RUSSIA'S CIRCULAR IRONCLADS: THE *POPOVKAS*

The circular ironclads *Novgorod* and *Vitse-admiral Popov* are probably the Russian ships best known to westerners, and have often been used to illustrate the foolishness – or outright incompetence – of Russian naval authorities. In this article **Stephen McLaughlin** takes a fresh look at these peculiar vessels.

Under the terms of the Treaty of Paris which ended the Crimean War (1854-56), Russia was allowed to have only six 800-ton corvettes in the Black Sea.[1] The General-Admiral of the Navy, the Grand Duke Konstantin Nikolaevich, an energetic and forward-looking leader, was naturally unhappy about this limitation, and in 1862 some attempts were made to design a vessel with 4.5in (114mm) armour on this tonnage, but it was soon realised that it would be impossible to combine thick armour, heavy guns and good sea-going qualities in a ship of such small size.

The next approach to the problem came in 1863, when the war minister, General D.A. Miliutin, wrote a 'very secret' memo to the director of the Naval Ministry, Admiral N.K. Krabbe, in which it was proposed that armoured self-propelled batteries be built to defend the Kerch Strait.[2] This narrow channel was the entrance to the Sea of Azov, where British naval raiding forces had wreaked a good deal of havoc during the Crimean War. Miliutin believed that by building strictly defensive craft, lacking any sea-going potential, Russia could avoid accusations of violating the Treaty of Paris. In August Krabbe had the Shipbuilding Technical Committee (*Korablestroitel'nyi tekhnicheskii komitet*, or KTK) investigate such batteries. The resulting design was apparently the work of naval constructor S.I. Cherniavskii. It showed a simple wooden-hulled ironclad with a shallow draught and a very low freeboard (10in/254mm); dimensions were 160ft x 42ft x 8ft 10in full load (48.8m x 12.8m x 2.7m).[3] It was armed with four guns (possibly 60pdr smoothbores or 8in rifles) housed in a rectangular casemate, which would also have rifle loop-holes. Armour over the hull and casemate was to be 4.5in (114mm), and the twin-shaft machinery would provide a speed of 5 knots. Although Emperor Aleksandr II approved the further development of this proposal in September, it seems to have been something of a dead-end.

By early 1864 attention had switched to building monitors of the *Uragan* class.[4] Because there was virtually no industrial base in southern Russia, it was assumed that the materials for the vessels would have to be manufactured at some distant place and transported to a shipyard where they would be assembled. This presented difficulties insofar as the railway network in south Russia was still undeveloped; however, Russia's vast inland waterways offered an alternative means of moving bulky materials. Captain-Lieutenant A.I. Fëdorov was sent to scout out potential building sites; having previously supervised the prefabrication of the monitors *Koldun* and *Veshchun* in Belgium, he was well acquainted with the sort of process that would be needed to build similar ironclads for the Black Sea. After travelling extensively throughout south Russia, he presented his report in November 1864. His conclusion was that by using the existing industrial and transportation network it would be possible to have the Votkinskii Iron Works (today the city of Votkinsk) fabricate the parts for monitors, then transport the materials down the river system for assembly at an existing boatyard at Kalach-na-Donu; the completed monitors could then travel down the Don River to the Sea of Azov. If the vessels were ordered in January 1865, Fëdorov believed that the first would be ready for launching in summer of 1866, and the second by the autumn of 1866 or the spring of 1867.

The commander of the Port of Nikolaev, Vice-Admiral B.A. Glazenap, now chimed in, arguing that ironclads were needed not only to defend the Kerch Strait, but the Dnepr-Bug estuary as well, and that no fewer than twenty-one *Uragan*-class monitors were therefore required. Better still in his opinion would be the construction of casemate batteries, since he believed that such vessels would be smaller and better protected than the monitors, as well as healthier for their crews in the warm climate of southern Russia; five would be needed for the Kerch Strait and three for the Dnepr-Bug estuary. Such purely defensive vessels, he argued, would not cause protests based on the Treaty of Paris; moreover, if they stayed within the Sea of Azov and the river system without actually entering the Black Sea, they might not be regarded as subject to the restrictions of the Paris treaty at all. As a result of Glazenap's proposal, in March 1865 the KTK worked out a design for an iron-hulled battery with the following characteristics:

Displacement:	2,037 tons
Dimensions:	210ft x 48ft 3in x 9ft 10in (64m x 14.7m x 3m)
Armament:	6 x 9in (229mm)
Protection:	5.5in (140mm) casemate, 4.5in (114mm) belt
Machinery:	Twin screws

The guns could be shifted from one side to the other, so that all six could fire on either broadside.

In the end, both Glazenap's and Fëdorov's plans were rejected, and in November 1865 it was decided to establish an entirely new shipyard near the Kerch Strait for building both *Uragan* and *Smerch*-type turret ships. Preparatory work was started at the site in January 1866, and everything seemed set for the construction of the first Black Sea ironclads. However, later that year the empire was confronted by a tremendous financial crisis, as a result of which the Naval Ministry's budget was cut by 28%. Konstantin Nikolaevich, determined to continue the construction of the Baltic ironclads he considered essential for the defence of St. Petersburg, was forced to make deep cuts elsewhere in the budget. In October 1866 the Black Sea flotilla was abolished, and in 1867 the existing Lazarevskoe Admiralty (shipyard) at Sevastopol was turned over to the private ROPiT shipping line. Russia's nascent naval presence in the Black Sea was liquidated, and with it her plans for a fleet of defensive ironclads there.

The Popovkas*: Design*

General Miliutin, however, was not about to let the matter lapse. In the latter part of 1869, alarmed by Turkish ironclad construction and Austrian plans for building monitors on the Danube, he again called attention to the need for ironclads to defend the Black Sea coast, his concerns as before focused on the Dnepr-Bug estuary and Kerch Strait.[5] As a result a special conference was called to study the question of naval defences in the Black Sea. In addition to conventional turret ships the conference considered a proposal by Rear-Admiral A.A. Popov for circular ships, an idea that the respected Scottish shipbuilder John Elder had also recently put forward at the Royal United Service Institution.[6]

Popov later explained his rationale for choosing a circular form: he noted that Edward Reed, the former Chief Constructor of the Royal Navy,

> …said many years ago that by shortening the ship we diminish the extent of the surface which must be protected by armour, and by broadening the ship we increase the displacement or power to carry the armour. He said also that very moderate increase of steam power was needed to give to the short ship the same speed as to the long one…
>
> When my Government found it necessary to build ironclads for shallow water and special purposes, and as inexpensive as possible, I began to think about this question from the point of view of Mr. Reed. As a consequence, I shortened the ships and increased their breadth, and after investigation carried the principle to its extreme limit, making the breadth equal to the length.[7]

Popov's circular ship was to mount the most powerful guns then available to the Russian Navy, either 11in rifles or 20in smoothbores, in a 'fixed turret' – that is, an open-topped barbette. He originally thought that two propellers would be sufficient to drive the ship.

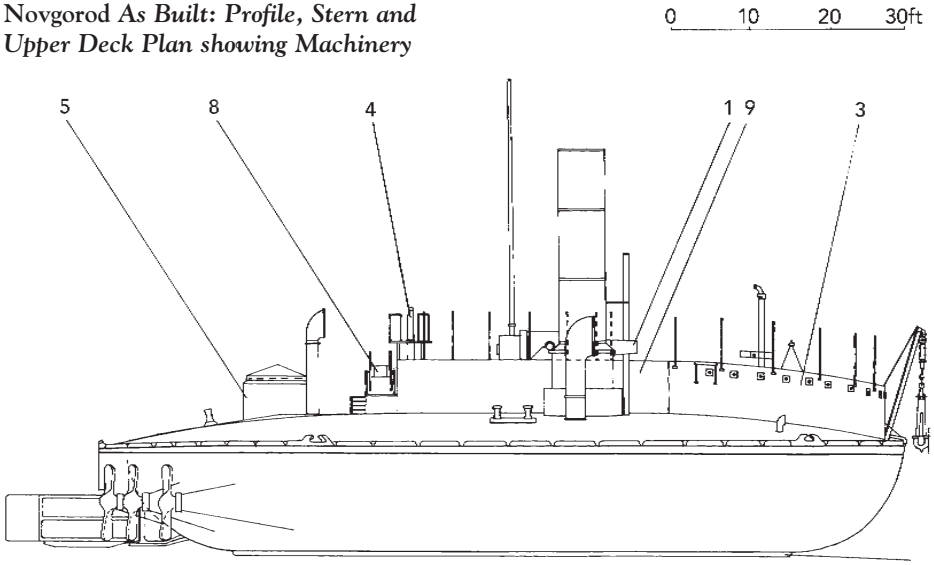
Whether conventional or circular ironclads were selected for construction there would be many problems to overcome – for example, the major port of Sevastopol still lacked railway connections with the rest of the empire.[8] Therefore a second special conference on Black Sea defences, chaired by the general-admiral, was convened in the latter half of December 1869. The result of the conference was a decision to build four small ironclads at the old Nikolaev Admiralty, at a total cost of four million rubles. The conference narrowed the choices to a vessel similar to the Baltic ironclads of the *Rusalka* class (1,882 tons, draught 11ft, four 9in rifles), or Popov's circular type. However, the characteristics specified by the army engineers for the ships – draught of about 11ft, main battery of 11-in guns, armour 'greater than on the largest foreign armourclads' – prejudiced the choice, for they ruled out a conventional ship like *Rusalka*.

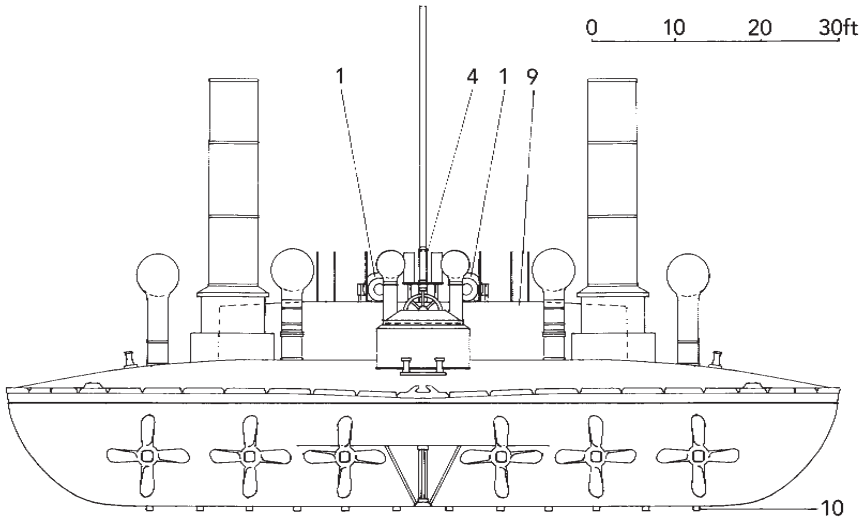
Meanwhile, a circular test boat, with a diameter of 11ft, was built at St. Petersburg and ran her trials in April 1870 (a channel had to be hacked through the ice of the still-frozen Baltic for the purpose). The odd craft moved well, and was considered a success. When this was reported to the emperor, he ordered that the circular ironclads should be called *popovkas* – a diminutive form of their originator's name.[9]

Popov and his assistants were soon busy working out a variety of circular ironclad designs. Different combinations of hull diameter and armament were explored, including designs with barbettes or rotating turrets for 11in rifles or 20in smoothbores; the task of the designers was eased somewhat when the Naval Technical Committee (*Morskoi tekhnicheskii komitet*, MTK, which replaced the KTK in 1867) increased the permissible draught to 14ft.[10] On 26 May/7 June 1870 the results were presented to the general-admiral, who selected the 'maximum' popovka: 6,054 tons, 151ft in diameter, 12ft 6in draught, armed with four 20in smoothbores and protected by 21.7in armour. The MTK subsequently altered the armament to 11in rifles. An experienced naval constructor, Colonel A.V. Mordvinov, was chosen to oversee the detail design work, and the naval attaché in Britain, Rear-Admiral I.F. Likhachev, was soon buying the machinery and tools needed to equip the long-dormant construction workshops in Nikolaev.

However, apparently Admiral Krabbe soon had second thoughts about building a single huge vessel of a new and unproven type; estimates indicated the vessel would cost 4.14 million rubles, more than had been specified earlier for the construction of the four coast defence ironclads originally proposed. On 23 July/4 August 1870 he ordered the commander-in-chief of the Port of Petersburg to work out a programme for ten smaller circular ironclads, to be fabricated at St. Petersburg and Kronshtadt and assembled at Nikolaev. The port's constructors started with a much smaller hull, 80ft in diameter, and a displacement of 1,200 tons; each ship would be armed with two 9in rifles in a barbette, while the armour would be 6-8in. In order to

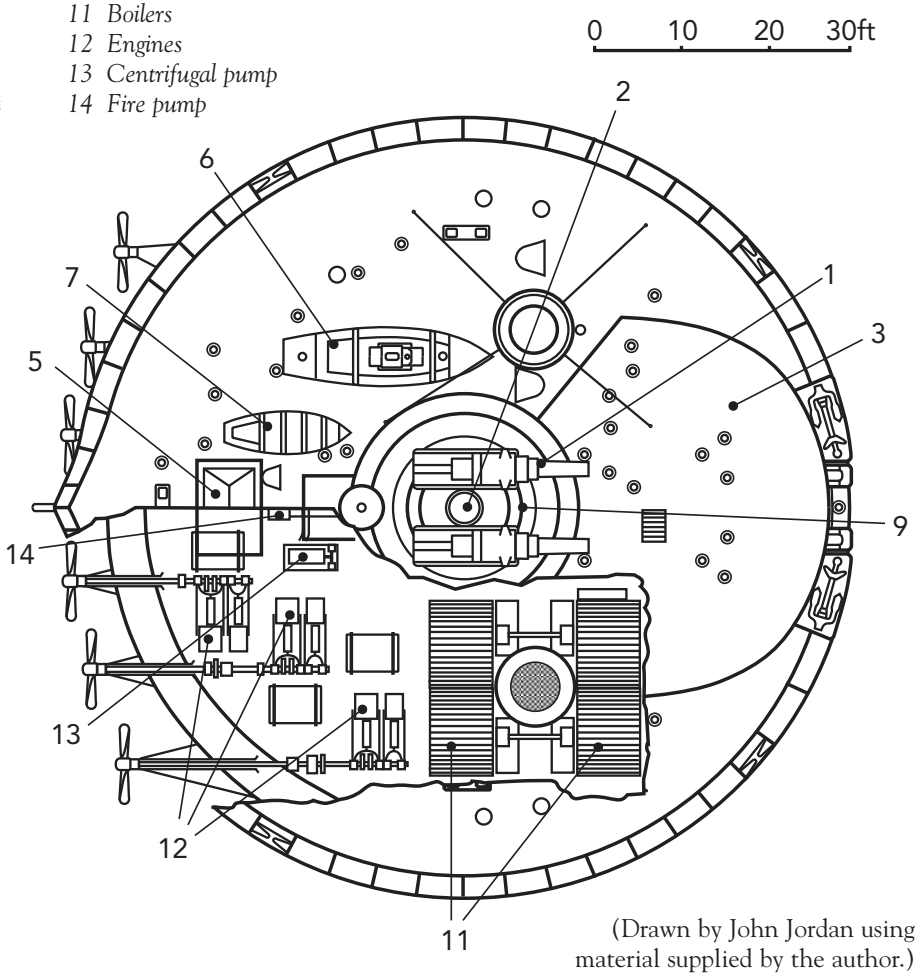
Novgorod *As Built: Profile, Stern and Upper Deck Plan showing Machinery*





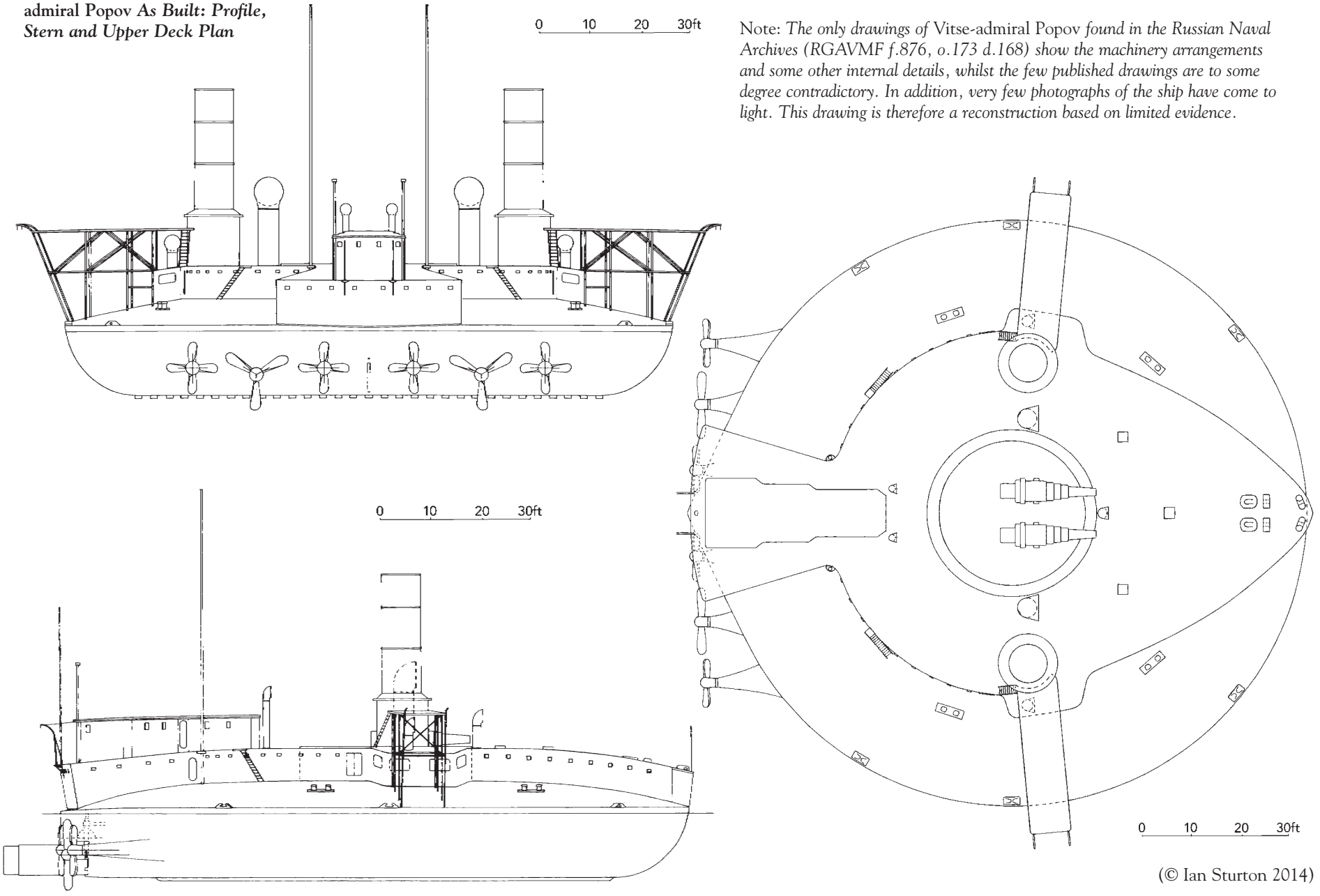
Key to drawings:

1 280mm gun
2 Hatch for passing ammunition
3 Superstructure
4 Compass
5 Engine-room skylight
6 Steam pinnace
7 6-oared pulling cutter
8 Steering wheel
9 Barbette
10 Keels
11 Boilers
12 Engines
13 Centrifugal pump
14 Fire pump



(Drawn by John Jordan using material supplied by the author.)

Conjectural Drawing of* Vitse-admiral Popov *As Built: Profile, Stern and Upper Deck Plan



Note: *The only drawings of* Vitse-admiral Popov *found in the Russian Naval Archives (RGAVMF f.876, o.173 d.168) show the machinery arrangements and some other internal details, whilst the few published drawings are to some degree contradictory. In addition, very few photographs of the ship have come to light. This drawing is therefore a reconstruction based on limited evidence.*

save money these craft would be propelled by four 70nhp engines taken from existing gunboats – 32 such engines were available, so only eight new ones would have to be built. The entire program would cost 9.5 million rubles and take 15 months to complete.

Faced with this competition, Popov was compelled to reduce the size and cost of his brain-child. He and his team worked out six new variants, and on 12/24 October 1870 the emperor approved the construction of a 96ft diameter vessel. The ship would be armed with two 11in guns, protected by 12in armour and propelled by four (later increased to six) engines. The cost of construction, shipment to Nikolaev and reassembly would be 1.94 million rubles per ship; the total cost, including improvements to the shipyards, was estimated at 8.5 million rubles.

While design work was underway on the popovkas, events were unfolding in Europe that could have changed the plans for naval defences in the south. On 19/31 October 1870 Russia's foreign minister, A.M. Gorchakov, announced the emperor's decision to renounce the Black Sea neutrality clauses of the Treaty of Paris. The moment was well chosen; Russia was supported by the Prussians, who at that moment were besieging Paris, leaving France powerless to interfere. Austria-Hungary, with Russian troops massing on her border – Russia's *quid pro quo* to Berlin, intended to prevent Vienna from seeking revenge for her recent defeat by Prussia – was also in no condition to object. Britain was thus diplomatically isolated. Despite protests, the Russian move had to be accepted, and was confirmed in March 1871 by an international conference held in London. Russia was free to rebuild her Black Sea Fleet, although it had to remain in that sea; no warships except those of the Ottoman Empire were allowed to pass through the Turkish Straits.

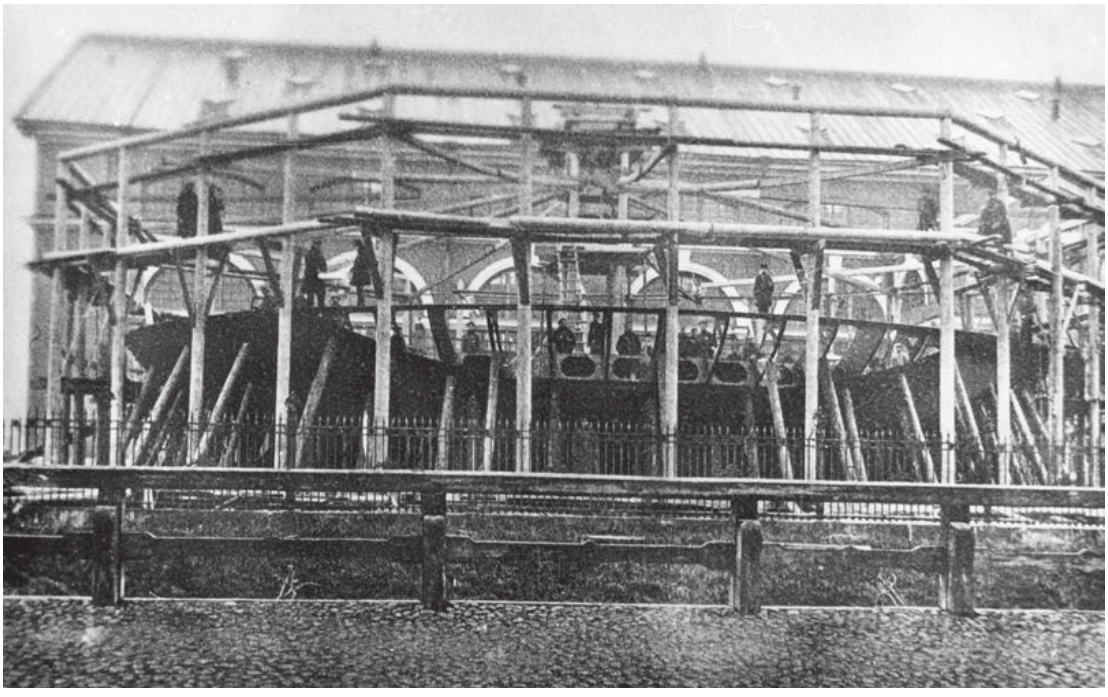
Despite this new freedom, however, the navy did not start planning the construction of a sea-going Black Sea fleet. Russia's economy could barely support the construction of a naval force in the Baltic, so, as Konstantin himself wrote: 'An armourclad fleet for the Black Sea must have, for the time being, an exclusively defensive character'.[11] Therefore work on the defensively-oriented popovkas continued.

In January 1871 a temporary slipway was hacked out of the frozen ground at the New Admiralty yard in St. Petersburg. Construction of the first popovka actually began on 1/13 April 1871, the work going on in two shifts to speed things along. Meanwhile, a second small circular craft had been constructed. She was appropriately named *Kambala* (flatfish or flounder), and had a diameter of 24ft. She was powered by two 8nhp engines, and her trials in the summer of 1871 were considered a success.

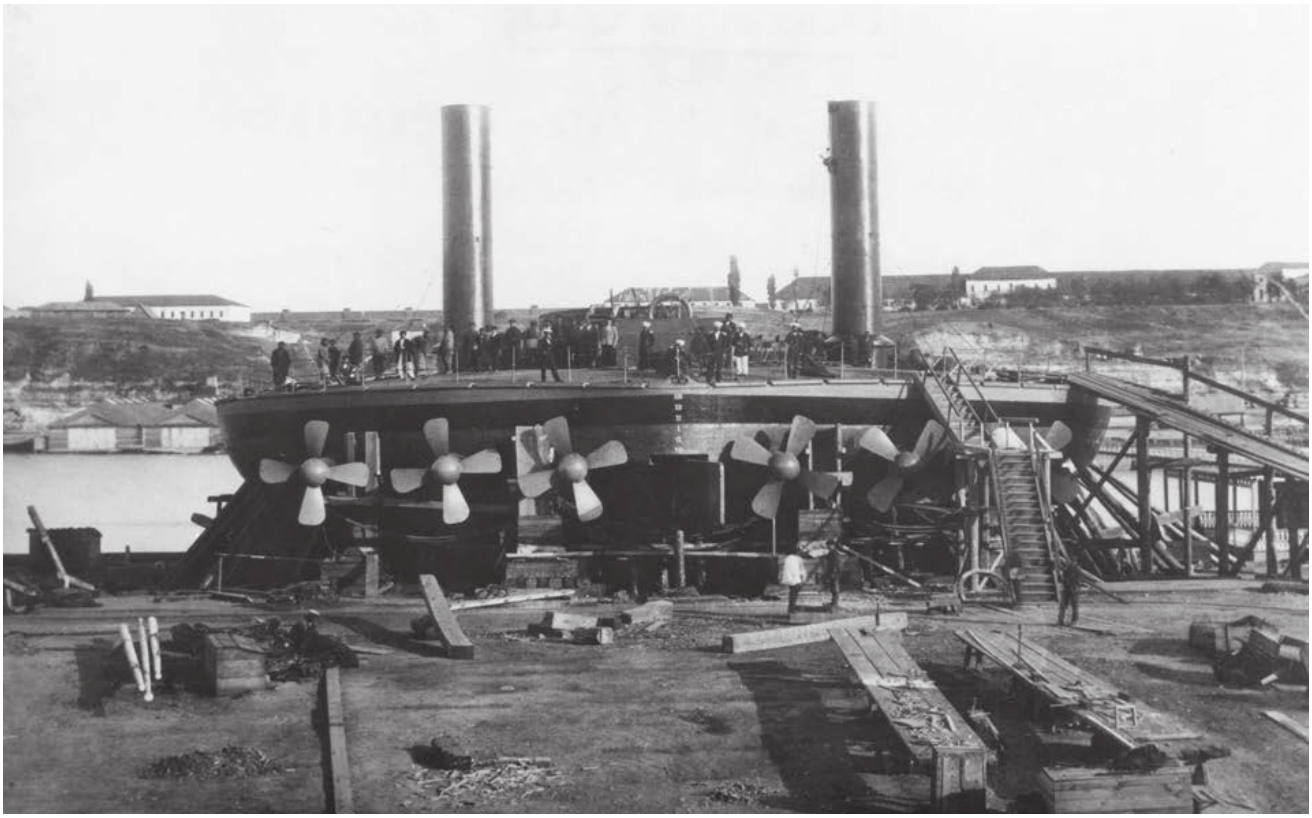
Construction

The construction of the ironclad's hull went quickly, and was completed by the date of the official keel-laying ceremony, 17/29 December 1871. Within two weeks the hull, bolted together rather than riveted, had been disassembled and the parts were ready for shipment. The first batch arrived at Nikolaev on 21 March/2 April 1872 and re-assembly began eight days later on a specially prepared slipway. Because there was as yet no direct railway link to Nikolaev, the shipments were sent first to Odessa, then delivered to Nikolaev by river barges and steamers. The boilers, too large for railway shipment, had to be sent around Europe by ship to Odessa and then carried to Nikolaev by river craft.

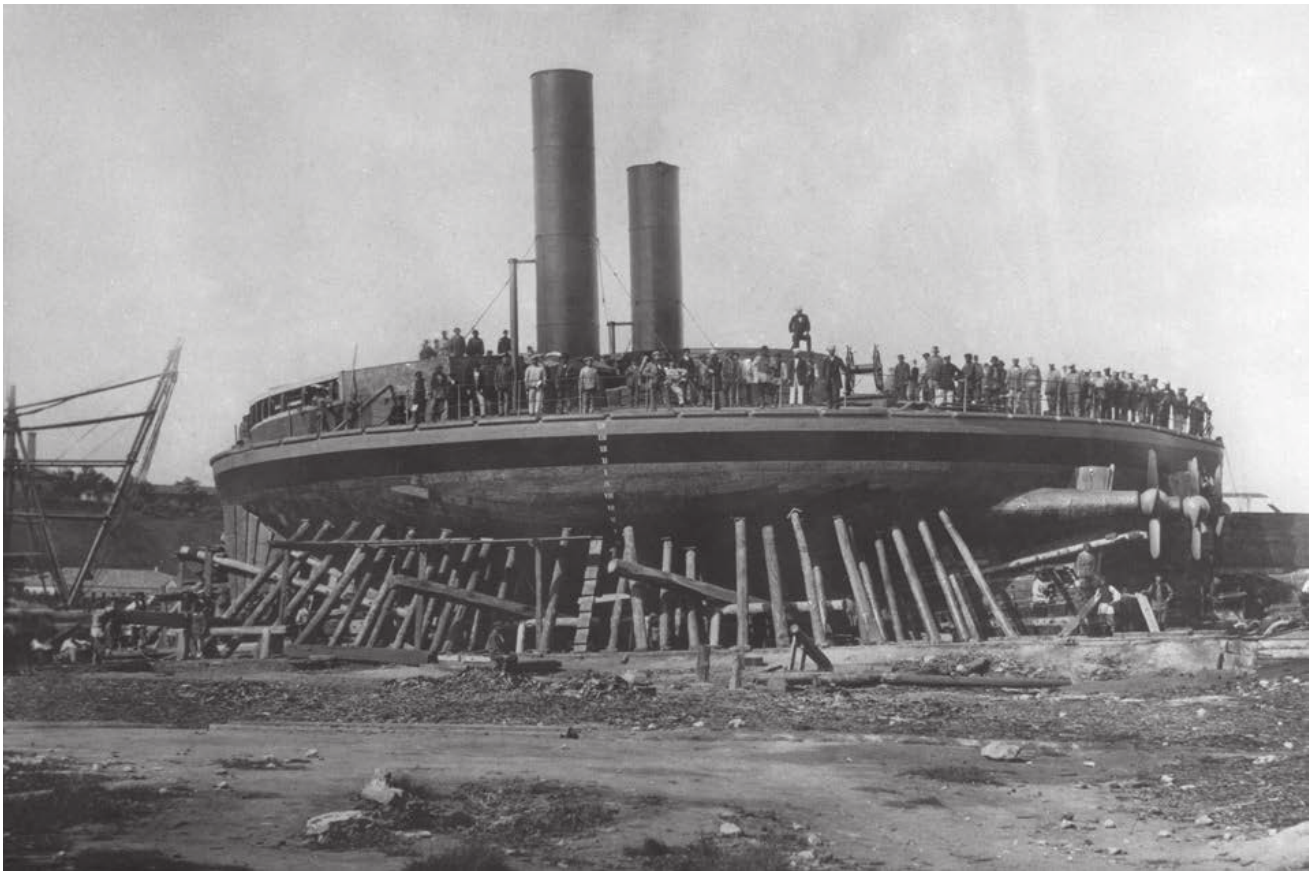
Problems with the delivery of parts from St. Petersburg caused numerous delays in construction. Nikolaev lacked everything, including tools and even timber – it proved to be cheaper to buy Russian timber in England and have it sent to Nikolaev than to have domestic firms deliver it directly. In addition, the workers in Nikolaev were inexperienced. Complicating matters for the constructors was the fact that Konstantin Nikolaevich was determined to



Novgorod *under construction at the New Admiralty shipyard in St. Petersburg. The sections of the hull were bolted together so that it could be disassembled and sent to Nikolaev by rail.* (Courtesy of Sergei Vinogradov)



Novgorod *at Nikolaev a few days before her launch. Her six propellers can be seen, as well as her rudder, angled over to starboard. This picture, and the next, make clear how primitive conditions were at the shipyard.* (Courtesy of Sergei Vinogradov)



Another view of Novgorod *shortly before her launch, this time from the port side. The steering wheel can be seen abaft her barbette, which apparently still lacks its armour plating. The forward superstructure also appears to be incomplete.* (Courtesy of Sergei Vinogradov)

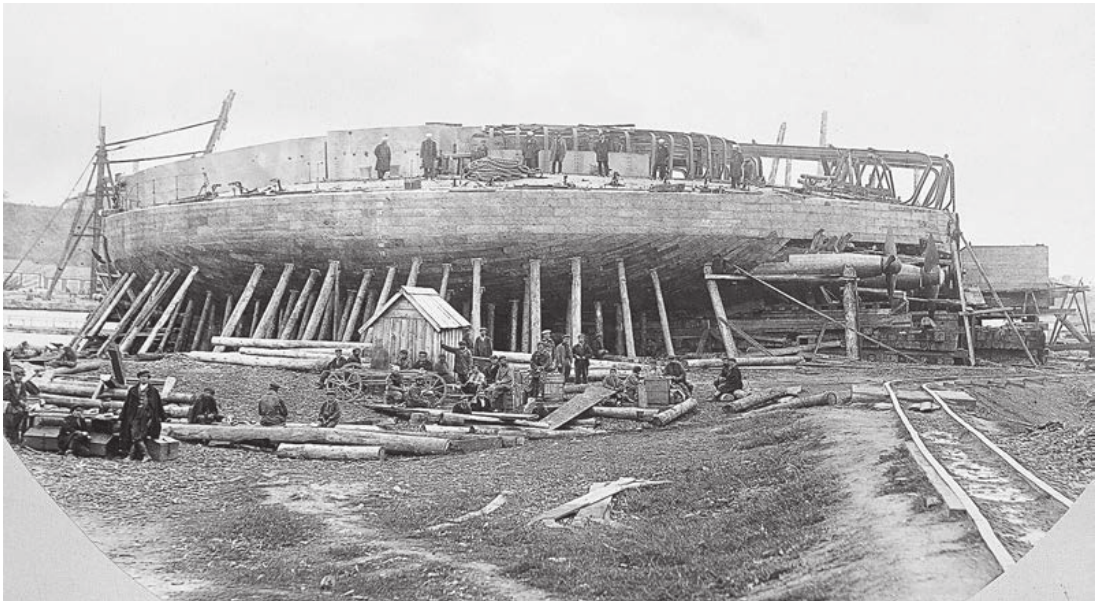
TABLE 1: CONSTRUCTION DATES

	Novgorod	*Vitse-admiral Popov*
Contracted:	—	—
Added to List:	13/25 Nov 1871	13/25 Nov 1871
Construction begun:	1/13 Apr 1871 (St. Petersburg)	Jan 1872; halted mid-1872; resumed to a new design in the spring of 1873
Laid down:	17/29 Dec 1871 (St. Petersburg)	27 Aug/8 Sep 1874
Reassembly begun:	29 Mar/10 Apr 1872 (Nikolaev)	—
Launched:	21 May/2 Jun 1873	25 Sep/7 Oct 1875
Entered service:	1874	1876
Builder:	New Admiralty Yard, St. Petersburg; reassembled at Nikolaev Admiralty	Nikolaev Admiralty
Constructor:	N.K. Glazyrin	?
Cost (hull and machinery):	2,830,000 rubles	3,260,000 rubles

Notes:

Added to List: The date a ship was officially added to the list of the fleet and given a name.
Construction begun: The date when the first iron was laid on the slipway.
Laid down: The date of the ceremonial keel-laying, not necessarily corresponding to an important stage in the ship's construction.

Vitse-admiral Popov *under construction at Nikolaev, taken from off her starboard bow. The forward superstructure looks virtually complete, and most of the wood and copper sheathing is in place.* (Courtesy of Dmitry Lemachko)



Another photograph of Popov *under construction, this time from the port quarter. The framing for the after superstructure from the barbette to the stern is in place, as are the rudder and screws. Note the larger size and deeper placement of the inboard propeller.* (Courtesy of Dmitry Lemachko)

attend the launch, which meant that the event had to dovetail with his crowded schedule. By early 1873 work was proceeding at a frantic pace, with 2,000 workmen bustling around the ship night and day. Even so, the launch date had to be postponed, and the ship finally took to the water on 21 May/2 June 1873. Christened *Novgorod* after one of the ancient cities of Russia, she was the first large Russian ship launched with her machinery and armour already mounted.

There had been changes to the design during construction, the most substantial being the addition of wood and copper sheathing, which increased the diameter of the hull by 5ft. This, combined with other changes (bronze propellers in place of cast iron ones, an increase in the number of false keels from seven to twelve, and so forth), led to a 400-ton increase in displacement, increasing draught by 1ft. The guns were finally mounted in September 1873; by this time the ship had already run her official machinery trials. She entered service in the following year.

The construction of the second circular ironclad, originally to be named *Kiev*, was begun at Nikolaev to the same drawings as *Novgorod*. But Admiral Popov, having introduced many alterations during the construction of the first ship, made even more substantial changes in the design of the second. The first of these modifications was the substitution of vertical compound engines for horizontal engines, for which Popov obtained approval in March 1872. Popov was given another opportunity to tinker with the design when work on *Kiev* was suspended in mid-1872 so that all available workers could be shifted to *Novgorod*. Moreover, he foresaw 'the necessity of improving the popovka, to make some changes in its construction indicated by experience' once *Novgorod* was completed.[12]

In July 1873 Popov reported on the preliminary trials of *Novgorod*, then went on to point out that, in order to counter powerful new ironclads like Britain's *Devastation*, the size of the *Kiev* had to be increased, so that she could carry thicker armour and heavier guns. On 3/15 August 1873 Popov presented what amounted to a new design to the MTK: the diameter of the hull would be increased by 19ft (the maximum that could fit in the available facilities at Sevastopol), the 11in guns would be replaced by 12in, and the thickness of the vertical armour would be increased to 18in. On 13/25 August the emperor granted his consent for the construction of the second popovka to these new drawings, and on 9/21 October an imperial *prikaz* (order) changed her name to *Vitse-admiral Popov*, in honour of her inventor.

With the approval of the new design it was necessary to dismantle some of the work already completed; this was done in the autumn of 1873.[13] The order to re-start work came on 15/27 October, but actual construction did not begin until the spring of 1874, with the launch planned for the autumn of 1875, and trials to follow in May 1876.

Facilities at Nikolaev were still far from satisfactory – for example, there was no floating crane of sufficient capacity to hoist the boilers aboard the ship, so one had to brought up (apparently from Sevastopol) – but as it was winter time the Ingul River was frozen, and a channel had to be cut through the ice to get the crane to the building yard, causing a month's delay. A factory in south Russia, at Iuzovka, was contracted to supply some of the iron for the ship, but its products proved to be of such inferior quality that it was necessary to transfer the order to the Raivolovskii Works in Finland. Despite these and other problems, *Vitse-admiral Popov* was ready for trials in June 1876, only a month behind schedule.

A 'Utopia' of Circular Ironclads?

In several respects *Vitse-admiral Popov* was more than just a scaled-up version of *Novgorod*; Popov introduced a number of important changes in the design which, taken together, give the impression that its author was either forgetting the popovkas' original coast-defence rationale, or (more likely) was trying to prove that circular ironclads could be competent sea-going ships. Thus, during construction the superstructures were greatly expanded, to the point where they completely enveloped the barbette; this was done in order to improve the ship's seaworthiness – surely a minor concern for a vessel designed to operate in river estuaries. More telling were the changes in the propulsion plant; although the new design had six shafts, like *Novgorod*, the middle shaft on both sides was powered by two engines and had a larger screw that was set deeper in the water. This was intended to improve propulsive efficiency, but it also increased the draught by more than four feet, a considerable handicap for a ship intended to operate in shallow waters. Popov proposed two minor 'fixes' for this: first, since the larger propellers were three-bladed, by stopping them at the right position their immersion could be decreased somewhat; second, the stern could be raised by selectively flooding the between-bottom spaces in the bow. But these 'solutions' were obviously afterthoughts. Some effort was even devoted to equipping the popovkas with a sailing rig, and three small circular boats were built to test their handling under sail, but nothing came of this somewhat hare-brained scheme.

The impulse to scale the circular ironclad up into a full-fledged, ocean-going battleship was due not only to Popov's ambitions; it was also backed by Konstantin Nikolaevich, who was always seeking ways to improve Russia's naval position, especially if it could be done cheaply using new technologies. The circular ironclad seemed to offer just such a possibility; with its great carrying capacity and relatively small surface area, a ship with a round hull could carry the same heavy guns and armour as a much larger ironclad with a conventional hull. Spurred on by this prospect, in 1875 the Russian Naval Ministry requested, and the British Admiralty granted, permission for William Froude to carry out tests with models of several circular ships at Torquay, then the only towing tank in the world. In addition to the hull forms of *Novgorod* and *Vitse-admiral Popov*, Froude was asked to test a 'proposed' circular ship of 6,740 tons (160ft diameter, 13.7ft draught) with a speed of 14 knots, obviously intended to serve as the basis for a sea-going ship.[14] A young naval constructor and close associate of Popov, E.E. Guliaev, was sent to participate in the tests; having been educated at the School of Naval Architecture in South

Kensington, he was an apt choice.[15] In experimenting with the larger model, Froude found that it required five times the horse-power of conventional ships to achieve the desired speed of 14 knots. As a result, he suggested that an elliptical hull form would be more suitable, and Popov almost immediately took this idea to heart; he designed the imperial yacht *Livadiia* (4,420 tons, 260ft oa x 153ft x 7ft) as a prototype for a battleship of similar form. *Livadiia*, built by Elder's Clydeside shipyard, was an indifferent success; although she was very steady even in rough seas, her shallow draught and flat bottom subjected her to severe slamming during a storm in the Bay of Biscay on her voyage from Britain to Sevastopol. By the time she had arrived at her destination on 27 May/8 June 1881, her intended patron, Emperor Aleksandr II, was dead, killed by an assassin's bomb in March; his son and heir Aleksandr III harboured a deep dislike of his uncle, Konstantin Nikolaevich, and so he dismissed him from the post of general-admiral. The new emperor's younger brother, the Grand Duke Aleksei Aleksandrovich, became general-admiral. The new regime soon showed itself hostile to both the popovkas and their inventor; the new emperor himself sarcastically commented on Popov's 'rounding of our naval architecture', while the recently-appointed professional head of the Naval Ministry, Admiral I.A. Shestakov, referred to Popov's plans for an 11,250-ton elliptical-hulled battleship armed with eight 12-inch guns as Popov's 'utopia of circular-hulled armourclads'.[16] And so Popov's influence on ship design was abruptly terminated, bringing Russia's experiments with circular and elliptical ironclads to an end.

General Characteristics

After John Elder's death in 1869, some of his supporters claimed that Admiral Popov was presuming too much in his claims for the originality of his circular ironclad. However, while Popov was certainly familiar with Elder and his work, it is clear that the Russian ships were substantially different to the proposals Elder had publicly described, which called for vessels with a convex hull form and waterjet propulsion, whereas the popovkas were flat-bottomed craft with conventional propellers. (Elder had apparently also considered the possibility of flat-bottomed circular armourclads, but never published this idea.) Ultimately, the controversy seems to have been resolved to the satisfaction of all, since toward the end of the 1870s Popov specifically recommended the Elder yard for both the construction of the imperial yacht *Livadiia* and the re-engining of the ironclad *Pëtr Velikii*.

Popov's choice of a flat-bottomed circular hull was deliberate, even though he knew that it was less hydrodynamically efficient than Elder's convex-bottomed ships (which minimised frictional resistance), because it allowed a greater displacement on a shallower draught. The popovkas had no keel, the hulls instead being built on a series of radial frames tied together with circular stringers. Structurally, *Vitse-admiral Popov* was a scaled-up version of *Novgorod*, with its flat bottom having a diameter of 96ft, as opposed to 76ft in the smaller ship. In both ships the sides curved upwards in the quadrant of a circle, while the double bottom was carried up around the turn of the bilge, creating a side-protection system of modest depth. *Novgorod* had twelve false keels, 8in deep, on the bottom of the hull, to distribute the weight of the ship evenly when she was docked; *Popov* had similar false keels, but details are lacking.

Freeboard at the sides was minimal – 18in in both ships – and the hull was topped by a convex deck with the barbette in the exact centre. An unarmoured superstructure extended forward from the barbette to the bow in both ships; it housed the captain's cabin, the wardroom and a portion of the crew's quarters; the rest of the crew was accommodated on the deck directly below the superstructure. As completed, *Novgorod* had no after super-

TABLE 2: CHARACTERISTICS AS DESIGNED AND COMPLETED

	Novgorod	***Vitse-admiral Popov***
Displacement:	2,491 tons normal 2,706 tons full load	3,600 tons full load
Dimensions:	101ft x 101ft x 13ft 6in max *30.78m x 30.78m x 4.11m max*	designed: 120ft (*36.57m*) diameter; actual: 126ft 10in x 117ft 8in x 14ft 9in draught (hull), 19ft (including propellers) *38.66m x 35.86m beam x 4.49m/5.79m*
Armament:	2 x 11in/20 (280mm) rifles spar torpedoes	2 x 12in/20 (305mm) rifles 4 x 87mm spar torpedoes
Protection:	wrought iron armour *sides*: 9in (229mm) + 2in (51mm), tapering to 7in (178mm) below water *barbette*: 9in (229mm) + 2in (51mm) *deck*: 2.75in (70mm)	wrought iron armour *sides*: 9in (229mm) + 7in (178mm) *barbette*: 16in (406mm) *deck*: 2.75in (70mm)
Machinery:	six horizontal compound engines, six shafts, eight cylindrical boilers, 3,360ihp	eight vertical compound engines, six shafts, twelve cylindrical boilers, 4,480ihp
Speed:	6.5 knots	8.5 knots
Endurance:	200 tons coal, 480nm at full speed	250 tons coal, 540nm at full speed
Complement:	15 officers, 136 enlisted (14/123 in 1876)	19 officers, 187 enlisted

structure, but one was added later, and *Popov* had an extensive after superstructure from the beginning; she also had accommodations for an admiral.[17]. Aft of the barbette was an unprotected steering wheel, used for normal steaming, while in battle the ships were to be controlled from a wheel located below the armoured deck.

The drainage system followed the pattern of earlier ironclads, with a single master pipe running above the inner bottom; it was connected to the various compartments by branch pipes. In theory this allowed the entire pumping capacity to be brought to bear on flooding in any compartment. Total pumping capacity in *Novgorod* was about 15.75 tons/minute.

Initially, there were concerns about the sea-keeping abilities of these unique ships; on *Novgorod's* first voyages, the commander of the Black Sea Fleet, Vice-Admiral N.A. Arkas, ordered that she always be escorted by another vessel. Such precautions proved excessive; trials showed that she had an easy roll even in rough weather, rarely exceeding 7-8° – none of the available sources provide her metacentric height, but it must have been enormous. On the other hand, the ships lost headway very quickly in heavy weather, a phenomenon also discovered to a lesser extent on Reed's short, bluff British ironclads. On one occasion in the spring of 1877, *Novgorod* was unable to make any headway in Force 8 weather. The shallow draught also made for problems in some sea conditions, since the ships sometimes pitched their propellers out of the water, greatly reducing speed.

The blunt hulls also made for a very poor flow of water to the single rudder, reducing its effectiveness; it took 40-45 min for the ships to steer a complete circle by rudder alone, and in heavy wind and waves the ships were almost ungovernable. After weathering a Force 7 storm, *Vitse-admiral Popov's* captain reported that

> the vessel took on a lot of water through the hatches in front of the ventilators.... The steering wheel was torn out of [one's] hands, and the vessel did not answer the helm; it was necessary to steer by means of the engines, and to make fast the rudder.[18]

In fact, steering by the engines became the normal mode of operation for the ships, although this entailed a loss of speed.

Armament

Novgorod's armament consisted of two 11in/20 Krupp-pattern 28-ton guns mounted in a central barbette; these guns could penetrate 11in armour at 800 yards, and at an elevation of 14.5º had a range of 4,600 yards. The barbette had an outside diameter of 30ft, and ammunition was supplied from below through a central hatch.[19]

The mountings were designed by Major General F.B. Pestich. Edward Reed described the operation of the guns and their mountings in these terms:

> These guns stand in an open-topped fixed turret, and are each worked by seven men only. The loading arrangements, the running out and in, the elevation and depression, and the training of these guns, are all of the simplest character, and insure [sic] great rapidity of action. I observed one quality which these guns possessed, which our guns in revolving turrets do not possess. While capa-

TABLE 3: GUNS OF THE *POPOVKAS*

	11in Pattern 1867 (a)	**12in Pattern 1867 (b)**	**4pdr/3.4in (c)**	**Hotchkiss (d) 5-barreled**
Calibre:	11in/279.4mm	12in/304.8mm	3.4in/86.87mm	37mm
Dates:	1873	1875 (official trials)	1867?	1879
Weight:	25,979-28,698kg	35,682-39,038kg	460kg	209kg
Barrel length:	5,588mm/20 cal	6,096mm/20 cal	1,713mm/19.7 cal	740mm/20 cal
Bore/rifled length:	4,750mm/17 cal	5,169mm/17 cal	1,182mm/13.6 cal	616mm
Rate of fire:	6-8 minutes/round	c.14 minutes/round	?	32rpm
Projectiles and performance:				
Weight:	222kg	290kg	5.74kg	0.5kg
Charge:	36.4-37.5kg	53.2kg	0.615kg	0.08kg
MV:	392m/sec	447m/sec	306m/sec	442m/sec
Range:	3,704m @ 9.5°	2,963m @ 6°	3,294 @ 14.13°	2,778m @ 11°

(a) Based on a Krupp gun, four of which were delivered in August 1871. The Obukhovskii Works began manufacturing a domestic version of these guns in 1873.

(b) Based on a Krupp design, manufactured by the Obukhovskii Works. Only six guns were produced, of two slightly different patterns; all were mounted afloat (four in the Baltic Fleet battleship *Pëtr Velikii*, two in *Vitse-admiral Popov*).

(c) A standard field artillery calibre adopted for shipboard use. These short, low-velocity guns were used in cases where armour penetration was not the primary consideration. They were manufactured by the Obukhovskii Works and Krupp; the steel tube was not reinforced. The mounting was of the carriage type.

(d) It is not clear whether the popovkas carried the Hotchkiss 5-barrelled 37mm or the single-barrelled gun; on balance, the former seems more likely.

Sources: Shirokorad, *Entsiklopediia otechestvennoi artillerii*; Titushkin, 'Korabel'nye pushki epokhi paravogo i bronenosnogo flota'; Titushkin, 'Artilleriia russkogo flota v 1877-1904 gg'.

> ble of being fired in parallel directions like our own guns, each has an independent action for training, so that, within certain limits, they can be directed at different objects.[20]

Each gun was indeed on an individual carriage, and these could be trained at different targets, although at some point their carriages would interfere with one another. They could also be locked so that they rotated together. The guns could be trained through 180º in 2-3 minutes, but despite the 'great rapidity of action' Reed observed, rate of fire was rather slow: one round per gun every ten minutes or so.

In *Vitse-admiral Popov* the main battery consisted of two 12in/20 41-ton Obukhovskii guns mounted in the central barbette with an external diameter of 34ft.[21] The mountings, of the Moncrieff 'disappearing' type, were designed by Lieutenant L.A. Rasskazov, and were ordered from Armstrong in England. But by the autumn of 1876 Anglo-Russian relations were strained due to disturbances in the Balkans, and there were fears that war might break out before their delivery. It was therefore decided to build mountings in Russia to a design based on *Novgorod's* gun carriages, but scaled up to take the 12in guns.

The guns received their first trials on 11/23 October and 15/27 November 1876; it was soon apparent that the substitute mountings were too weak – as were the nearby superstructures, which were damaged by blast. Both mountings and superstructures had to be strengthened; a circular bulkhead was added below the armoured deck, and the newly partitioned space between this bulkhead and the base of the barbette was used for six officers' cabins. Further gunnery trials in April 1877 were considered satisfactory, although there was still some blast damage. Nevertheless, the mountings were considered insufficiently robust, and during the Russo-Turkish War (1877-78) Rear-Admiral N.M. Chikhachev, commander of Odessa's naval defences, reported that full charges could only be fired 'in case of extreme necessity'.

The British-built disappearing mountings finally arrived in Odessa in early 1878, but they were not installed until the autumn. The mountings were made from cast steel and training was done by two 40hp engines, which drove a large toothed ring, weighing 7 tons, on which the guns were mounted. Recoil and elevation were controlled by hydraulic mechanisms. When lowered, the guns were completely protected behind the barbette. Reloading took no less than 14 minutes. The ship conducted gunnery trials in November, during which it was noted that 'the mountings were lowered and raised smoothly'.

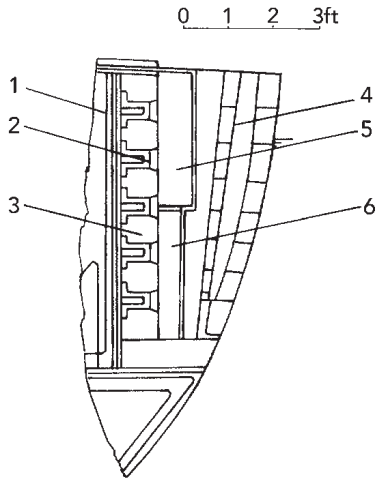
During the Russo-Turkish War *Novgorod* was fitted with two 4pdr (87mm) guns on the after superstructure as protection against torpedo boats. By 1892 two 37mm guns had been added. *Popov* entered service with four 4pdrs, mounted near the funnels below the navigating bridge wings. During the war two more 4pdrs were mounted on the bridge wings, and by 1892 two 37mm guns had been fitted.

During the winter of 1873/1874 *Novgorod* was fitted with a telescoping spar torpedo; *Vitse-admiral Popov* received similar gear at some point. During the design process, it was also suggested that *Popov* be equipped with side-mounted spar torpedoes, but this proposal was rejected.

Protection

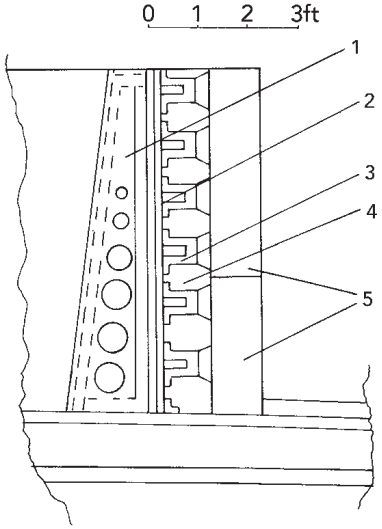
Most of the armour plate was manufactured by the Izhorskii Works, the two popovkas requiring such a large amount that armour production for the Baltic battleship

Novgorod – *section through side armour*



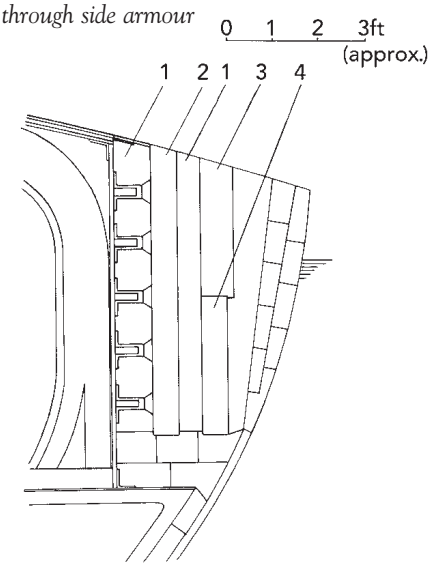
Key:
1 *Side plating (38mm)*
2 *Channel iron (178mm)*
3 *Teak backing (229mm)*
4 *Wooden sheathing outside armour*
5 *Upper armour belt (229mm)*
6 *Lower armour belt (178mm)*

Novgorod – *section through barbette armour*



Key:
1 *Iron support*
2 *Sheet iron (9.5mm)*
3 *Channel iron (178mm)*
4 *Teak backing (229mm)*
5 *Armour plates (229mm)*

Vitse-admiral Popov – *section through side armour*



Key:
1 *Teak backing*
2 *Inner armour belt (178mm)*
3 *Upper outer armour belt (229mm)*
4 *Lower outer armour belt (178mm)*

Pëtr Velikii was delayed.[22] When a breakdown at the Izhorskii plant forced the Naval Ministry to order some 7in armour from Britain, a special authorisation was required because in 1866 the emperor had issued an order that all shipbuilding materials be Russian-made.

The vertical extent of the armour was exactly the same in both ships, extending from 18in above to 4ft 6in below the waterline, for a total of 6ft. *Novgorod's* side protection was made up of two strakes of armour, each 3ft high.[23] The upper strake was 9in thick and the lower 7in; the teak and channel iron of the backing were considered equivalent to another 2in of armour – hence the frequently seen figure of 11in for the side protection.

The heavier protection of *Vitse-admiral Popov* created difficulties, since the Izhorskii Works could not roll plate thicker than 9in, so a sandwich system of protection had to be used to achieve the desired thicknesses. The upper strake of the side armour was made up of an outer 9in layer and an inner 7in layer, with teak reinforced by channel iron between the plates. This was regarded as equivalent to 18in of solid armour. The lower strake of armour is nowhere described in detail, but it was held to be equivalent to 16in of solid armour; it was therefore probably made up of two 7in layers, again with teak and channel iron between.

Novgorod was the first Russian ironclad to mount her main battery *en barbette*; it was 7ft high and protected by 9in armour with teak backing, identical to the upper strake of belt armour. *Popov's* barbette was likewise identical to her belt, with a 9in outer plate and a 7in inner plate, with channel iron and teak in between.

Guliaev noted that the open-topped barbette was considered an adequate form of protection for the gun crew

> …because being intended for the defence of certain narrow straits and entrances they [the popovkas] can, when in action, occupy positions behind some defensive protection, such as submerged torpedoes [ie mines]; and, when attacked, can choose their own distance from the enemy, placing themselves always beyond the reach of rifle-fire.[24]

In *Novgorod* the lower portion of the funnels and the base of the engine room skylight were protected by 6in armour; details for these features on *Popov* are lacking. In both ships the rounded upper deck was protected by two layers of 1in iron plus a third layer of 0.75in, for a total thickness of 2.75in.

Machinery and Trials

The machinery for both popovkas was manufactured by the Berd (Baird) Works in St. Petersburg, once Russia's leading marine engineering firm. However, by the early 1870s there had been a serious falling-off in the quality of Berd's machinery; the engines and boilers of the Baltic Fleet's breastwork battleship *Pëtr Velikii*, also made by Berd, were plagued by so many problems that they eventually had to be replaced entirely.[25] *Novgorod* and *Vitse-admiral Popov* also suffered throughout their careers from problems caused by defects in workmanship and poor-quality materials.

The contract price for *Novgorod's* engines and boilers was 348,000 rubles, and the machinery was to be ready by 1/13 July 1872, but in the event was delayed by three months. There were six horizontal steam engines, each driving its own propeller. Steam was supplied by eight fire-tube boilers arranged in two boiler rooms located on either side of the barbette.

The control of so many engines was an interesting problem. Guliaev described the arrangements:

> There is one engineer for each side of the engine room, and both of them are stationed on a common platform upon which the starting and reversing gear, &c., for all the engines are fitted. Voice-pipes from above are led to this platform to transmit the captain's orders. The engines are supplied with Hearson's strophometers, so as to show at any moment the number of revolutions which each engine is making, and to regulate the uniformity of the speed accordingly.[26]

On 24 May/5 June 1873 – three days after her launch – steam was raised and *Novgorod*, still without guns, moved under her own power. Official trials were held in August; at 104rpm the ship made a bare 7 knots. The trials were conducted in something of a hurry, as the ship had to be prepared for a visit by the emperor; the acceptance commission did not even measure the indicated horsepower of the engines before accepting them as satisfactory. Fuel consumption was, as might be expected, prodigious; depending on the quality of the coal, it ranged from 1.6 to 2 tons per hour at full speed.

Throughout October 1873 Popov tinkered with the propeller pitch, trying to find the right combination to maximise speed. The final result was a 10ft pitch on the innermost propellers, 11ft on the next pair, and 12ft on the outermost pair. In the summer of 1874 *Novgorod* managed 7.5 knots. That was the highest speed she ever made; soon afterwards the speed dropped as the Berd engines began to show their defects.

The contract for *Vitse-admiral Popov's* machinery was signed in 1872 and was based on the construction of a ship similar to *Novgorod*; it therefore called for six vertical (instead of horizontal) compound engines and eight fire-tube boilers; when the ship grew larger it was necessary to add another two engines and four boilers to the contract.

As in *Novgorod* there were six propeller shafts, but in *Popov* the middle shaft on either side was driven by two engines. These shafts had three-bladed propellers, 14ft in diameter, as opposed to the other screws, which were four-bladed and had a diameter of 10ft 6in.

Vitse-admiral Popov ran her first machinery trials in June/July 1876, reaching 8 knots without much difficulty. But the official trials that followed soon after were marred by repeated machinery break-downs; the ship was forced to return to Sevastopol for repairs. Trials resumed on 10/22 August, when the ship ran a nine-hour trial, average speed being 8.25 knots with a maximum boiler pressure of 4.2 atmospheres. However, no attempt was made to push the engines or boilers to their contractual limits, for fear of damaging them. The acceptance commission nevertheless rated the machinery as satisfactory. Fuel consumption at full speed amounted to 2.15 to

3.3 tons per hour, depending on the quality of the coal. By the time of the Russo-Turkish War, she was considered good for only 6-6.5 knots.

Trials conducted before the Russo-Turkish War showed that *Vitse-admiral Popov's* large middle propellers were far more effective than the smaller screws; without them, she could barely manage 4 knots. On the other hand, in both ships the outermost engines contributed little to the vessels' propulsion, and the steam production of the boilers was insufficient to supply all the engines, so in 1876-1877 these engines were removed from *Novgorod*.[27] This reduced the total power from 480nhp/3,360ihp to 320nhp/2,000ihp, and her maximum speed fell to about 6 knots; by the time of the Russo-Turkish War, she was capable of only about 5 knots, although this was due at least in part to the fact that her bottom had not been cleaned in three years. Plans were made to remove the outboard engines from *Popov* as well, but the outbreak of the war in April 1877 forced a postponement. The two engines were finally removed in 1878, and as a result, the ship's total power was reduced from 560nhp/4,480ihp to 480nhp/3,066ihp, and her maximum speed was reduced by about 1 knot.

In 1879, after repeated problems with the Berd machinery, the director of the Naval Ministry, Admiral S.S. Lesovskii, ordered that *Vitse-admiral Popov* run trials until the engines met the contract specifications. The results of these trials are not given in available sources, but apparently the machinery remained unsatisfactory throughout her career.

Boats

Novgorod carried two steam cutters, which could also serve as torpedo boats, plus a six-oared boat and a four-oared boat. The ship's low freeboard and the curve of the upper deck allowed them to be stowed on crutches on deck without the use of davits; rails were used to lower them to the water. However, in the winter of 1873/1874 davits were fitted, so that the boats could be raised sufficiently to protect them from damage when heavy seas washed over the low deck.[28]

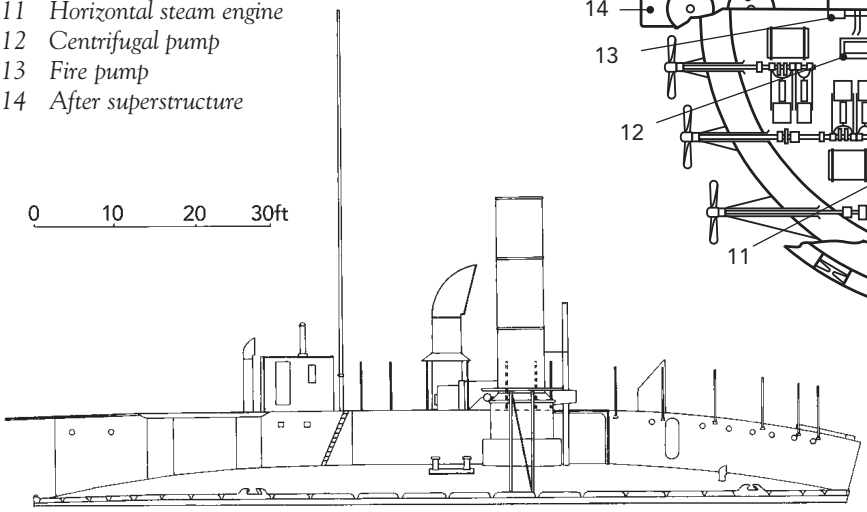
Vitse-admiral Popov carried all her boats on davits from the start, although when firing on after bearings they could be lowered to the deck to get them out of the way of the blast.

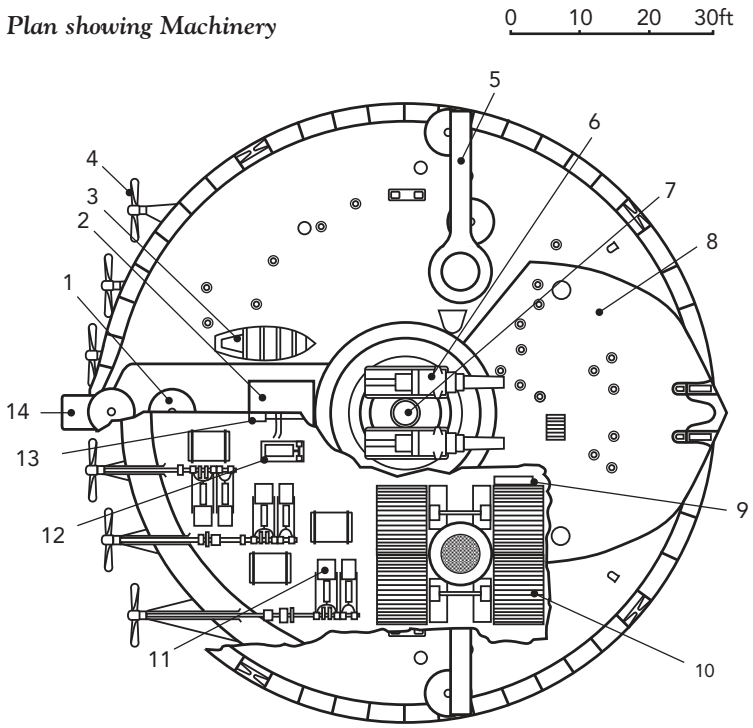
Modifications

As built, *Novgorod* had no after superstructure, but following her initial voyages it was decided to add more extensive deckhouses aft. This work was carried out in the winter of 1873/1874 while the ship was at the ROPiT yard in Sevastopol. Small deckhouses were built abaft the barbette, connected by a hurricane deck, and the engine room skylight was raised. A light enclosed wheelhouse was added atop the new superstructure. In an effort to improve the ship's sea-keeping qualities, the forward superstructure was also altered at this time, receiving a sharper forward end that overhung the bow slightly. The anchors were

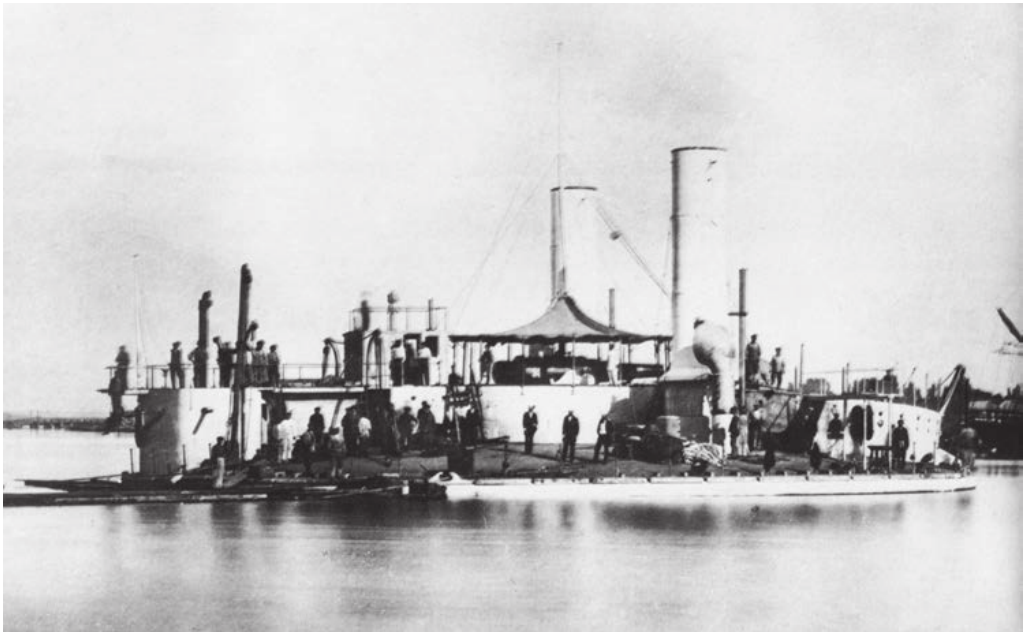
Novgorod *As Reconstructed: Profile and Upper Deck Plan showing Machinery*

Key to drawing:
1 *Location of 87mm gun*
2 *Wheelhouse*
3 *6-oared pulling cutter*
4 *Propeller*
5 *Bridge wing*
6 *280mm gun*
7 *Hatch for passing ammunition*
8 *Forward superstructure*
9 *Donkey engine*
10 *Boiler*
11 *Horizontal steam engine*
12 *Centrifugal pump*
13 *Fire pump*
14 *After superstructure*





(Profile: © Ian Sturton 2014; Plan: Drawn by John Jordan using material supplied by the author.)



Novgorod *in 1874. The photo can be dated by the location of the bridge wing that can be seen forward of the nearside funnel; this was added over the winter of 1873/1874; the following winter its inboard end was shifted to the base of the funnel. Other modifications made in 1873/1874 include the extension of the forward superstructure – difficult to see in this view – and the addition of a superstructure abaft the barbette, topped by the wheelhouse (with the compass on the roof). Note also the awning over the barbette.* (P.A. Vicary collection)

shifted from the deck edge to hawse-holes on top of the superstructure, and bridge wings extending to the hull sides from the superstructure were also added at about this time. In the winter of 1874/1875 the inboard ends of the bridge wings were shifted from the superstructure to the funnels.

From the outset ventilation posed a difficult problem. As built, *Novgorod* had two small cowls near each funnel for the boiler rooms; there were two even smaller cowls at the forward end of the engine room skylight, while the main source of fresh air below decks was the central hatch in the barbette. Ventilation engines were fitted to circulate air within the ship. These arrangements proved inadequate, and eventually a large ventilation cowl was fitted over the central hatch of the barbette and the ventilation engines were removed. At the same time the mast had to be moved from inside the barbette to the forward side of the wheelhouse.

Sometime before the Russo-Turkish War *Novgorod* was fitted with improved sights for her 11in guns, as well as the Davydov system for automatically firing the guns electrically. During the war the wheelhouses were removed from both popovkas, as they blocked their arcs of fire on after bearings.

War experience led to other changes. The Turkish river monitor *Lüft-ü Celil* (often spelt *Lutfi Djelil*) had been destroyed by Russian artillery fire, reportedly due to a plunging shell that detonated her magazine. This led to concerns about the skylights and central hatches in the barbettes of the popovkas, so in both *Novgorod* and *Popov* these were provided with armoured covers with holes in them for ventilation. For reasons which are unclear, parts of *Novogorod's* ventilation system were removed, which unsurprisingly led to severe heating in the boiler rooms; temperatures could reach 104-122ºF (40-50ºC), stokers were fainting and full speed could not be maintained. The ventilation engines removed in 1874/1875 had to be re-installed to improve air circulation. In *Popov* a ventilation engine removed from the Baltic Fleet battleship *Pëtr Velikii* was installed to improve the flow of air inside the ship.

In the early 1880s both ships were fitted with electric lighting, and in 1883 *Popov* was re-boilered; her old boilers were refurbished and transferred to *Novgorod*.

By 1893 the hulls and machinery of both ships were in poor condition, but with new battleships entering service with the Black Sea Fleet, the popvkas were regarded as having little military value, so no work was done.

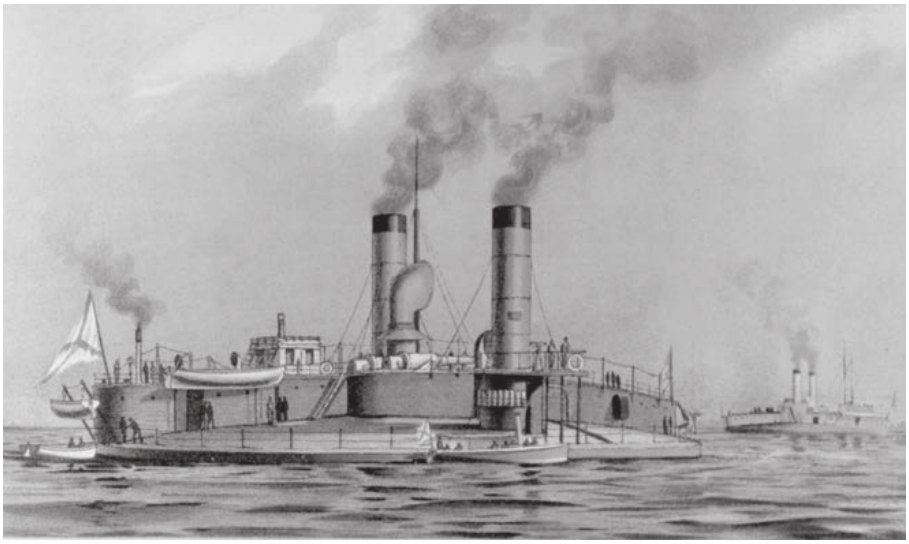
Summing Up: Criticism and Reality

Soon after the popovkas entered service they became the target of a great deal of criticism in the Russian newspapers, which, under the liberal reign of Emperor Aleksandr II, experienced relatively mild censorship. As a result there was an extended debate over the merits of the circular vessels – so extended that two substantial collections of newspaper articles were published in book form.[29] This public controversy is the source of many of the criticisms that have been levelled against the popovkas over the years.

The central issue was the effect of the circular hulls on the steering of the ships. In a long article published in the newspaper *Golos* [The Voice] on 10/22 January 1875, it was claimed that

> …during a trip along the Dnepr estuary, it [*Novgorod*] knocked over the buoys marking the channel, having all of a sudden been thrown several compass points off course while turning, and the helmsman had absolutely no confidence that he could steer her as he would have been able to do with other vessels.[30]

The other major charge levelled against the ships was their alleged tendency to spin (rather than simply wander off course). Ironically, this may owe its origin to Edward Reed, despite the fact that he was a staunch defender of these ships; in reporting his personal experiences of a trip aboard *Novgorod* in the great bay of Sevastopol, he described what happened when the ship was turned by reversing the engines on one side:



A well-known illustration of Novgorod *(with* Vitse-Admiral Popov *in the right background) showing her in her final appearance, with a large ventilator cowl in the barbette, and the bridge wings anchored on the funnel bases rather than the forward superstructure. Note also what appears to be a 37mm Hotchkiss gun in the bridge wing. This illustration was one of a series of lithographs of Russian warships by Lieutenant V.V. Ignatius, published in* La marine russe *(St. Petersburg, 1892). Ignatius rose to the rank of captain and was killed while commanding the battleship* Kniaz Suvorov *at Tsushima.* (USNHHC, NH72525)

> The circular form is so extremely favourable to this kind of handiness that the *Novgorod* can easily be revolved on her centre at a speed which quickly makes one giddy. She can, nevertheless, be promptly brought to rest, and, if needed, have her rotary motion reversed.[31]

The two above items, if combined, may be the source of the widely reported tendency of the popovkas to spin uncontrollably in river currents. Fred T. Jane described it in these terms:

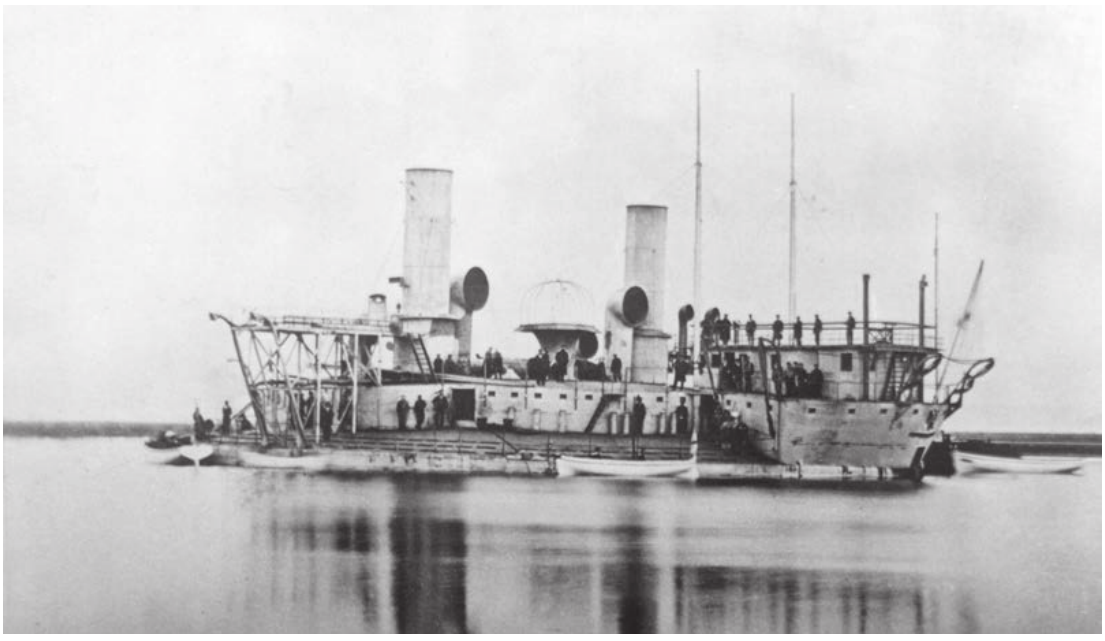
> On a trial cruise they [*Novgorod* and *Vitse-admiral Popov*] went up the Dnieper very nicely for some distance, till they turned to retire. Then the current caught them, and they were carried out to sea, whirled helplessly round and round, every soul on board hopelessly incapacitated by vertigo.[32]

It is easy to imagine how rumours of *Novgorod's* giddy spinning could have been combined with the ship wandering off course on the Dnepr to produce stories of their crews being rendered prostrate due to dizziness as the ships were swept uncontrollably downriver.

Other stories are more easily disproved; Jane claims that the popovkas were so unmanoeuvrable that 'no attempt to use them was made' during the Russo-Turkish War, but in fact the ships made several voyages in the Black Sea during and immediately after the war, twice traveling as far as the Danube; on one occasion, according to a recent Russian publication, 'the popovkas manoeuvred confidently on the river in strong currents'.[33]

Another version of spinning popovkas is that, if one gun was fired, the ships would rotate from the off-centre force of the recoil. This story seems to date from *Novgorod's* gunnery trials in November 1874, which revealed that the stops that held the gun platforms in place were weak, leading to the platforms themselves rotating when they fired.[34] Reinforcement of the stoppers put an end to this problem, but the stories remained.

There are also claims that any inequality in the thrust of the outermost engines, located so far from the centreline, would drive the ships off course or cause them to rotate.[35] A specific origin for this story has not been



A rare photo of Vitse-admiral Popov *from her port quarter. She had far more elaborate superstructures than* Novgorod. *Note the unusual mushroom-shaped structure with a framework on top – possibly a ventilator of some sort.* (Courtesy of Sergei Vinogradov)

found, but it may owe something to Guliaev's description of the elaborate machinery control arrangements (quoted above under 'Machinery'), combined with the fact that the popovkas were often steered using their engines rather than their rudders.

Another fault attributed to the popovkas is that as their speed increased they tended to bury their bows into the sea. There was some truth in this, as William Froude discovered when testing circular hull forms at the request of the Russian Navy in 1876. But there was also an important qualification to this: it would only become dangerous if the forward superstructures were completely destroyed, and in that case the ship was unlikely to be in a condition to steam at high speeds. Moreover, Froude's experiments showed that, as the trim by the bow increased, the resistance of the hull's form *decreased* – a conclusion which has been less commonly recorded. Froude explained this phenomenon in the following terms:

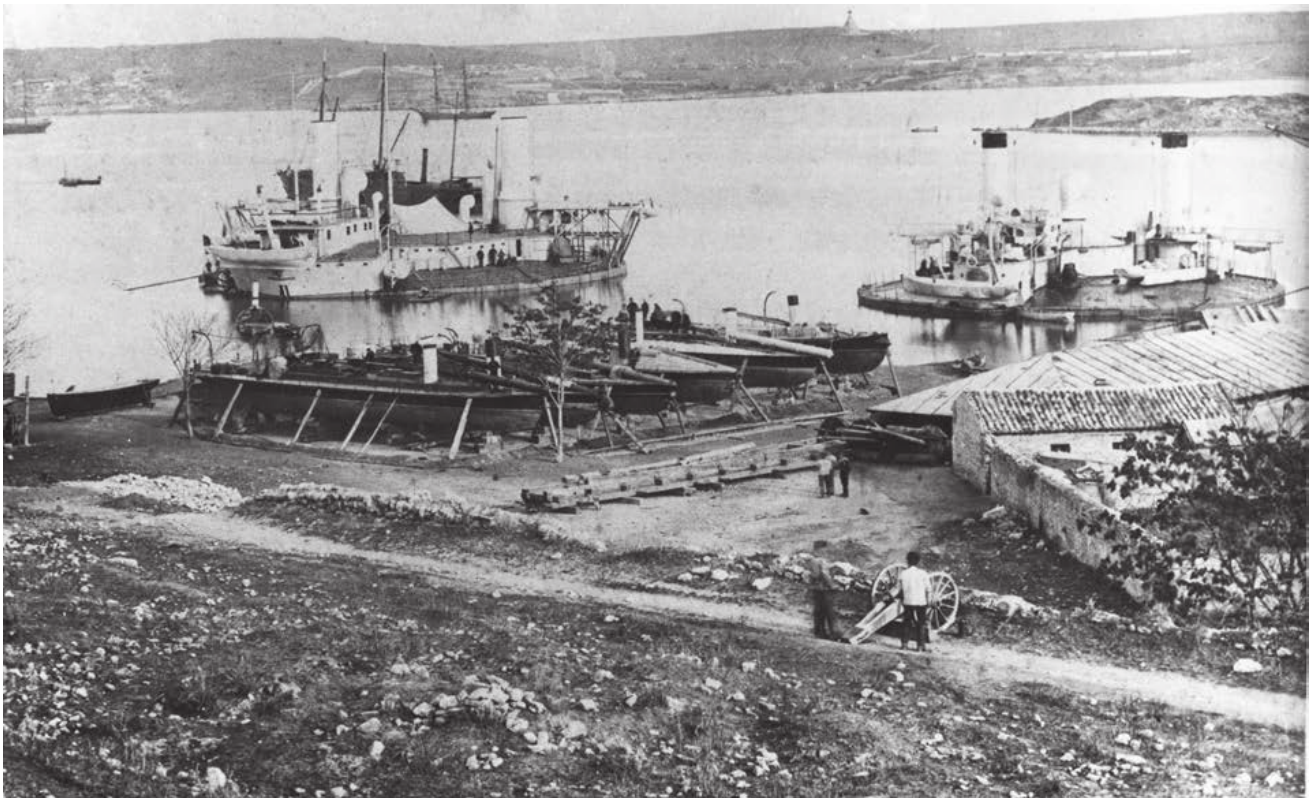
> …eddies are usually formed behind, and not before, abrupt features of form; now a large proportion of the eddies so formed by these ships will undergo an increasing diminution, the nearer the abrupt turn of bilge aft is raised towards the surface of the water, by the depression of the bow; and the resistance due to them will be proportionately lessened in consequence.[36]

The combination of hull form and trim by the head led to a beneficial effect – but one unlikely to be of much use in practical terms!

In the final analysis, the popovkas seem to have been relatively effective coast-defence vessels; certainly their combination of armament and armour could only have been carried by a conventional ship of much greater draught. Their faults – and they certainly had faults – were exaggerated by critics, both in Russia and aboard, and have left as a legacy stories of uncontrollable ships designed by incompetent men.

Careers

Novgorod (an ancient city on the Volkhov River near Lake Ilmen, one of the great trading centres of mediaeval Russia): Trials began August 1873 and continued in 1874. Cruised to Taganrog on the Sea of Azov in 1875; October 1875 cruised the Crimean coast with Admiral Popov and Edward Reed, visiting Feodosiya and Yalta. Assigned to the defence of Odessa during the Russo-Turkish War of 1877-78, along with *Vitse-admiral Popov*. In the summer 1878 both popovkas cruised to Sulina, on the Danube. Stationed at Sevastopol throughout 1880s, with short summer cruises every year. 1/13 February 1892 reclassified as a 'coast defence armourclad'. By 1893 her hull and machinery were in poor condition. Handed over to the Port of Nikolaev for disposal on 19 April/1 May 1903; stricken 21 June/3 July 1903 and used as a storeship. Offered for sale to Bulgaria in 1908, but the offer was turned down.[37] Sold to private firm for scrapping in December 1911.



Vitse-Admiral Popov *(left) and* Novgorod *(right) in Sevastopol's Southern Bay (Iuzhaia buchta) in the 1880s. Note the six small torpedo boats hauled up on shore; these appear to be several different types of first-generation boats, built at the time of the Russo-Turkish War of 1877-78; originally equipped with spar torpedoes, these craft were rearmed with tubes for Whitehead torpedoes in the 1880s.* (Courtesy of Sergei Vinogradov)

Vitse-admiral Popov (Vice-Admiral Andrei Aleksandrovich Popov, 1821-1898, favourite of General-admiral Konstantin Nikolaevich and inventor of the Russian circular ironclad): Laid down as *Kiev*; renamed on 9/21 October 1873. Trials in 1876. Assigned (with *Novgorod*) to defence of Odessa during Russo-Turkish war (1877-1878). In company with *Novgorod* cruised to Sulina on the Danube in the summer of 1878. Gunnery trials continued after the war with new mountings. Throughout 1880s based at Sevastopol, making annual summer cruises. 1/13 February 1892 reclassified as a 'coast defence armour-clad'. By 1893 hull and machinery were in poor condition. 19 April/2 May 1903 turned over to Nikolaev port authorities for disposal, stricken 21 June/4 July 1903. Offered for sale to Bulgaria in 1908, but the proposal was rejected. Sold for scrap to a private firm in December 1911.

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Sources:
The major source for these vessels is Andrienko, *Kruglye suda admirala Popova* (St. Petersburg: Gangut, 1994) and the same author's earlier article, 'Bronenostsy beregovoi oborony konstruktsii A.A. Popova' (*Sudostroenie*, no. 11, 1985, pp.58-61). Also useful are V.Iu. Gribovskii and I.I. Chernikov, *Bronenostsy beregovoi oborony tipa 'Admiral Seniavin'* (St. Petersburg: Leko, 2009, pp.40-45) and *Istoriia otechestvennogo sudostroeniia*, I.P. Spasskii, general editor (5 volumes; St. Petersburg: Sudostroenie, 1994-1996, vol. II, pp.84-93, 498-499).

Footnotes:
1. It may be noted in passing that it is not clear how the 800-ton size was to be measured, since there were several 'tonnage' formulae in use, and actual water displacement was not yet accepted as the standard measure for the size of warships.
2. The following paragraphs are based on *Istoriia otechestvennogo sudostroeniia*, 2:47-49; Gribovskii and Chernikov, *Bronenosets 'Admiral Ushakov'*, p.40; and Mel'nikov, 'Podgotovka k bronenosnomy sudostroeniiu na Chernom more', *Sudostoenie*, no. 1, 1978, pp.66-69.
3. V.D. Dotsenko, *Morskoi biograficheskii slovar'* (St. Petersburg: Logos, 1995), p.435; *Istoriia otechestvennogo sudostroenie*, 2:84.
4. For details of these vessels, see Stephen McLaughlin, 'Russia's "American" Monitors: The *Uragan* Class', *Warship 2012*, pp.98-112.
5. Jacob W. Kipp, 'Tsarist Politics and the Naval Ministry, 1876-81: Balanced Fleet or Cruiser Navy?' (*Canadian American Slavic Studies*, vol. 17, no. 2 [Summer 1983], pp.151-179), p.158.
6. For Elder's concept, see 'Circular Ships of War with Immersed Motive Power' (*Journal of the Royal United Service Institution*, vol. XII, no. LII (1868), pp.529-547; see also E.E. Guliaev (Goulaeff), 'On Circular Iron-clads' (*Transactions* of the Institute of Naval Architects, vol. XVII [1876], pp.29-61), pp.55-56, 60-61.
7. Quoted in Edward Reed, *Letters From Russia in 1875* (London: John Murray, 1876), p.16.
8. Kipp, 'Tsarist Politics and the Naval Ministry', p.158 n.22.
9. The Russian plural is *popovki*, but the anglicised version, 'popovkas', will be used here.
10. Kipp, 'Tsarist Politics and the Naval Ministry', p.159, mentions the 14ft limit, but does not say when it was adopted.
11. Andrienko, *Kruglye suda admirala Popova*, p.7.
12. Andrienko, *Kruglye suda admirala Popova*, p.14.
13. There is some confusion over just how much work had to be undone; Andrienko, *Kruglye suda admirala Popova*, p.14, says that the existing double bottom structure was dismantled. However, Goulaeff (Guliaev), 'On Circular Iron-clads', p.34, indicates that the existing double bottom structure of the second popovka was simply increased in diameter, without having to be dismantled.
14. The National Archives, Kew: ADM 226/1, William Froude, 'Report of Experiments with Models of Russian Circular Ironclads', 1 March 1876.
15. D.K. Brown, *A Century of Naval Construction: The History of the Royal Corps of Naval Constructors* (London: Conway Maritime Press, 1983), p.40; *Morskoi biograficheskii slovar'*, p.135.
16. Andrienko, *Kruglie suda admiral Popova*, p.37.
17. Goulaeff (Guliaev), 'On Circular Iron-clads', p.35.
18. Andrienko, *Kruglye suda admirala Popova*, p.23.
19. Goulaeff (Guliaev), 'On Circular Iron-clads', p.31.
20. Reed, *Letters From Russia in 1875*, p.17.
21. Goulaeff (Guliaev), 'On Circular Iron-clads', p.31.
22. V.V. Arbuzov, *Bronenosets 'Pëtr Velikii'* (St. Petersburg: Nauchno-Populiarnoe Izdanie, 1993), p.35.
23. Goulaeff (Guliaev), 'On Circular Iron-clads', p.31; *Conway's All the World's Fighting Ships, 1860-1905* (London: Conway Maritime Press Ltd., 1979), p.177. V.M. Tomitch, *Warships of the Imperial Russian Navy*, vol. 1: *Battleships* (San Francisco [?]: BT. Publishers, 1968), p.91, says the total height of the armour was 5ft 11in; this is probably a conversion error working back from a metric figure.
24. Goulaeff (Guliaev), 'On Circular Iron-clads', p.31.
25. V.V. Arbuzov, *Bronenosets 'Petr Velikii'*, pp.49-57.
26. Goulaeff (Guliaev), 'On Circular Iron-clads', p.32.
27. Andrienko, 'Bronenostsy beregovoi oborony konstruktsii A.A. Popova', p.61.
28. Goulaeff (Guliaev), 'On Circular Iron-clads', p.33.
29. *Popovka. Sbornik statei o kruglykh sudakh* (St. Petersburg: A.A. Kraevskii, 1875) and *Dopolnenie k sborniku Popovka. Eshche stat'i o kruglykh sudakh* (St. Petersburg: A.A. Kraevskii, 1875).
30. Reprinted in *Popovka. Sbornik statei o kruglykh sudakh*, p.168.
31. Reed, *Letters From Russia in 1875*, pp.45-46.
32. Fred T. Jane, *The Imperial Russian Navy* (originally published in 1904; reprint edition: London: Conway Maritime Press, 1983), p.175. Donald W. Mitchell, *A History of Russian and Soviet Sea Power* (New York: Macmillan Publishing Co., Inc., 1974), pp.178-179, repeats much the same story.
33. Andrienko, *Kruglye suda admirala Popova*, p.23.
34. Andrienko, *Kruglye suda admirala Popova*, p.12.
35. William Hovgaard, *Modern History of Warships* (reprint edition: London: Conway Maritime Press, 1978), p.40.
36. ADM 226/1, William Froude, 'Report of Experiments with Models of Russian Circular Ironclads', 1 March 1876.
37. *Conway's All the World's Fighting Ships 1906-1921* (London: Conway Maritime Press, 1980), p.411.