. But the *Bellerophons* were fitted with continuous longitudinal bulkheads that protected not only the magazines and shell rooms but the engine and boiler rooms as well; this feature was then repeated in the *St Vincent* class and also in *Neptune* of the 1908–09 programme.[14]

Destroyers and submarines

Fisher began his time as First Sea Lord by declaring that '[a]ny intermediate type of cruiser . . . is utterly useless . . . One armoured cruiser [of the new type]

[13] Roberts, *Dreadnought*, pp. 9–17 and 28–30 and *Battlecruisers*, pp. 19–25 and 96–7. See also Parkes, p. 494 and Rüger, pp. 79–81.
[14] *CAWFS 1906–21*, pp. 22–3. Roberts, *Dreadnought*, p. 32 and *Battlecruisers*, p. 109. Burt, pp. 69–70, 85 and 128–9. Parkes, *passim* for armour details.

would overtake and gobble them up one after the other.'[15] He promptly cancelled the orders for four additional cruisers of the *Gem* class and no small cruisers were laid down in Britain in the three years 1904–07. He also put a stop to the anticipated orders under the 1904–05 estimates for an improved design developed from the *River* class, proposing instead a new type of 900 tons with 4in guns and a speed of 36 knots. Even had this been technically feasible, the cost would have been prohibitive. More realistic requirements were set out in November 1904 when the specialist firms that built torpedo craft were asked to tender for destroyers armed with three 12pdr guns that would burn oil fuel for a speed of 33 knots. The brief to the Committee on Designs further stipulated two torpedo tubes and a displacement of about 600 tons for what was described as an ocean-going destroyer 'to accompany Fleets in all weathers . . . to any part of the world'. But the tenders received had evidently established that only a few could be afforded, since the Committee was instructed to consider also a small coastal destroyer of about 250 tons carrying two 12pdrs and three tubes at 26 knots. They were also informed that the Board had decided to build one 36-knot experimental vessel.[16]

The 'ocean-going' destroyer was developed as the turbine-powered *Tribal* class. Their displacement climbed to 850 tons and more: while at between £130,000 and £141,000, they cost much more than the last batch of the *River* class (£72,500–81,000). Only five, two and five *Tribals* respectively were built in the three programme years 1905–08, the final seven being given a heavier gun armament of two 4in. The first of the class did not join the fleet until April 1908; thus no new destroyers were commissioned in 1906–08 and only four in the following year. Their speed trials led to much legal dispute and, even when they did reach 33 knots, it was at the expense of high fuel consumption. They were not good sea boats, their endurance was poor, and throughout the War, they served as part of the Dover Patrol; thus they fell far short of the ocean-going fleet destroyers imagined by Fisher.

The coastal destroyers were at first named after insects and known as the *Cricket* class; twelve were ordered in each of the years 1905–08. They too were turbine-powered and oil-fuelled (they were nicknamed the 'oily-wads'), but they lacked beam and were too lightly built to undertake destroyer duties. After the trials of the first two in 1906, they were reclassified as torpedo boats numbered *TB1-TB36* and employed only in coastal patrol and local defence flotillas. Thus they added nothing to the Royal Navy's strength of destroyers capable of operating on the enemy's coast or with the fleet. The large destroyer

[15] *Naval Necessities* (see note 12), p. 39.
[16] *CAWFS 1860–1905*, p. 84. Friedman, *Destroyers*, pp. 93–6. *Naval Necessities*, p. 27. March, pp. 84–7. *Committee on Designs* (see note 12), pp. 33–4.

Swift was built to meet Fisher's demands for a 36-knot vessel but, despite her high displacement and cost and prolonged experiments, she barely exceeded 35 knots. She was used as a flotilla leader, but she was too frail for service in northern waters, and in 1915 she too joined the Dover Patrol.[17]

With the *B*-class, Britain established a lead in submarine design and construction. As First Sea Lord, Fisher, already a submarine enthusiast, was prepared to commit to an extended production run of *C*-class boats; thirty-eight were authorised in the four years from 1905–06, and all had been commissioned before the end of 1910. They were little different from the *B*-class, though Fisher was convinced that even these small coastal types were capable of playing a major part in the defence of British coasts and harbours against invasion. However, even in 1904 the need had been recognised for a substantially larger 'overseas' type that could operate for some days on an enemy coast. Though delayed in part by negotiations to break Vickers's monopoly of submarine construction, and probably also by the time needed to develop a satisfactory diesel engine, the prototype *D1* was ordered in 1906 and she ran her trials in late 1908. *D2* was built under the programme for 1908–09 and the rest of the class (*D3–D8*) under that for 1909–10, the last for which Fisher was responsible as First Sea Lord.[18] Thus, while at first he had no option but to build coastal submarines, he was also responsible for the first British class of submarines capable of offensive operations.

Tirpitz's response

At the turn of 1904–05, the German naval attaché in London reported on Vickers's proposals for an all-10in gunned battleship and on British intentions to increase the capabilities of the battleships of the 1905–06 programme.[19] The latter intelligence may have been influenced by an article in the *Daily Mail* for 30 December 1904.

> The British Admiralty's reply in this friendly competition with our possible ally [the USA] will be a ship carrying ten 12in. guns and displacing 17,000 to 18,000 tons.
>
> She will be able to destroy any battleship now afloat or as yet designed with consummate ease, firing as she will a broadside of seven 850lb. shells.[20]

This implies (incorrectly) that three guns were mounted on each side in single turrets. But the report may have had some influence on the German design

[17] *CAWFS 1906–21*, pp. 71–3. Brown, *Warrior to Dreadnought*, p. 195. March, pp. 70–1 and 85–95. Friedman, *Destroyers*, pp. 102–11.
[18] Mackay, pp. 297–303. *CAWFS 1906–21*, p. 87. *Quarterly Return, October 1915* (see note 2), pp. 29–30. Brown, *Grand Fleet*, pp. 80–3. N Lambert, *Fisher*, pp. 154–7 and 182.
[19] *FDSF I*, p. 57. Seligmann *et al*. (eds.), p. 156.
[20] Press cutting with Narbeth to DNC, 30 December 1904 in Ship's Cover 213/12, *Dreadnought*, NMM.

study of March 1905 (Project c) for a small all-big-gun battleship of 15,400 tons with eight 11in guns in two dual centre-line turrets and two single turrets on each side; it also mounted eight 6.7in in casemates.[21] Tirpitz was deeply disturbed when more accurate information on *Dreadnought* reached Germany in the summer of 1905 (her chief characteristics were published in *Engineering* for 26 May 1905). Previously he had been opposed to an increase in displacement beyond the capacity of existing infrastructure. He now realised that, rather than permit any further decline in the relative fighting power of his capital ships, he had no choice but to respond to Fisher's initiative, despite the high costs of bigger ships and the enlargement of fixed works, including the Kiel Canal, to accommodate them. On 22 September, Tirpitz chaired the meeting that agreed the principal characteristics of what would be Germany's first dreadnought battleships, the 18,570-ton *Nassau* class.[22] They mounted six dual 11in turrets, two on the centre line and two each side, but, despite the additional turret, their broadside of eight heavy guns was no greater than *Dreadnought*'s and their reciprocating engines gave them a speed of only 19 knots. But they had a substantial secondary battery of 12–5.9in, and they were better protected.

Dreadnought herself was launched, with great fanfares, in February 1906. In Germany, the *Flottenverein* was criticising Tirpitz for the inferior quality of existing ships, while the Moroccan crisis had heightened the sense of rivalry with Britain. Thus there was little opposition when in May 1906 the Reichstag passed a further *Novelle* under which the construction tempo remained at two battleships and one armoured cruiser per annum despite the considerable increase in the cost of dreadnought battleships.[23] Because of the time required to produce the radically new designs, no German capital ships were actually laid down in 1906 but, between June and August 1907, all four *Nassau*-class battleships were started. And Britain was not the only country capable of building rapidly. Thus the tempo of German completions barely faltered. *Nassau* and *Westfalen* commissioned and began their trials in October and November 1909, though they did not join the fleet until the following May; the trials of *Rheinland* and *Posen* began in April and May 1910, and they both entered service in September 1910.[24] The characteristics of *Blücher*, the first German armoured cruiser with a uniform main armament, were also decided at the meeting of 22 September 1905, but she was not laid down until February 1907, and she also commissioned in October 1909. Her design was too far advanced to change when news of the 12in guns of the *Invincible* class reached

[21] Seligmann *et al*. (eds.), pp. 156 and 165–9.
[22] Herwig, pp. 57–8. *IDNS*, p. 58. Epkenhans, '"Opportunity"', p. 84. Seligmann *et al*. (eds.), pp. 157 and 172–5. Kelly, pp. 256–7.
[23] Herwig, p. 59. Seligmann *et al*. (eds.), pp. 157–9.
[24] Gröner I, pp. 23–4. *CAWFS 1906–21*, p. 145. Herwig, pp. 59–60.

Germany and she was built with twelve 8.3in guns arranged as in the *Nassaus*. Unlike the British ships, she also had a secondary battery, of eight 5.9in: but, with a maximum belt thickness of 7.1in, her protection was little better than previous armoured cruisers. In contrast, during the design of Germany's first 'battlecruiser', *Von der Tann* of the 1907–08 programme, it was accepted, despite Tirpitz's initial opposition but with the Kaiser's support, that she must be capable of fighting in the battle line. Hence at 9.8in, her belt was only fractionally less than the 10in thickness fitted to contemporary British battleships. Her eight turret guns were 11in pieces, with the two midships turrets *en échelon* before and abaft the second funnel; this arrangement allowed them to fire across the deck over arcs of 125°. She too had the usual German secondary battery, in her case of ten 5.9in guns. She was the first German capital ship powered by turbines for a design speed of 24.75 knots.[25] In the *Invincibles*, which displaced almost 2,000 tons less than *Von der Tann*, Fisher had accepted the mediocre protection of previous armoured cruisers in order to obtain high speed and mount a uniform armament of heavy guns. Now, in a future conflict with Germany, British battlecruisers could expect to face German ships of the same class that, by British standards of protection, were fast battleships.

By May 1907, the Imperial Navy Office concluded that the latest designs of foreign dreadnoughts, not only British but American and Japanese, would necessitate further increases in displacement and cost for the ships of the German programme of 1908–09. To meet this rise in expenditure, a new amendment was needed. With the public mobilised by the Navy League in favour of naval expansion and an expectation of majority support in the Reichstag, in September Tirpitz seized the opportunity 'to make hay while the political and military sun shines'. On 18 November 1907, a new bill was published which increased the tempo of dreadnought construction for the next four years (1908–09 to 1911–12) to three battleships and one battlecruiser per annum; though it would then reduce to one of each in later years. The cost ceilings for both types were also substantially increased. The *Novelle* was passed by the Reichstag in March 1908 with a substantial majority.[26] The first three battleships of the *Helgoland* class, laid down for 1908–09 under the new law, were the first German dreadnoughts with 12in guns but the six turrets, arranged as in the *Nassaus*, could only deliver a broadside of eight guns. Although the *Helgolands* still had reciprocating engines, they were designed for 20.5 knots, a performance that could only be obtained by an increase in displacement of almost 4,000 tons over the *Nassaus*; they also displaced nearly

[25] Herwig, pp. 44–5. Gröner I, pp. 53–4. *CAWFS 1906–21*, pp. 150–2. Staff, *1914–18*, pp. 3 and 5–6 and Burt, pp. 11–15.
[26] Seligmann *et al*. (eds.), pp. 164 and 226–31. Herwig, pp. 63–4.

3,000 tons more than HMS *Neptune* of the same year. In 1909–10, Germany began a fourth *Helgoland* and the first two ships of the *Kaiser* class; another three *Kaisers* followed in 1910–11 (Tables 1.5 and 1.6). The new class were the first German battleships driven by turbines, which gave them a design speed of 21 knots. They mounted ten 12in guns in three centre-line turrets, the after pair arranged for superfiring; the two amidships turrets were positioned *en échelon* as in *Von der Tann* allowing across-deck firing over 120° arcs. Their armour, with a maximum thickness of 13.8in, established a standard of protection that would never be matched by British dreadnought battleships but these advances required a further displacement increase of almost 2,000 tons. In the *König* class, of which the first three were built under the programme for 1911–12, all turrets were on the centre line, for the first time allowing the full main armament to fire without restriction on either broadside.

Germany laid down three battlecruisers in the three years 1908–11 (Tables 1.7 and 1.8). Like *Von der Tann*, they were all turbine-powered and they were protected almost as well as contemporary British battleships. They retained the 11in gun but mounted ten of them, the extra two in a superfiring turret aft; the two turrets amidships were *en échelon*, as in *Von der Tann* and the *Kaisers*. The last of the three, *Seydlitz*, was, at 26.5 knots, a knot faster than *Moltke* and *Goeben* and her armour more than an inch thicker. She was followed in 1911–12 by *Derfflinger*; she had similar protection and the same speed, but mounted eight 12in guns, all on the centre line. Like all German dreadnoughts, battleships and battlecruisers, these ships had continuous longitudinal torpedo bulkheads.[27]

In the four years 1902–06, Germany had laid down light cruisers at the rate (almost three per annum) authorised by the 1900 amendment. But, for 1906–07, perhaps because it was known that Britain had stopped building this type of vessel or because of the financial demands of Germany's dreadnoughts, the rate of construction was cut to an average of two per annum; this rate was then regularised by the 1908 amendment for the years up to 1916–17.[28] Although turbines had been tried in earlier classes, they were first fitted uniformly in the *Kolberg* class (1907–09); these ships, which were bigger than their predecessors, had twelve rather than ten 4.1in guns and a speed of 25.5 knots. The next class, the *Magdeburgs*, was delayed by the design of their new longitudinal frame system so that all four were not started until 1910–11. They were designed for 27 knots with, for the first time, mixed coal and oil firing. They carried the larger 50cm torpedo and were given a cut-down quarterdeck to serve as a mine deck with a capacity of 120 mines;[29] these features were repeated in

[27] Staff, *1914–18*, p. 7 *et seq*. Campbell, p. 20. [28] Seligmann *et al*. (eds.), pp. 75–7 and 233.
[29] *CAWFS 1906–21*, p. 159. Brown, *Grand Fleet*, pp. 70–1 for longitudinal framing.