17 The impact of the war on naval warfare

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From a naval point of view, the Russo-Japanese War was the most important campaign since the Napoleonic Wars, and had a marked influence, albeit brief, on the development of warfare at sea. Its greatest impact was obviously on the fleets of Russia and Japan. Whereas the former, the world's third largest, declined substantially after the war, the latter burgeoned into one of the world's mightiest. In addition, it was primarily the British Royal Navy, the leading naval force at that time, that showed great interest in the naval engagement of the war. The lessons learnt in the war played a significant role in the minor revolution in naval development and the subsequent naval race that took place among the powers, Britain and Germany in particular, in the decade before World War I.

The naval dimension had extreme importance in the Russo-Japanese War. Several years before its outbreak, both Japan and Russia concluded that domination of the seas in their vicinity would be crucial to any future conflict between them. As soon as the war began the two combatants vied fiercely for the control of the waters in the vicinity of Korea and Manchuria, knowing that it would determine the conflict. They were absolutely right. Other naval powers, however, expressed much interest in this naval struggle for other reasons. Both navies were equipped with numerous modern warships, and their unprecedented clash was supposed to yield invaluable information on naval tactics and construction, as well as on subsequent weapon development. For this purpose, they dispatched scores of observers who impatiently followed the great drama and sought to learn its lessons.

Since the Russo-Turkish War of 1877–8 and the battle of the Yalu River in 1894, the world had not witnessed any major naval engagement, and in this interval the warship had undergone tremendous evolution. Accordingly, avid observers had much to report on any naval engagement from the first day of the war. The drama reached its climax with the epic voyage of the Baltic Fleet and its ultimate demise at the battle of Tsushima. For many months before the battle the fleet drew the attention of the entire world. Not only were its position and objectives no secret, but also throughout the journey the press reported on its progress and predicaments. As in a Greek tragedy, the Russian armada slowly progressed toward its inevitable clash

with the entire Japanese fleet. In the aftermath of the battle the expectation of significant lessons was entirely fulfilled. The war served as an overture to the great naval battles of World War I, and the strategic circumstances at the outbreak of war even bring to mind the later fierce American–Japanese clash during the Pacific War (1941–5). In technology the naval campaign of the Russo-Japanese War signaled the end of an era in naval evolution, yet it served as a precursor for the weapons systems and tactics that major navies would adopt and the dilemmas they would face during the following 40 years.

The war and the fate of the battleship

The most immediate contribution of the war to naval warfare was its impact on the development and virtually the destiny of the battleship in the following decades. Following several radical developments, if not revolutions, in naval technology during the nineteenth century, the status of the capital ship, a large steel-built vessel protected by thick armor and armed with large guns, lay in doubt.[2] During the 1880s the leading navies held heated debates as to the role of this warship in the future naval arena. Some of them, notably the French group known as *La jeune école* and headed by Vice Admiral Théophile Aube, argued that the battleship was an outdated and expensive vessel that had lost its advantage in view of the technological developments of the time. In the future, asserted the adherents of that school, only relatively small and fast vessels such as the cruiser at most, and perhaps just the small torpedo boat, would be able to cope with the new threats such as the torpedo, rapid guns, and mines. Concerned by their inability to compete with the accelerated pace of expansion of the Royal Navy, other large fleets were drawn to this approach and began to equip themselves with small torpedo boats and destroyers (which were intended to combat torpedo boats) in ever growing numbers.[3]

Opposing this school were the proponents of the large battleship, arguing that it had not lost its hegemony. Prominent among them was the leading American naval historian and theorist Alfred Thayer Mahan. In two major works published in 1890–2, Mahan asserted that naval power was a key to international success and that whoever ruled the sea and seaborne commerce would win the war.[4] Mahan's views did not contain much that was new, but they sounded the bell at the right time and reinforced widespread tendencies that were already prevalent. His books won high acclaim from naval circles of all the powers, as well as from advocates of imperialist expansion, and were soon translated into German, following the personal initiative of Kaiser Wilhelm II, Russian, and Japanese. They marked the beginning of a 15-year period known today as the pre-modern age in the development of naval warfare (1890–1905). It was a brief but intensive spell, which ended abruptly soon after the Russo-Japanese War. It witnessed the introduction of smokeless gunpowder, armor-piercing shells,

and rapid-firing guns; significant improvements in torpedo engines that turned them into efficient weapons; and slight improvements in firing control that doubled the effective range of the big guns.

The most significant naval transformation in this short period, however, took place in the construction of the battleship itself. In 1889, a year prior to the publication of Mahan's first book, the keel of the first ship of the *Royal Sovereign* class was laid in Britain. Naval experts considered this class the first of a new type of battleship that would be labeled 17 years later as the Pre-Dreadnought. Compared with earlier battleships, it was characterized by a high turret in its prow that made it easier to withstand a high sea and facilitated sailing at higher speeds. In addition, the use of steel and nickel plates improved protection and saved weight. The outcome was a stronger ship that became the prototype for most battleships built throughout the world until the end of the Russo-Japanese War. The new battleship also marked the beginning of a renewed naval arms race in Europe, mainly between the Royal Navy and the French and Russian navies, with the Imperial German Navy trailing behind them. In view of the impressive build-up of French naval power in the early 1880s, Britain declared a "two-power standard" (in the 1889 Naval Defence Act) and adopted greater expansion programs, with the intention of being able to face any combination of two of the other largest fleets. For this purpose Britain appropriated large budgets that allowed the rapid construction of additional battleships, ending by late 1905 with an unmatched force of 47 Pre-Dreadnought battleships. They all shared a similar design and had a primary battery placed on two turrets, each with two barrels of the same caliber.[5]

On the eve of the Russo-Japanese War more than a hundred battleships of Pre-Dreadnought design were sailing the seas, flying the flags of nine navies.[6] The construction of these warships involved enormous expenditure, which placed a heavy burden on the defense budgets of their countries. This financial burden was accompanied by serious doubts, for both military and economic reasons. Without any naval battle since the onset of the Pre-Dreadnought age, and with the constant improvements in the quality of the torpedo, naval experts had strong reasons to question the ability of the ever growing battleship to cope with the new threats in the naval arena. Quite a few thought therefore that, like dinosaurs, they would become extinct at the first encounter with smaller, cheaper, and more efficient warships.

The emergence of the *Dreadnought*

Doubts about the use of the battleship in general, and its primary armament in particular, vanished altogether as a consequence of the battle of Tsushima. In the eyes of the major navies, the outcome of this battle confirmed Mahan's theses regarding the decisive importance of the battleship. At the same time, the battle left no doubt about the necessity for further improvements that would make the battleship more resistant and powerful. First and

foremost, the lessons of the naval engagements of the Russo-Japanese War concerned the armament of the battleship. Until 1905 the leading navies equipped their battleships with a primary and a secondary battery. The purpose of the primary battery was to engage primarily other battleships and it usually relied on four guns in two turrets, front and rear—usually 305-millimeter caliber (12 inches in bore diameter).[7] The secondary battery was intended for assisting the primary battery against capital ships, but also for engaging smaller warships, mostly torpedo boats and destroyers, and included scores of guns with calibers ranging between 76 and 152 millimeters (3–6 inches).[8]

Analyses of the battle of Tsushima emphasized the decisive, but not necessarily exclusive, importance of the primary battery in an engagement between battleships. In Tsushima, and even more so in the battle in the Yellow Sea nine months earlier, fire was opened at distances previously unknown.[9] The fact that only guns of large caliber were used in such a long-distance engagement had dramatic repercussions. First, the development of armor, in thickness and quality, made it possible only for guns of especially large caliber to cause any significant damage and even to sink battleships or armored cruisers; second, only ships with especially thick armor were able to withstand a hit by those guns. The logical outcome was evident. A well-protected battleship with eight or even a dozen big guns could be equivalent to two or even three existing Pre-Dreadnought battleships of the size of the Japanese flagship *Mikasa*.

One reason for the need for an efficient and drastic solution to the problem of firepower was the wide variety of firing systems that had been created over the years. This variety prevented the possibility of control and complicated the necessary uniformity.[10] The other reason was the availability of proper technology. The idea of arming a battleship with numerous big guns and stripping it of its secondary battery began to take form even prior to Tsushima. Already in 1903 the Royal Navy had conducted several successful experiments in long-range fire and improved fire control. The promising results induced experts such as Edward Harding to contend that additional improvement in fire control and fire rate of the heavy guns, in several years' time, might put engagement between battleships beyond the range of small caliber guns and would keep them at a distance even beyond the efficient range of torpedoes.[11]

The last but not least important reason for the need for a new type of battleship was economic. At the outbreak of the Russo-Japanese War the budget of the Royal Navy was double its budget 15 years earlier, bringing the burden on the empire to new limits.[12] Appointed as First Sea Lord in October 1904, Admiral John Fisher expressed his readiness for budget cuts. Actually, he had no intention of either reducing the fleet's firepower or overstraining its budget, but he was willing to decommission over 150 obsolete vessels. At the same time, he was aware of the necessity to provide high-quality replacements for the quantitative loss and to increase the fleet's

firepower against the rising German competition. Fisher had in fact voiced his readiness to cut the number of warships but not the firepower a few years earlier, but the reports that the British naval observers sent from East Asia left him no further room for doubt.[13]

In March 1905, two months before the battle of Tsushima, the Admiralty approved plans for a revolutionary all-big-gun battleship. It was to be armed with ten 305-millimeter (12-inch) guns, all capable of simultaneously aiming at a single target under a central firing control. The decision did not require the lessons of Tsushima, since already at the end of the battle in the Yellow Sea in August 1904 the senior British naval observer, Captain William Pakenham, composed an encomium to long-range fire. Stationed aboard the Japanese battleship *Asahi* throughout most of the war, Pakenham suggested it was possible to open fire at a distance of 20,000 meters (about 22,000 yards) and to consider a firing range of 10,000 meters as being at close quarters. In the following months other British naval observers added their support to this view and quoted the opinions of Japanese officers that heavy guns were much more efficient than medium guns at the long ranges that were expected in future naval battles. Pakenham himself wrote:

> the effect of the fire of every gun is so much less than that of the next larger size, that when 12-inch guns are firing, shots from 10-inch pass unnoticed, while, for all the respect they instill, 8-inch or 6-inch guns might then just as well be pea-shooters, and the 12 pr. [pounder guns] simply does not count.[14]

The reports of the British naval observers soon reached the Admiralty, and for years afterwards their conclusions were used in discussions within the Royal Navy regarding the absorption of new technologies.[15] In the fall of 1905 Fisher conducted a new gunnery exercise in which the firing ranges were from 4,500 to 6,300 meters (5,000 to 7,000 yards) instead of the 2,000 yards until then. The greater number of guns in the primary battery was not the only factor in the firepower of the battleship, and in the following years the Royal Navy sought also to increase the caliber of the guns and improve the firing control system. Within a few years it increased the caliber of the primary battery from 305 millimeters (12 inches) to 343 millimeters (13.5 inches), and in 1912 it ordered the first class to be armed with 381-millimeter (15-inch) guns. The Americans and the Japanese did not sit idly by, but armed their own new capital ships with 356-millimeter (14-inch) guns. Three decades later the gunnery race reached its peak, when the Imperial Japanese Navy armed a pair of battleships, the *Yamato* and her sister ship the *Musashi*, with 460-millimeter (18.1-inch) guns.

The conclusions derived from the battle of Tsushima supported greater reliance on big guns but did not entirely solve the issue of the secondary battery. Was it necessary at all? In 1905 some believed it was useless, and supported the construction of an all-big-gun ship without a secondary

battery. The idea of such a battleship had emerged before the war,[16] and even Fisher considered it earlier, but now the time was ripe.[17] From then on, British shipbuilders faithfully followed this conception, and eliminated completely the use of the secondary battery in their subsequent designs. It remained doubtful, however, to what extent the battle of Tsushima confirmed this idea. Mahan, for example, was among those who stated that the battle proved exactly the opposite. Except for certain decisive hits by the primary battery, he argued, the victory was due to the rain of shells from medium guns that, although they could not sink the ships, did cause critical damage to human life and equipment. British opponents of the all-big-gun ship also regarded the outcome of Tsushima as contradicting that concept. Admiral Edmund Fremantle, for example, believed that the firing distances in the battle in the Yellow Sea were an exception, and urged that the idea of avoiding close range was alien to British naval traditions.[18] The pressure was fruitful, gradually eroding the intention of having a battleship with virtually no secondary battery. From 1910 onward, new battleships were rearmed with a secondary battery.[19]

The thickness and the quality of the ship's armor became another important target for improvement in the wake of the battle of Tsushima. In the traditional duel between armor and armament, it seemed that the armor had the upper hand in the Russo-Japanese War. After the battle of Tsushima, for example, the Japanese counted about 40 hits by 305-millimeter gun shells to their ships, similar to the number of hits they inflicted on Russian ships.[20] Yet not a single Japanese battleship was sunk in this engagement. True, the Russian shells were of lesser power and some of them did not explode, but the main reason that no Japanese ship was sunk was the quality of British shipbuilding, the armor in particular. The Japanese ships were built to the finest metallurgical technology of the time, were well compartmented, and were designed in the sturdiest fashion so that their resistance to Russian shells was relatively high. Still, the Japanese gunnery too failed in most cases to breach the armor of its rival's battleships, even though it did cause extensive damage that effectively put the ships out of action, and often facilitated *coups de grace* delivered by torpedoes fired at close range.[21] These testimonies were unequivocal proof that thicker armor plating amidships, but also on the decks and around the turrets, could provide better defense against any type of shell, and ultimately might guarantee the battleship's survival.

The importance of speed for battleship action also gained significant support during the war. Admiral Tōgō Heihachirō's ability to execute his famous maneuvers at Tsushima, allowing him to move parallel with the Russian main force, was attributed to his ships' advantage of speed. By contrast, the lack of such an advantage in the Battle of the Yellow Sea prevented Tōgō from bridging the gap with its opponent, and, were it not for a lucky strike at the Russian flagship *Tsesarevich*, the battle would have been lost. British observers emphasized in their reports the speed factor and

saw it as second in importance only to firepower. They argued that greater speed would allow not only a quick entry into an effective firing range against enemy ships but also a quick exit from the danger range. It could also enable the battleship to avoid torpedo attacks and contact with submarines. Fisher himself used to say that speed "is armor," but the question was at what price.[22] Even a small increase in the speed of the battleship required bigger engines, bigger fuel tanks, and consequently heavier armor to protect them. In turn, they increased the weight of the ship and lowered its speed. Thus, the balance between thick armor and higher speed demanded vast resources in a period of budgetary cutbacks. Only a new propulsion system, the steam turbine, was able to break this vicious circle, but this technology had never been used to propel a warship on the scale of a capital ship. Its eventual utilization in the new British battleship soon after the war increased its speed drastically as compared with other naval vessels of similar displacement.[23]

Overall, the naval battles of the Russo-Japanese War confirmed the convictions of British supporters for a future all-big-gun battleship with stronger armor and higher speed. In October 1905, four months after the battle of Tsushima, the Royal Navy started constructing a battleship that included substantial improvements in armament, armor, and speed. The project was completed with great effort in exactly a year, and the new ship, named *Dreadnought*, was an immediate sensation. It was superior to any contemporary battleship in each of the three cardinal yardsticks for battleships. Its ten 305-millimeter guns constituted an unprecedented primary battery; it had an extremely thick armor plating of 280 millimeters (11 inches) under the water line; and its maximum speed was 39 kilometers an hour (21 knots), almost 4 kilometers an hour (2 knots) faster than its fastest competitor.[24] Until the *Dreadnought*, the 15-year period of rapid development of the battleship had witnessed a gradual improvement in all these features, but no ship could claim a significant improvement in all three at once. Hence, the *Dreadnought* was nothing short of a revolution, at least in the short evolution of the modern battleship. It was, however, a conceptual rather than a technological revolution, since by and large the technology already existed and the Admiralty merely required Fisher's forceful leadership to utilize it in concert.

Taking place after the decision to build the *Dreadnought*, the battle of Tsushima served as a catalyst for the construction, but not as its underlying cause. Paradoxically, with the launching of the *Dreadnought* the following year, all battleships that had taken part in the battle became outdated at one fell swoop, along, of course, with over 100 battleships of seven other navies. The Royal Navy, which had led naval technology throughout the nineteenth century, won a new edge, and forced other major fleets to reconsider their expansion programs. In this sense, British lessons learned from the Russo-Japanese War had a lingering effect on the construction of capital ships at least until the end of World War II. The *Dreadnought* itself soon became

a generic name for all new battleships with large numbers of heavy guns, and the enormous sums invested in the construction of the latest Pre-Dreadnought classes were virtually wasted.

The development of battleships did not end with the birth of the *Dreadnought*. By 1911 the Royal Navy completed ten new battleships of five consecutive classes, each bigger than its predecessor, and within five years from the completion of the *Dreadnought* it developed a second generation of battleships known as Super-Dreadnought. Every new class boasted a slight improvement in armament, armor, and speed, at a rate that astonished the naval experts. World War I accelerated the rapid evolution of the battleship and, during the 1930s, when the International Conferences on Naval Limitation lost their influence, the pace of development increased even further.

Together with the *Dreadnought*, the Russo-Japanese War was associated also with the birth of the battlecruiser. This mutation between the battleship and the cruiser was born in the fading pre-war debate over the fate of the battleship. Unlike the *Dreadnought*, however, it did not fit the new naval circumstances Britain faced after the war and proved less successful and more short-lived. The battlecruiser was entirely the brainchild of Fisher. Although his term as First Sea Lord coincided with the golden age of the battleship, he himself was an enthusiastic supporter of fast vessels, and envisioned the development of a new capital ship similar to the *Dreadnought* in firepower, but with much greater speed as a result of more powerful engines and thinner armor.[25] His vision was based on a pre-war scenario that emphasized defense of imperial trade routes and engagements against inferior Russian and French cruisers.[26] Fisher's new warship was supposed to be fast enough to avoid torpedo attacks and to use its heavy guns against enemy warships of any size. His vision did not alter much during the Russo-Japanese War. He believed that greater firing range and improved armor-piercing shells would ensure that the difference between the armament of the battleship and of the battlecruiser would prove insignificant. Moreover, Fisher estimated that a fleet composed of battlecruisers would be more economical and efficient than a fleet combining battleships and ordinary cruisers.[27] Consistent with this approach, he authorized in 1905 the first three British battlecruisers of the *Invincible* class, which were completed three years later.[28]

Nevertheless, the Russo-Japanese War was detrimental to the concept of the battlecruiser. More than anything, it was the change in Britain's naval adversaries that affected the destiny of this warship. As Russia ceased to be a genuine menace, and France became an ally, German naval aspirations and expansion programs suddenly seemed much more threatening than before. Concern with the nearby German threat required solid battleships rather than fast long-range cruisers. The rude awakening from Fisher's dream did not take long. The Royal Navy's original plan had been for only one battleship of the *Dreadnought* class and three battlecruisers of the *Invincible* class, but at the outbreak of World War I it had three times more

battleships than battlecruisers. Furthermore, as a result of the lessons of the Russo-Japanese War and the strong support for the *Dreadnought*, the *Invincible* class bore ultimately greater resemblance to a battleship than to a cruiser. During the construction of the *Dreadnought* Fisher fought against the widespread tendencies in the Royal Navy to prefer this warship over battlecruisers, but was unsuccessful. In this case, at least, his opponents proved right.[29]

Repercussions on the major fleets

For a few years after the Russo-Japanese War, the Royal Navy stood in an unprecedented position. With the demise of two of Russia's fleets, and with the emergence of the *Dreadnought* and the *Invincible* classes, it gained the both qualitative and quantitative lead it had not had during the previous two decades. Still, Britain followed the naval campaign off Manchuria closely not only for technological reasons.[30] The rapprochement with France, the world's second naval power, and notably the massive losses of the Russian navy, allowed Britain to reconsider the need for the costly two-power standard it had set since 1889. By late 1905, Britain maintained, in fact, a three-power standard in Europe![31]

The alliance with Japan signed in 1902, and subsequently the diminished Russian threat as a result of the war, allowed the Royal Navy to accelerate the process of replacing most of its outdated cruisers and gunboats, and concentrate its build-up on the German threat in the Atlantic.[32] The British choice of a lean, high-standard fleet rather than a multi-vessel one was sharply criticized at home.[33] Critics too pointed to the war and its lessons to prove that old vessels could be useful. In particular, they argued, the inability of Japan to stop assaults on its shipping lanes by Russian cruisers during the first half of the war proved that a limited number of British battlecruisers, however superb, were insufficient to defend the shipping lanes of the vast empire and locate enemy warships. Old cruisers, they further maintained, were better than no cruisers at all. Another warship that the war proved to be useful, in their eyes, was the slow gunboat that used to guard diplomatic missions in foreign ports. The sinking of the Russian-protected cruiser *Variag* and the gunship *Koreets* in Chemulpo at the outbreak of the war was an example of the risk such vessels faced, resulting in the British decision to reduce their presence. On the other hand, the assistance two British gunships provided during the riots in Shanghai in December 1905 demonstrated that the decision was appropriate perhaps in times of war, but in times of peace and for "police duties" in colonial ports there was still room even for such obsolete vessels.[34]

The minor revolution Fisher initiated was followed closely by the other major navies. With the completion of the *Dreadnought* they were forced to reconsider their plans and even to halt actual construction of their suddenly outdated battleships and large cruisers. The Imperial German Navy, under

the dynamic command of Admiral Alfred von Tirpitz, was the first to be affected. While starting its expansion program (the first *Flottengesetz*) in 1898, during the decade of 1904–14 it shot up meteorically from being the world's sixth largest navy to being second only to the Royal Navy. With the enthusiastic encouragement of the kaiser, it responded to the *Dreadnought* challenge with an interval of two years. Initially, the development of the *Dreadnought* was a significant blow, as Germany was forced to stop the construction of the new *Nassau* class for a year and to widen the Kiel Canal to allow the passage of larger warships.[35] German industrial capability, however, could face the challenge, and its accelerated pace of warship construction caused great concern (known as the "naval crisis") in Britain during 1908–9, but less in the Admiralty. In turn, Britain reacted by increasing its own naval allocations and accelerating naval construction while simultaneously proposing means to win the naval race.[36]

After the Russo-Japanese War Britain identified the Imperial German Navy as its main rival. In October 1906 Fisher acknowledged that Germany was the only plausible foe, and to deter it Britain should maintain a fleet double Germany's in power.[37] Fisher did all he could to maintain this lead by keeping control over the navy budgets. To this end he overstated the power of the German navy and emphasized only the shrinking gap between the two navies regarding the *Dreadnought*-class battleship, while disregarding the enormous surplus of Pre-Dreadnought ships at the disposal of the Royal Navy. Accordingly, the official announcement of the cancellation of the two-power standard was postponed until 1912, two years after the replacement of Fisher, when the standard was altered to an advantage of 60 percent in the number of *Dreadnought*-class battleships over those of Germany.[38]

In the naval race that began between the two navies, the British had a slight edge for constructing the first *Dreadnought* battleship, but they virtually lost the enormous advantage they had held in Pre-Dreadnought classes before the war.[39] The confrontation turned into a two-headed race between Britain and Germany because the battleship had become the pinnacle of technological capability, and only extremely wealthy nations could afford to finance its construction. By the time World War I broke out Germany had 15 *Dreadnought*-class battleships, only seven less than Britain.[40] Still, the inability of the German navy to compete with its British rival in both quantitative and qualitative terms in the first two years of the war pushed Germany into accelerated construction of submarines in an attempt to compromise the blockade and disrupt the Allies' supply lines.

After 1904, the French navy witnessed a rapid decline, notably in relative terms. With the conclusion of the Entente Cordiale, France literally abandoned the naval race with Britain and started appropriating a greater portion of its defense budget to the development of massive land forces to face the German menace.[41] With diminished allocations and changing priorities (starting partly in 1902), the French navy did not counteract aptly

the challenge set by the emergence of HMS *Dreadnought*.[42] This inability notwithstanding, in the aftermath of Tsushima, the French navy abandoned completely its attraction to the warfare of small vessels, and in 1909 became committed to a battleship navy.[43] This move was too late and indecisive. Within two years of the war, not only did the French navy lose its position as the world's second naval power, but its ships were increasingly regarded as obsolete.[44] The new runner-up was momentarily the US Navy. Completing the expansion program envisioned by President Theodore Roosevelt, the US Navy posed a challenge but not a genuine threat to the hegemony of the Royal Navy. Roosevelt wanted a stong navy that could deter and face any threat, and after the war he regarded the Japanese navy as the foremost likely opponent. While attempting to calm the tensions with Japan, he acted vigorously to obtain greater budgets for naval construction. In spite of Mahan's opposition, the navy entered the *Dreadnought* age aggressively, but without the full support of Congress. When Roosevelt left office in 1909, the US Navy remained with neither a close friend in the Oval Office nor an accepted policy, and it gradually lost it strength, one it would regain only after World War I.[45]

In terms of sheer size and motivation, the Russo-Japanese War most affected the Russians' naval power, the world's third largest force before the war. It marked its eclipse, dropping to sixth place and virtual marginality. The Imperial Japanese Navy was affected less adversely, and retained the fifth place it held before the war.[46] In absolute terms, however, the Japanese navy increased its size substantially by incorporating several Russian battleships, and newly built capital ships, whereas the Russian navy was the only naval force among the powers that dwindled considerably. Moreover, the Russian navy not only lost a great part of its able officer cadre but also the remnants of its credibility faded with the decision makers in St Petersburg. The Japanese navy, by contrast, gained much combat experience and self-confidence, which affected its ambitions overseas and its conduct in subsequent interservice competition at home.[47]

For the Russian navy, indeed, the war was a total disaster. It lost about two-thirds of its capital ships, but also much of its fighting spirit and self-confidence.[48] Thereafter, it experienced a continuous decline that reached its nadir in the 1920s. In the intervening years naval officers who returned from Japanese captivity underwent a series of interrogations and court-martials, and until 1907 the Duma objected to granting the navy any construction budgets. It was only five years after the war that the Russian navy began building battleships again, and two more years passed until its construction budget showed any significant shift upward. After the war the Russian naval presence in the Pacific Ocean became symbolic, and the Baltic Fleet began its reorganization only a few years before World War I, although as a combat unit it never regained its former strength. The Black Sea Fleet was the only naval force to remain intact, and during World War I it played an inglorious role in the war against Turkish and German forces. Another

factor in the decline of the Russian navy was the revolutionary activity among its men. During the revolution of 1905 the navy had become an ideological hotbed, manifested in local mutinies, the most famous of them being the mutiny aboard the battleship *Kniaz Potemkin Tavritcheskii*. This radical activity did not cease even after the Bolshevik Revolution, and in March 1921 it culminated in a large-scale mutiny at the naval base of Kronstadt. The suppression of the mutiny and the execution of thousands of navy personnel caused serious damage to the navy as a whole and the Baltic Fleet in particular, resulting in a lingering distrust and limited allocations for many years to come. After 1921, the Soviet navy entered into an extended period of relative paralysis and decline, from which it re-emerged as a considerable naval power only in the 1960s and 1970s.[49]

For the Japanese navy, the experience of the war had a conspicuous effect in four spheres that lingered until its disbanding in 1945. These were the view of the decisive naval battle as a single engagement determined by large capital ships armed with heavy guns; the preference for high-quality ships and armament over quantity; the emphasis on night torpedo strikes; and the concept of a war of attrition against an enemy with numerical advantage.[50] The perception of a huge decisive naval battle was undoubtedly the main legacy from the battle of Tsushima. Thereafter, all naval plans for war against a future enemy, the US Navy in particular, anticipated a decisive battle near the shores of Japan. According to this conception, one large engagement such as the battle of Tsushima could determine the naval campaign, but also the entire war. Even in December 1941, on the eve of the attack on Pearl Harbor, large surface battles still held a central place in the strategic plans of the Japanese navy and its construction plans. The attack on Pearl Harbor was not a refutation of this view, but a gamble intended to realize it. Anticipating American recovery and the regrouping of its naval forces, the principal Japanese scenario for the Pacific War foresaw a decisive naval battle that would lead to the final victory.[51]

The impact on the development of naval weaponry

The insights and experience of the Russo-Japanese War led to further technological development in virtually every naval weapon, such as the gun, the torpedo, and the naval mine. The impact of this development on naval warfare was felt throughout the first half of the twentieth century. The first field in which significant innovations were made was naval artillery. Despite the relatively short fire range of the primary battery in the battle of Tsushima, the accuracy rate of both belligerents remained low—less than 10 percent, and probably far less.[52] Moreover, the need to keep battleships out of range of medium- or small-caliber guns resulted in the increased use of long-range fire, hence even lower accuracy. The deficiencies of naval artillery revealed at Tsushima called for urgent improvements. In the next decade all major navies made considerable efforts to improve fire control. Still in the lead,

the Royal Navy had begun to put greater emphasis on naval artillery before the turn of the century, but in the post-war years it made a special effort in this realm. Improvements in fire control kept the heavy guns as the main naval weapon and led to a rapid increase in the effective fire range and weight of the shell.[53]

As a promising naval weapon, the torpedo was perhaps the greatest technological disappointment of the war, due to its very low accuracy.[54] Nonetheless, the fear of an enemy using torpedoes shaped to some extent the style of combat on both sides. They avoided approaching each other and were afraid of night warfare, in which small torpedo boats could gain the upper hand. Other navies did not underestimate the torpedo, and, despite its limited effectiveness in the war, the pre-war momentum of its development was not checked. An ardent advocate of torpedo use, Fisher regarded it as a weapon of the future. In May 1904 he received a report about another technical improvement that increased the range of the torpedo to about 2,700 meters (about 3,000 yards). With such progress it was obvious that in a short time the range of the torpedo could be longer than the effective range of gunfire from the ships against which it was to be launched. Fisher's forecast was correct, and was realized probably sooner than he imagined. Within a decade the torpedo range, which stood at about 4,000 meters (about 4,400 yards) in 1905, increased to about 10,000 meters (about 11,000 yards), while its speed more than doubled.[55] Ten years later the torpedo emerged as a reliable weapon, and during World War I it proved to be relatively accurate, especially when launched at close range from submarines.[56]

Another naval weapon that made its virtual debut in the Russo-Japanese War was the naval mine. Mines were used unsuccessfully against warships as early as the seventeenth century, but the spring of 1904 marked the beginning of massive use of this inexpensive and unsophisticated weapon, which was nevertheless far more efficient than the torpedo. Both sides used mines extensively, and both lacked suitable means to counter them. In those circumstances their effect was highly destructive. Mining of the coastal area off Port Arthur caused the sinking of three battleships, five cruisers, and three destroyers, and the loss of thousands of crewmen on both sides.[57] All the Japanese capital ships lost in the war were sunk by mines. Critically, mines had strategic significance as evident from the sinking of the two Japanese battleships *Hatsuse* and *Yashima*—a third of Japan's battleships—in one day. For Russia, mines had even greater repercussions because of the loss of the charismatic commander of the Pacific Fleet, Vice Admiral Stepan Makarov, aboard the battleship *Petropavlovsk*. His death due to a mine hit brought the Russian naval initiative to a halt, and condemned the Port Arthur squadron to a slow death in the harbor.

In the aftermath of the war the naval powers recognized the threat of the mine and attempted to ban its use at the Hague Convention of 1907. Rather than being atrocious it was simply a novel weapon, and the world, to paraphrase Basil Henry Liddell Hart's view on the introduction of chlorine gas

in warfare a decade later, condones abuses but abhors novelty.[58] Eventually, the mine's murderous effectiveness kept it operational, and instead of banning it all major navies endeavored to develop minesweepers to locate and neutralize it.[59] It comes as no surprise that the Russian navy was the first to recognize this need, and in 1910 it built a vessel intended specifically for minesweeping. Initially, the Royal Navy did not regard the mine as a valid weapon, but due to Fisher's strong impressions of its effect in the war it was finally included in the war plans of 1913 with the support of the First Lord of the Admiralty, Winston Churchill.[60] During World War I, mines continued to be the primary means of sinking warships, as the German navy demonstrated with the sinking of the British battleship *Odysseus* at the onset of hostilities.[61]

The epic voyage of the Baltic Fleet, and the inconvenient use of coal in particular, provided much food for thought in the field of logistics. Compared with the lengthy and precious time it required to coal ships at sea, oil seemed promising. Fueling with it was relatively quick and could be done in motion. Eventually, it was the success in obtaining reliable sources of oil in the years after the war, rather than the ordeal of the Baltic Fleet, that spurred a gradual shift to using it for military purposes. In 1909 the Royal Navy decided that all its future destroyers would be powered by oil, and within three years this decision was implemented also in regard to the new class of battleships, the *Queen Elizabeth*.[62] The transition to the use of oil by the major navies was also associated with the development of naval diesel engines, but nonetheless the ability to utilize this relatively new source of energy was more geopolitical than technical.[63] European powers went in quest of it to distant locations such as the Middle East and the Persian Gulf, and so began a bitter struggle for influence over those areas that has never ceased since. Similarly, the Russo-Japanese War did not result in the construction of auxiliary and coaling ships specifically built for supply and refueling. For the British the logistic constraints that hampered the Russian navy were less problematic, since Britain controlled many ports along the main routes of its empire. Eventually, only the vast and continuous needs of World War I speeded up the development and the use of special navy ships for these purposes.[64]

The war and the advent of a true naval revolution

While heralding a new age in the development of the battleship, the Russo-Japanese War missed out on the submarine and the airplane, the two most crucial developments in naval warfare in the twentieth century. Their absence does not necessarily mean that the war did not assist in promoting their development. On the contrary, operational requirements during the war increased awareness of these new technologies and the pressure to further develop them for full operational use.

The submarine missed the war by several months. In late 1904 both belligerents had submarines, but they did not regard them as ready for operational deployment. By the end of the war the Russian navy transferred 14 small submarines to Vladivostok by means of the Trans-Siberian Railway, too late for any effective use. All the major navies shared their distrust of the submarine, even though it had a relatively long history. Beginning with David Bushnell's famous *Turtle*, which failed to sink a British warship during the American War of Independence, the subsequent century witnessed numerous attempts to construct submarines for military purposes.[65] Significant steps toward this objective were made only in the last decade of the nineteenth century. In 1892 a submarine was armed for the first time with a tube for launching torpedoes, and six years later this new weapon was launched successfully under water.[66] The Royal Navy began the construction of submarines in 1901, and a year later the Russian navy followed suit.[67] By the outbreak of the Russo-Japanese War all the large navies except the German had acquired submarines. Nevertheless, in 1904 all still defined the submarine as an experimental vessel and did not put it into operational use.[68]

The difficulties the Japanese navy faced in sinking the Russian warships hiding in the safe haven of Port Arthur aroused special interest in submarines. Believing a submarine could penetrate the port and sink the Russian ships, Fisher began to view it as a plausible offensive weapon. Two months after the war broke out, he wrote to a friend: "my beloved submarines . . . are not only going to increase the naval power of England seven times more than present . . . but they are going to bring the income tax down."[69] A month later he referred to the submarine in a longer letter, lamenting its absence in the fleets of the two belligerents. This time Fisher proved almost prophetic, stating that submarines on offensive missions would revolutionize the war at sea.[70]

On January 24, 1905, three weeks after the fall of Port Arthur, Fisher sent Prime Minister Arthur Balfour two "rough papers" (entitled "Submarines Used Defensively" and "Submarines Used Offensively"), in which he formulated his concept of "flotilla defense."[71] Fisher proposed to abandon the traditional dependence on battleships for deterrence and defense of the British Isles, and rely instead on the flotilla, that is destroyers and submarines, which can also be used offensively in the Channel and the Mediterranean. This vision of the submarine faced great opposition at the Admiralty, but Fisher's foresight was realized within a decade. Unfortunately, in his case, it was grasped by Britain's arch rival, the German navy. Fisher, however, was reacting to, rather than causing, a change. While the war provided him with the strategic insights, certain technological improvements at the same time enabled the submarine to play the role it was intended to. During the war the French navy, followed by the Royal Navy, developed diesel engines that replaced gasoline engines for surface power, and in 1908 the Royal Navy completed the first submarine that could sail

relatively long distances.[72] Fisher's vision of the submarine, however, won firm opposition, and after his retirement, and more so between 1912 and 1914, the production of submarines for operational purposes in Britain was reduced to a trickle.[73] The first submarines were used for intelligence gathering and for assault on merchant shipping, but with further development of the torpedo they soon emerged as an efficient weapon against warships as well. In 1912 a Greek submarine conducted an instructive demonstration of the submarine's offensive capacity when it attacked a Turkish cruiser with torpedoes. It missed its target, but during the first months of World War I German submarines did sink a number of capital ships, thereby displaying painfully the extent to which this vessel had advanced since the Russo-Japanese War.[74]

The airplane was totally absent from naval use in 1904–5, for the simple reason that the first flight of a powered machine took place less than two months before the outbreak of the war.[75] The Russo-Japanese War was the first military conflict after the pioneering flight of the Wright brothers, and it demonstrated the necessity of adopting such a technology for military use. On land, improvements in artillery range required means to locate enemy positions. Both the Russians and the Japanese solved the problem by flying balloons tied to the ground for lookout purposes. In the naval arena too, gunnery range had more than doubled compared with previous wars, but both sides continued to depend on observation posts on ships. Two years after the war the Wright brothers approached the Royal Navy with an offer to sell them a plane. The British rejected the offer, but the US Navy showed some interest in the new technology. By late 1910, the Americans had taken the lead in the development of the airplane for military use, as Eugene Ely took off from an inclined platform on the deck of the cruiser *Birmingham*; in a subsequent exercise two months later he landed on similar platform at sea.[76] Another direction in the development of naval aviation in the decade after the Russo-Japanese War was the transformation of merchant ships into mother ships for amphibious seaplanes. During the two years that preceded World War I the French, the British, and the Japanese began to make use of such airplanes for scouting and naval assault, and in September 1914 Japanese amphibian airplanes executed the first ground assault from the sea as they bombed the German base in Tsingtao, China.[77] In the following decade the specifically designed aircraft carrier emerged, to begin its long evolution via Taranto, Pearl Harbor, and Midway until it wholly succeeded the battleship as the centerpiece of the fleets of the foremost naval powers.

Conclusions

Twelve years after the Russo-Japanese War the submarine became an effective weapon of strategic value, although the battleship with its multiple heavy guns still epitomized naval power. Three decades later there was no

longer any doubt that the battleship had become an anachronism. German U-boats in the Atlantic Ocean almost choked Britain, and airplanes taking off from Japanese carriers struck at American battleships in Pearl Harbor and sank in minutes the imposing British battleship *Prince of Wales* and its battlecruiser consort *Repulse* on their way to Singapore. The lessons of the naval campaign during the Russo-Japanese War gave no inkling of that outcome, nor a model for future naval engagements. Instead, it served as a catalyst for developing ever larger capital ships. The example of the battle of Tsushima did not recur, however. The battle of Jutland in 1916 was momentous and demonstrated the ultimate failure of Tirpitz's strategic concept, but in terms of losses it was far from decisive. Without a dramatic climax, World War I was characterized, especially after Jutland, by a long war of attrition and a struggle over supply routes, where the submarines, destroyers, and even Q-ships enjoyed unprecedented importance.[78]

Although the Royal Navy under the command of the charismatic and visionary Admiral Fisher seemed to draw the most forthright conclusions from the Russo-Japanese War, it was these conclusions that contained the seeds of its downfall. In the short run, the war intensified the need for a revolutionary battleship, and the Royal Navy was able to apply the data its observers faithfully gathered and construct a ship of unmatched quality. Mahan, however, was aware of the risks inherent in too simplistic conclusions regarding the war. A year after the battle of Tsushima he argued against concentrating the resources of a navy around a small number of warships of massive power, and warned that the construction of ships of ever increasing size would be financially destructive.[79]

Initially, the *Dreadnought* yielded a significant advantage for the Royal Navy over its German rival; but it sparked a naval race that forced Fisher to allocate much of his resources to the construction of ever bigger capital ships. Other navies that were less aware of the lessons of the war, or unable to compete with the British, devoted a more significant portion of their budgets to more revolutionary solutions, such as the submarine and subsequently the aircraft carrier. Within a decade after the Russo-Japanese War Germany began to depend on submarines, and a decade later still, the American and Japanese navies started constructing modern aircraft carriers, which were to transform warfare at sea. The Russo-Japanese War preceded the onset of this new era by a few years. It nonetheless marked the sudden death of the pre-modern stage and served as a preface to a brief but fascinating period in which the modern battleship ruled the waves.

Notes

1 The author thanks Cord Eberspaecher, Felix Brenner, and Yigal Sheffy for their insightful comments on early drafts of this chapter.

2 These revolutions included the introduction of the steam engine, the screw propeller, armor, shell guns, and rifle ordnance. See Hobson, 2002: 24–57.

3 On the French school, see Bueb, 1971; Ropp, 1987: 155–80; and Walser, 1992: 58–90, 180–200. On the German attraction to the French school during the 1880s, see Lambi, 1984: 7–9.
4 See Mahan, 1890, 1892. On Mahan's influence on naval thought at the end of the nineteenth century, see Gough, 1988; and St John, 1971. Mahan's dictum was echoed, for example, in two speeches Kaiser Wilhelm II delivered in 1895 before members of the *Reichstag* and officers of the Prussian Royal Military Academy. See Lambi, 1984: 34.
5 On the European naval race in the 1880–90s, see Kennedy, 1983: 165–71.
6 During this 15-year period, other European navies also built a large number of battleships with similar features. France had twenty battleships of the first line, Germany twenty-five, Italy nine, Austria three, and Spain one. On the other side of the Atlantic the US Navy had twenty-four ships of five different classes before the end of the Russo-Japanese War; Russia and Japan also joined this exclusive club. The Imperial Russian Navy began building a Pre-Dreadnought battleship in 1892 and completed the construction of twenty ships during this period. The Imperial Japanese Navy ordered two of its first battleships from Britain based on the *Royal Sovereign* class in 1893, and three years later another four based on the *Majestic* class. See George, 1998: 78; and Neudeck and Schröder, 1904.
7 The caliber of the main battery ranged between 280 and 343 millimeters (11–13.5 inches), although 305-millimeter (12-inch) caliber was nearly the standard for most of the Pre-Dreadnought classes.
8 Completed in Britain in 1902, the Japanese flagship *Mikasa*, for example, was armed with four 305-millimeter (12-inch) guns, fourteen 152-millimeter (6-inch) guns, and twenty 76.2-millimeter (3-inch) guns.
9 The range for opening fire at the battle of Tsushima was approximately 6,400 meters (about 7,000 yards).
10 For example, *King Edward the Seventh*, the last class of battleship constructed in Britain before the war, was armed with four 305-millimeter (12-inch) guns, four 234-millimeter (9.2-inch) guns, and ten 152 millimeter (6-inch) guns.
11 On the British experiments in long-range fire, see Marder, 1961: 35.
12 On the governmental pressures to cut naval budgets in Britain, see Fairbanks, 1991: 262.
13 On Fisher's decision, see Grove, 1995: 47.
14 Cited in Marder, 1940: 531.
15 The observers' reports served as a reference for Corbett's classified book on the naval campaign during the Russo-Japanese War. See Corbett and Slade, 1914. Fisher himself mentioned Pakenham's report in a letter to Edward Grey in 1908; in Marder, 1956: 156.
16 In an article published in *Jane's Fighting Ships* in 1903 entitled "An Ideal Battleship for the British Fleet," the chief constructor of the Royal Italian Navy, Vittorio Emanuel Cuniberti, proposed a battleship of 17,000 tons armed with a dozen 305-millimeter (12-inch) guns and entirely without a secondary battery. In 1904 it was announced that the US Navy was planning a battleship (the *South Carolina* class) with eight 12-inch guns. On Cuniberti's article, see George, 1998: 91.
17 Fisher himself stated years later that the idea of a ship with guns of uniform caliber had been on his mind as far back as 1900 in Malta in a discussion with the chief engineer of the Royal Navy. Some attribute the idea of a battleship based on a primary battery alone to a conversation Fisher held as early as 1882. See, for example, Houge, 1964: 15–16.
18 Admiral Fremantle is quoted in Towle, 1977: 69.

19 Completed in Britain in 1910, the *Orion* class was armed with sixteen 102-millimeter (4-inch) guns, and five years later the *Queen Elizabeth* class was armed with a dozen 152-millimeter (6-inch) guns.
20 The number of hits suffered by Japanese ships should come as no surprise since the Russians had 41 guns of 254-millimeter (10-inch) and larger caliber, compared with only 17 guns of similar caliber on the Japanese side.
21 On the invulnerability of Russian battleship armor in Tsushima, see Evans and Peattie, 1997: 125.
22 Fisher's view on speed is quoted in Marder, 1961: 59.
23 For the discussion on the importance of speed in the Royal Navy, see Towle, 1977: 72–3.
24 For the *Dreadnought*'s specifications, see Parkes, 1990: 447.
25 On Fisher's support of the battlecruiser, see Sumida, 1993: 37–61.
26 For Fisher's warning against a Russo-French combined threat and surprise attack on Malta and Egypt during 1900–1, see Chapman, 2004.
27 Fisher's attraction to the battlecruiser concept is relevant to a current thesis suggesting that, when he was appointed First Sea Lord in 1904, he was not concerned with the German navy. Most elements of his reform plan, this thesis holds, emerged when France and Russia were still perceived as the major threat to Britain and even later on his early plans did not alter much. Fisher's persistence in viewing the battlecruiser as a main element in any future struggle was therefore related to identifying Britain's chief adversaries. See, for example, Lambert, 1999; 2001a: 70–2.
28 Having 96 percent of the displacement of the *Dreadnought*, the *Invincible* class was armed with eight 305-millimeter (12-inch) guns, and enjoyed an exceptionally long operational range and an unprecedented speed of 50 kilometers per hour (27 knots). These performances were obtained at the cost of having one turret less than the *Dreadnought*, and armor whose maximum thickness was only 152 millimeters (6 inches), half that of the *Dreadnought*.
29 Other navies did not overlook the gamble involved in the investment in this type of warship. Until World War I only three navies (of Britain, Germany, and Japan) were equipped with battlecruisers. Fear of the battlecruiser's inability to face battleships was confirmed a decade later in the battle of Jutland (1916) when the Royal Navy lost three battlecruisers and only one battleship, even though most of the warships in that clash were battleships.
30 On Fisher's interest in the war, see Mackay, 1973: 307.
31 In terms of battleships, for example, Britain had 47, whereas Germany had 17, France 18, and Russia 5. (O'Brien mentions 46 battleships.) In O'Brien, 1998: 31.
32 Following Fisher's decision, 90 obsolete and small ships were sold off and a further 64 were put into reserve.
33 Oblivious to Fisher's intentions, some of the British observers, Captain Pakenham in particular, emphasized the role of older vessels and the need to preserve them, thereby providing ammunition for Fisher's critics. Fisher, however, considered these reports to support his idea of an all-big-gun ship on which he was working at the time. See Towle, 1977: 74–5.
34 On the debate over the size of the Royal Navy during and following the war, see Towle, 1977: 75–7.
35 On the effects of the war and the *Dreadnought* revolution on the German navy, see Herwig, 1980: 33–68, 1991; Steltzer, 1989: 238–55; Weir, 1992; and Woodward, 1935: 100–20.
36 On the naval crisis in Britain in 1908–9, see O'Brien, 1998: 33–44, 73–97.
37 Fisher's position on the German fleet is presented in Herwig, 1980: 50.

38 On the change of standard in the Royal Navy, see Marder, 1961: 182–3; and O'Brien, 1998: 25–46.
39 On the British–German naval race after the war, see Goldrick, 1995.
40 On the eve of World War I, France had ten *Dreadnoughts* (as well as 21 Pre-Dreadnoughts), Italy had three (15), Austro-Hungary had six (6), Russia had four (11), Japan had two (8), and the United States had ten (25). In George, 1998: 99; Hough, 1998: 55.
41 Whereas the French defense expenditure reduced slightly in 1905, its army expenditure increased. For the French defense expenditures in the early twentieth century, see Stevenson, 1996: 4; and Herrmann, 1996: 237.
42 On the reasons for the French technological inferiority, and the failure of the *Danton* class in particular, in the naval race of 1906, see Halpern, 2001: 45–6; and Walser, 1992: 141–8.
43 On the commitment for battleships in the French navy after Tsushima, see Halpern, 2001: 46–7.
44 On the British estimation of French naval power in 1909, see O'Brien, 1998: 31–2.
45 On the post-war state of the US Navy, see O'Brien, 1998: 62–7.
46 In 1900 the Japanese navy was in sixth place, and rose to fifth place for a few years before the war. It returned to sixth place during the war, and for the five years that followed it went up to fifth place. For the relative naval standing before, during, and after the war, see Evans and Peattie, 1997: 147.
47 On the growing role of the navy in Japanese politics after the war, see Masuda, 1982; Schencking, 2002, 2005.
48 During the war the Russian navy lost a total of 18 battleships (11 first-line and 7 second-line), 5 armored cruisers, 4 gunboats, and approximately 20 destroyers. See Mitchell, 1974: 269.
49 On the evolution of the Russian navy until World War I, see Mitchell, 1974: 267–82.
50 Evans, 2001: 28–33; Evans and Peattie, 1997: 129.
51 See, for example, Admiral Nagumo Chūichi's statement three weeks before the attack on Pearl Harbor. In Ike, 1967: 247.
52 For data on the accuracy rate, see Evans and Peattie, 1997: 125.
53 By 1904 the Royal Navy had developed the first targeting device. It also unified the fire from all the gun turrets by remote control using analogous computing machines to align the position of the ship with the target. On the improvement in gunnery systems, see Padfield, 1972: 183–5; Sumida, 1993: chs 3–5.
54 On the Japanese side, for example, about 370 torpedoes were fired, but only 17 hit the target (a success rate of about 4 percent). See Marder, 1961: 329. For reports on even lower success rates (about 2 percent), see Gray, 1975: 175; Lambert, 2001a: 74. Experts did not attach much value to the partial success of the Japanese torpedo attack in Port Arthur at the outbreak of the war since it was conducted at very close range and against stationary targets with no defense.
55 The speed of the torpedo increased from 35 kilometers per hour (19 knots) when launched at the maximum distance, to 83 kilometers per hour (45 knots) for almost double that distance.
56 For the evolution of torpedo range and speed, see Marder, 1961: 329.
57 For details of the losses both belligerents suffered, see Corbett, 1914, II: 446.
58 Liddell Hart, 1972: 145.
59 On the development of minesweepers before World War I (1914), see George, 1998: 230.

60 On the attitude of the Royal Navy to the mine before World War I, see Marder, 1961: 328–9.
61 During World War I both sides laid about 240,000 mines, resulting in the sinking of 216 warships and hundreds of merchant ships. See Hartmann and Truver, 1991: 15.
62 The need for new energy resources in the Royal Navy became evident in 1912 with the appointment of Fisher as chairman of a royal committee reviewing the possibility of supplying oil to the fleet. See Churchill, 1923: 137–8.
63 Toward World War I the German navy also began to use oil as a secondary fuel for its larger ships. It still relied on coal, however, for the fear of shortage of a stable supply of oil, as well as the assumption that the ship's coal storages served as additional shielding against torpedoes, particularly below the water level. See Epkenhans, 2001: 61–2.
64 On the development of supply ships in the twentieth century, see Wildenberg, 1996.
65 For the early history of submarines, see Compton-Hall, 1983; Middleton, 1976: ch. 1; Roland, 1978.
66 For the introduction of submarines into the Royal Navy, see Lambert, 1999: 38–72; Preston, 2001: 24–43.
67 On submarines in the Imperial Russian Navy, see Lambert, 1992: 148–9; Spassky, 1998.
68 On the Russian use of submarines during the Russo-Japanese War, see Mitchell, 1974: 233.
69 In a letter to Arnold While, March 12, 1904. In Marder, 1952: 305.
70 In a letter of April 20, 1904. In Marder, 1952: 308–9.
71 Add. Mss 49710, reprinted in Lambert, 2001b: 109–12.
72 On the impact of the war on the advocates of the submarine within the French navy, see Walser, 1992: 136.
73 Lambert, 1999: 234.
74 On September 22, 1914, the German submarine U-9 sank in less than an hour three British armored cruisers: HMS *Aboukir*, *Hogue*, and *Cressy*. During the entire war, Germany built 332 submarines. In George, 1998: 159.
75 The Wright brothers are usually credited with the first controllable, powered, heavier-than-air flight, which took place in Kitty Hawk, North Carolina, on December 17, 1903.
76 On the early development of ships as airplane carriers, see Humble, 1982: 6–11; Layman, 1989; Preston, 1979: 6–11; and Robbins, 2001: 11–67.
77 A year earlier it had again been the small Greek navy that had opened a stage in the new era when one of its airplanes dropped four bombs on a Turkish battleship during the Second Balkan War of 1913.
78 The last recorded incident of a battleship sinking another battleship took place on October 25, 1944 when the USN *Mississippi* hit the IJN *Yamashiro* with a salvo at 18,000 meters. Half a year later the world's largest battleship *Yamato* was also sunk by multiple hits of bombs and torpedoes dropped by about 380 airplanes.
79 Mahan, 1906: 142. See also Seager, 1977: 525–7.