

NAVIES OF THE WORLD.

IV.—RUSSIA.

So extraordinarily rapid is the growth of the world's navies under the spur of feverish competition, that it is almost impossible to name the exact strength of each navy at any particular period of time. The present series of articles are based upon the actual number of ships built, building, or of which the keel was laid down on January 1, 1899. To secure this data, not to mention the copious illustrations, has been a work entailing no little correspondence and research; but our readers may rest satisfied that the comparisons as given in the general article of December 31 and amplified in the special articles treating of the separate navies are correct.

The tables of comparative strength show that on the opening day of the present year the effective and up-to-date vessels of the Russian navy numbered 86, with a total tonnage of 453,899 tons, divided as follows: Battleships, 23 of 250,891 total tonnage; coast defense vessels, 14 of 40,810 tons; armored cruisers, 11 of 90,432 tons; protected cruisers, 6 of 31,766 tons; small cruisers and gunboats, 32 of 40,000 tons.

The most striking feature in the Russian navy is the fact that more than half of its ships in numbers and 84 per cent in displacement consists of armored vessels in the shape of battleships, coast defense vessels, and armored cruisers. Out of a total of about 454,000 tons, only about 72,000 tons consists of unarmored ships. Furthermore, it should be noted that the Russians, like ourselves, have shown a fondness for extremely heavy batteries, the armament of such vessels as the battleship "Tri Sviatételia" and the armored cruiser "Rossia" consisting of batteries which surpass anything under construction, unless it be our own "Maine."

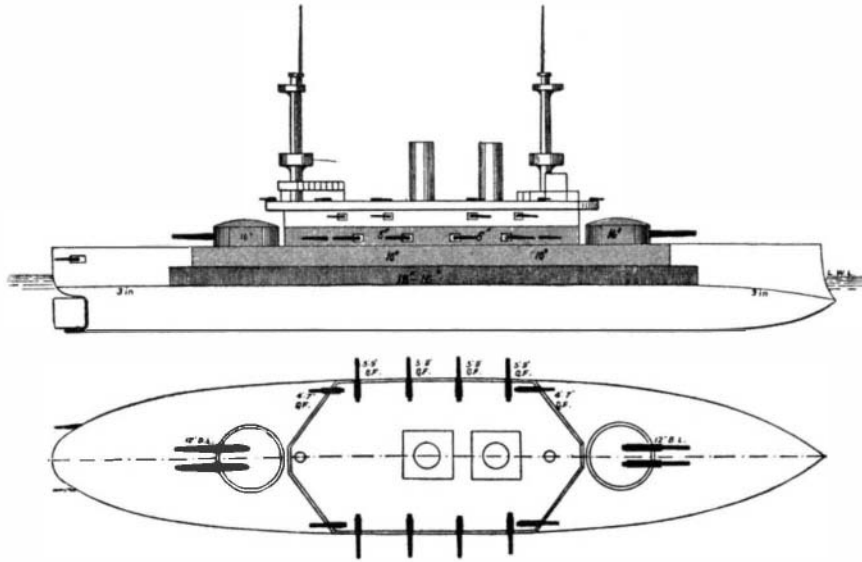
**BATTLESHIPS.**—In battleships of the first class Russia is exceptionally strong, having 17 excellent ships, none of which is over 10 years old. This is just one-half

smaller rapid-fire guns. The battery is carried on the main and gun decks and is well distributed, care being taken to avoid interference of fire. Eight of the 6-inch rapid-fire guns are carried in a central battery protected by 6-inch armor, on the gun deck. Forward of this battery on the same deck are eight 3-inch rapid-firers, while aft are four more. The main deck will be flush throughout, except where it is broken by the amidship superstructure. The 12-inch rifles will be carried in two elliptical turrets forward and aft of the superstructure. Within the superstructure, one at each angle and protected by Krupp armor, will be four 6-inch rapid-fire guns, while between them in broadside will be six of the 3-inch rapid-firers. On the superstructure deck will be two 3-inch guns, one on each broadside. The other twenty-eight rapid-fire guns of small

"Tavritchesky" and "Tri Sviatételia," of 12,480 tons and 18 knots speed. The latter vessel was launched in 1893 and is completed, while the former is still under construction. Both ships carry 12-inch guns as the main armament, while their heavy secondary or intermediate battery is made up of 6-inch, 4.7-inch, and 3-inch rapid-firers, as given under the diagrams on the accompanying page. The secondary battery of small guns is very powerful. The earlier ships carry fifty-six of these guns alone, or seventy guns in all. In the "Tri Sviatételia" the protection consists of 18 and 16-inch armor on the belt and barbettes, while in the "Tavritchesky" the use of face-hardened armor allows the thickness to be reduced to 9-inches on the belt and 10 inches on the barbettes.

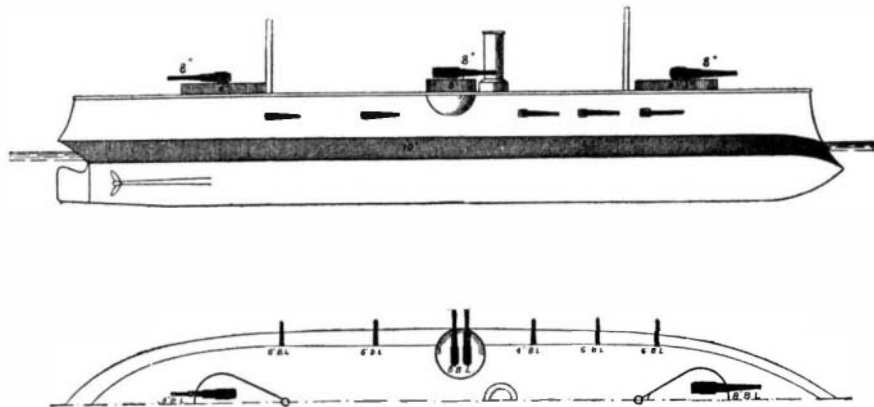
The battleships already mentioned are the pick of the Russian navy, and they will form a homogeneous fleet of nine practically identical ships of high speed, great size, and powerful armament, which will be the equal in fighting quality of any seven ships that could be brought against them. If they have a weak point, it is that the large crews carried must be badly crowded in ships so loaded with guns, and the weight of guns and crews, stores, and equipment must have necessitated a limited supply of ammunition. Thus the "Oslabya," of 12,674 tons and 732 men, carries about the same crew as the British "Formidable," of 15,000 tons and 750 men.

The next battleships preceding the "Tri Sviatételia" are the sister ships "Poltava," "Petropavlosk," and "Sevastopol," of 10,960 tons and 17.5 knots speed, the two former launched in 1894 and the latter in 1895. They are well protected, carrying 15 3/4-inch Harvey steel on the belt and 10 inches on the gun positions, while the deck is 3 1/2 inches in thickness. The armament is heavy and is disposed, as far as the secondary battery is concerned, after the manner of that on the French "Jauréguiberry," in pairs in turrets. It consists of four 12-inch, twelve

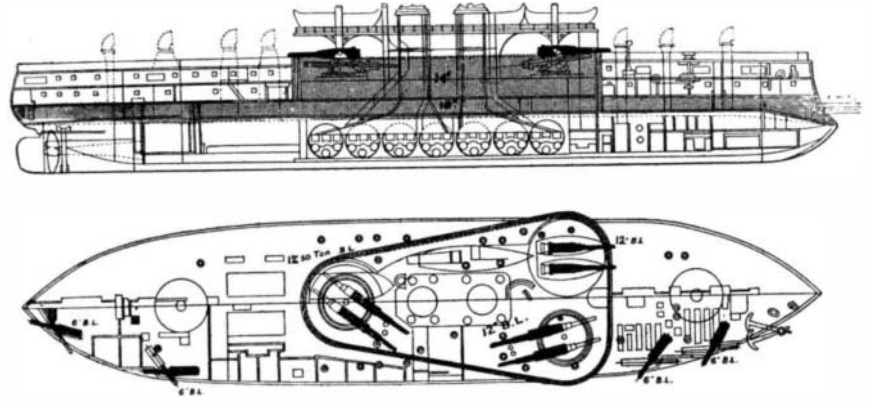


First-class Battleship "Tri Sviatételia." Also with modifications, the "Tavritchesky."

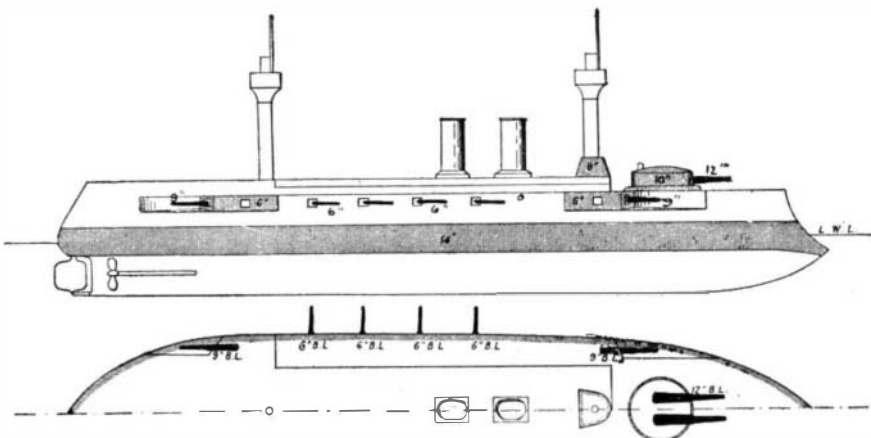
**Displacement,** 12,480 tons. **Speed,** 18 knots. **Normal Coal Supply,** 1,000 tons. **Armor:** Belt, 18 inches; gun positions, 16 inches; deck, 3 inches. **Armament,** four 12-inch B. L., eight 5.9-inch rapid-fire, four 4.7-inch rapid-fire, fifty-six small rapid-fire pieces. **Torpedo Tubes,** 6. **Complement,** 582. **Date,** 1893. **Five ships are building of the "Peresviet" type. These are improved "Tri Sviatételias,"** of 12,674 tons and 18 knots, with 9 1/2-inch belts and armed with four 12- or 10-inch B. L. guns, eleven 6-inch rapid-firers, sixteen 3-inch, ten 1.8-inch and seventeen 1.4-inch rapid-firers.



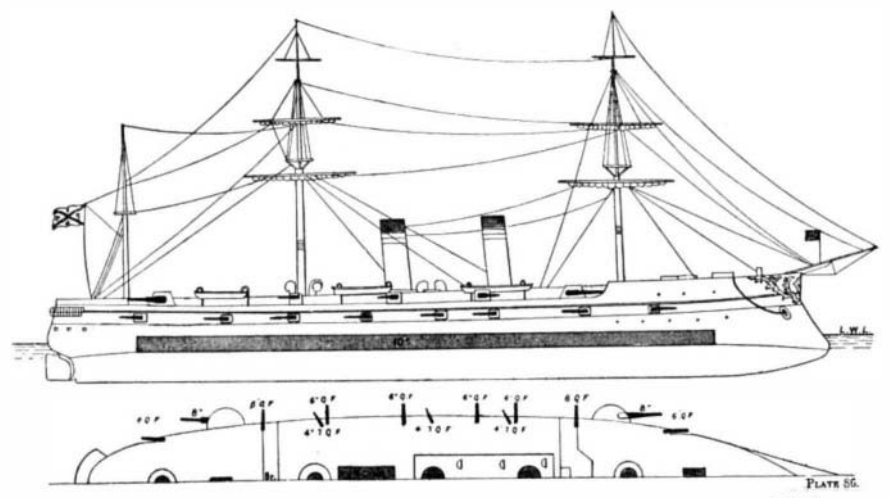
Armored Cruiser "Admiral Nakhimoff."



First-class Battleship "Tchisme." Class of Four Ships.



First-class Battleships "Nicolai I." and "Alexander II."



Armored Cruiser "Rurik," 10,923 Tons. Also Three of "Rossia" Class of over 12,000 Tons and 20 Knots.

as many battleships of this class as are built or building for the British navy, whose total tonnage is nearly four times as great as that of Russia; while France, whose tonnage is two-thirds greater than that of Russia, has only 14 battleships in the "10 year old or less" class.

The latest and best of these vessels is represented by the new battleship "Retvisan," now building for Russia at the Cramps' shipyard, Philadelphia, and illustrated in the SCIENTIFIC AMERICAN of November 5, 1898. Five of these ships are being built, the other four being under way in France and Russia. The particulars of the American-built vessel are as follows: Displacement, 12,700 tons; speed, 18 knots. Armor: Belt, 9 inches; upper belt, 6 inches; deck, 2 inches on flat, 4 inches on slopes. Armament: Four 12-inch B. L. rifles; twelve 6-inch, twenty 3-inch, and twenty-eight

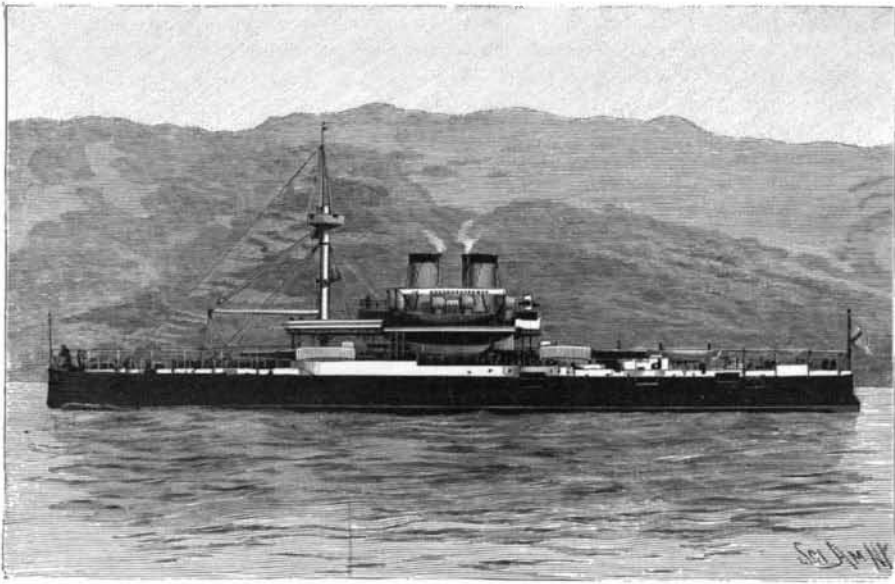
caliber will be scattered throughout the bridges, superstructure, and tops.

Preceding these five battleships in date of commencement are the battleships "Oslabya" and "Peresviet," the "Peresviet" forming the prototype for the whole five. They are being built on the Neva for the Baltic fleet, and the particulars are as follows: Displacement, 12,674 tons; speed, 18 knots; protection, a 9 to 7-inch belt, 9-inch barbettes, and a deck from 1 1/4 to 2 3/4 inches in thickness. The armament, though less powerful than that of the Cramp ship, is very effective, consisting of four 10-inch B. L. rifles, eleven 6-inch rapid-firers, sixteen 3-inch and twenty-nine smaller rapid-fire guns. The vessels will carry Belleville water-tube boilers and will be driven by triple screw engines. The maximum coal capacity is over 2,000 tons.

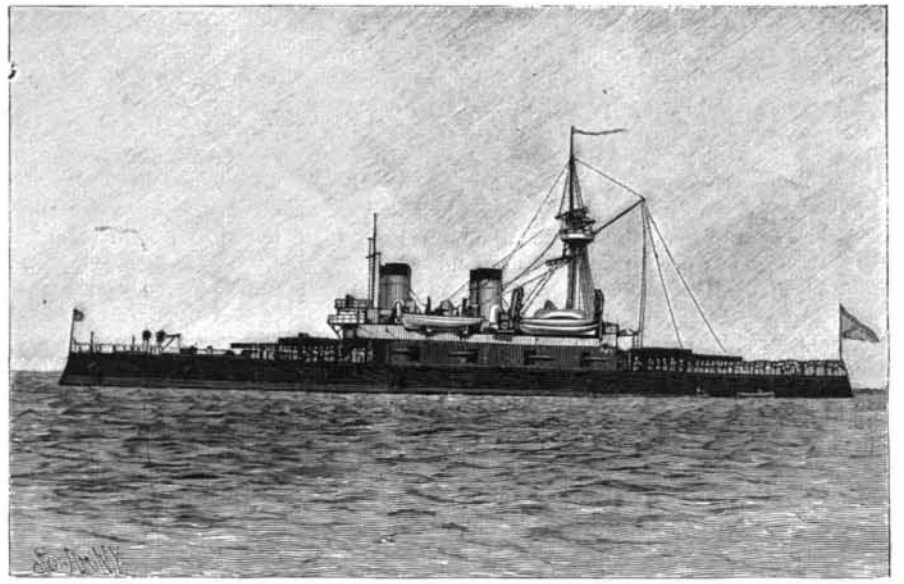
Of earlier date, and now building, are the battleships

6-inch, of which eight are in four turrets and four on the main deck mounted in casemates. There are twenty-four smaller guns. These three ships have easily maintained 17.5 knots on trial, and in every point of comparison they stand in the front rank as battleships.

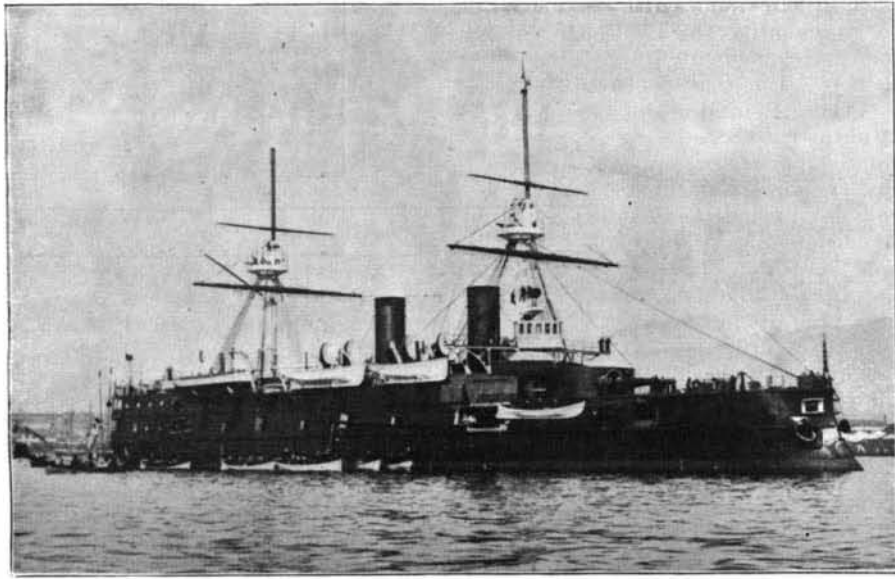
The two sister battleships, "Sissoi Veliky" (1894) and "Rostislav" (1896), and the "Twelve Apostles" (1890), are similar in size, speed, and offensive and defensive qualities. The two former are of 8,880 tons and 16 knots, carry 15 3/4-inch compound armor on belt and barbettes, and are armed, the "Veliky" with four 12-inch and six 6-inch rapid firers, and the "Rostislav" with four 10-inch and eight 5.9-inch rapid-firers, both carrying the large number of small rapid-firers characteristic of Russian ships. The "Twelve Apostles," of 8,076 tons and 16.6 knots, has 14-inch and 12-inch com-



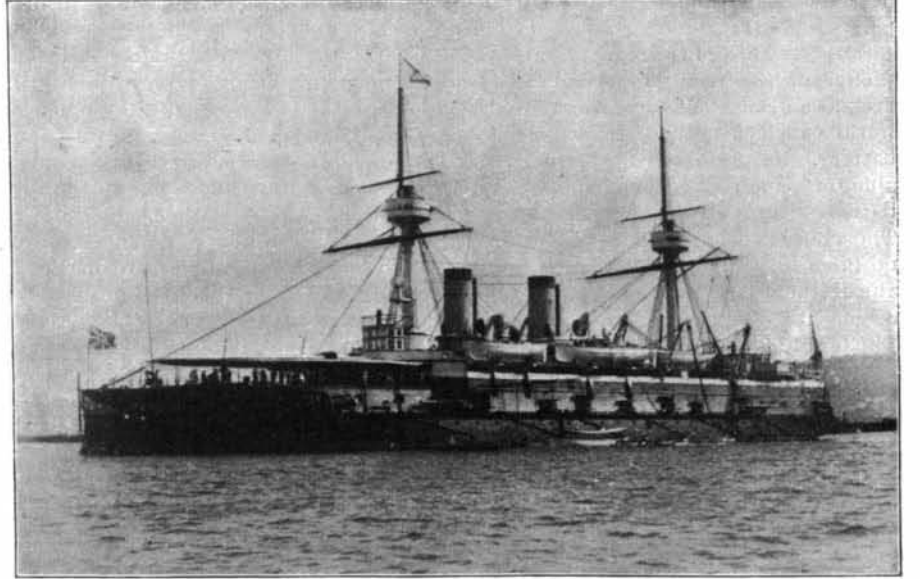
3.—First-class Battleship "Tchesme." "Sinope" Class of Four Ships.  
**Displacement**, 10,180 tons. **Speed**, 15 knots. **Normal Coal Supply**, 886 tons. **Armor**: Belt, 16 inches; gun positions, 14 inches; deck, 3 inches. **Armament**, six 12-inch, seven 6-inch B. L. rifles, eight small rapid-firers and six machine guns. **Torpedo Tubes**, 7. **Complement**, 325. **Date**, 1886.



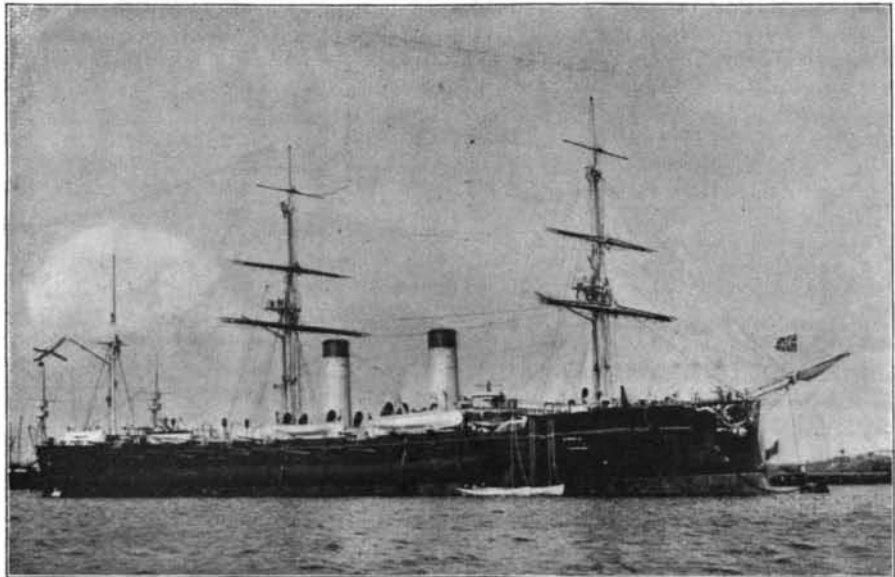
4.—First-class Battleship "Navarin."  
**Displacement**, 10,206 tons. **Speed**, 16 knots. **Coal Supply**, 1,200 tons. **Armor**: Belt, 16 inches; gun positions, 12 inches; deck, 3 inches. **Armament**, four 12-inch, eight 6-inch, fourteen small rapid-fire guns. **Torpedo Tubes**, 6. **Date**, 1891.



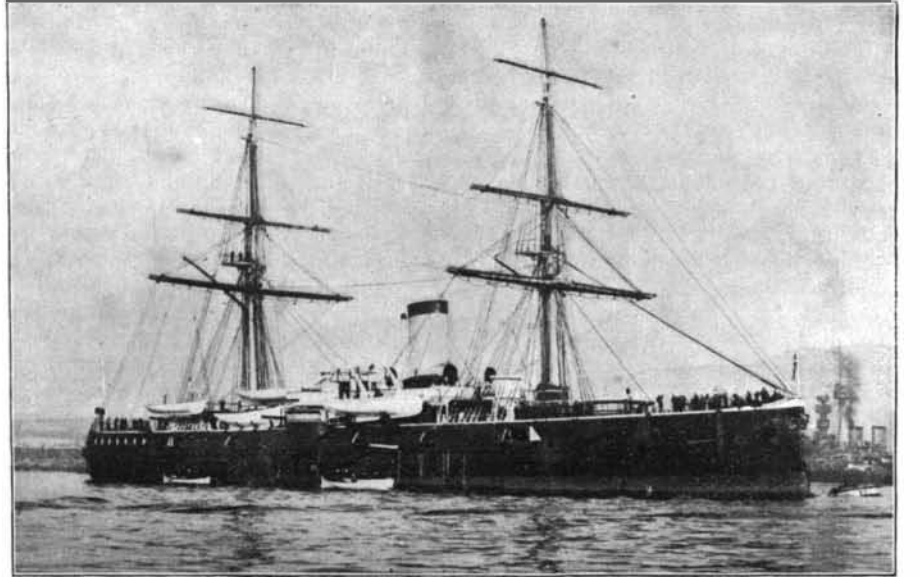
5.—First-class Battleship "Nicolai I."  
**Displacement**, 9,672 tons. **Speed**, 14.8 knots. **Coal Supply**, 1,000 tons. **Armor**: Belt, 14 inches; gun positions, 10 inches; deck, 2½ inches. **Armament**, two 12-inch B. L. rifles, four 9-inch B. L. rifles, eight 6-inch rifles, twelve small rapid-fire guns, eight machine guns. **Torpedo Tubes**, 6. **Complement**, 604. **Date**, 1888.



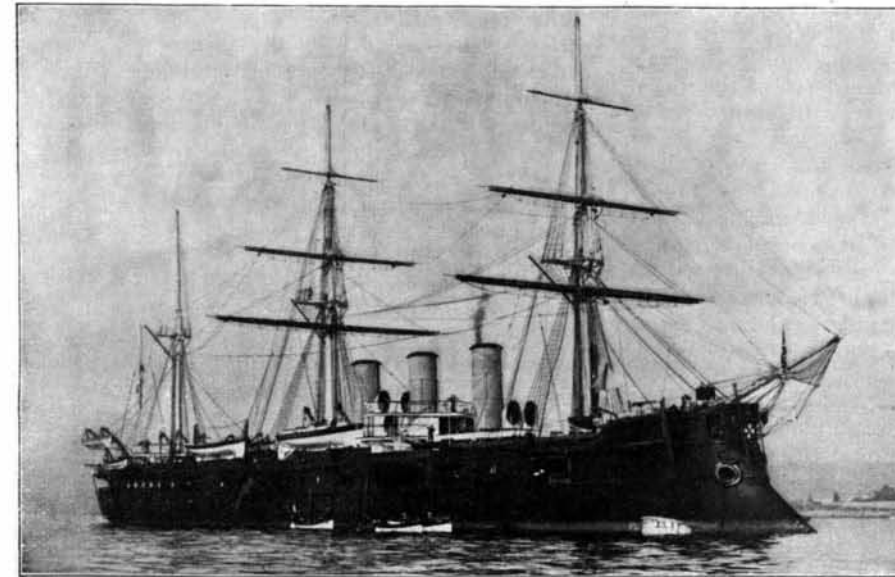
6.—First-class Battleship "Alexander II."  
**Displacement**, 9,927 tons. **Speed**, 16.5 knots. **Coal Supply**, 1,200 tons. **Armor**: Belt, 14 inches; gun positions, 10 inches; deck, 2½ inches. **Armament**, two 12-inch B. L. rifles, four 9-inch, eight 6-inch, four 3-pounders, six machine guns. **Torpedo Tubes**, 5. **Complement**, 604. **Date**, 1887.



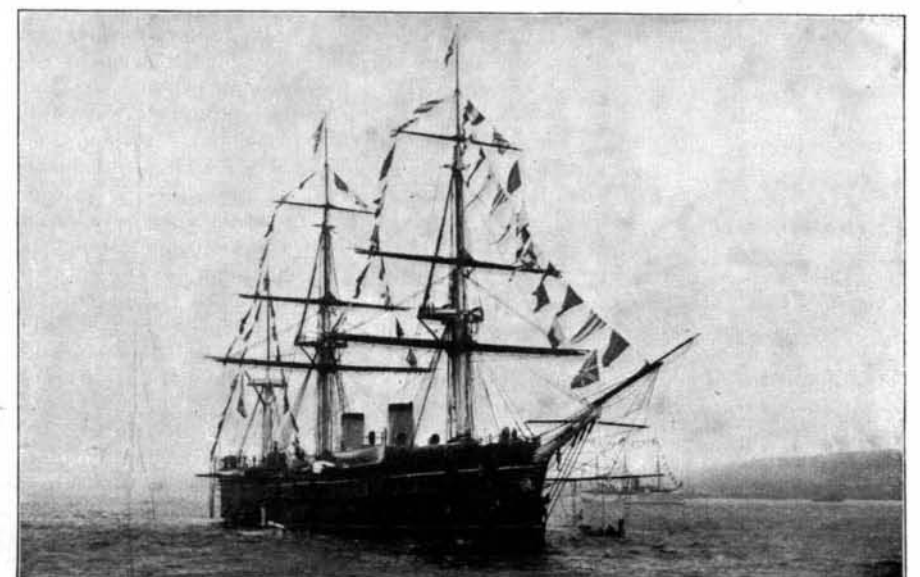
7.—Armored Cruiser "Rurik."  
**Displacement**, 10,923 tons. **Speed**, 18 knots. **Maximum Coal Supply**, 2,000 tons. **Armor**: Belt, 10 inches; deck, 2½ inches. **Armament**, four 8-inch, sixteen 6-inch B. L. rifles, six 4.7-inch rapid-fire guns, eighteen small rapid-fire and machine guns. **Torpedo Tubes**, 5. **Complement**, 765. **Date**, 1894.



8.—Armored Cruiser "Admiral Nakhimoff."  
**Displacement**, 8,524 tons. **Speed**, 16.7 knots. **Coal Supply**, 1,200 tons. **Armor**: Belt, 10 inches; gun positions, 8 inches; deck, 3 inches. **Armament**, eight 8-inch, ten 6-inch, fourteen small rapid-fire guns, six machine guns. **Torpedo Tubes**, 4. **Complement**, 567. **Date**, 1885.



9.—Armored Cruiser "Pamyat Azova."  
**Displacement**, 6,675 tons. **Speed**, 18.8 knots. **Normal Coal Supply**, 1,000 tons. **Armor**: Belt, 9 inches; gun positions, 8 inches; deck, 2½ inches. **Armament**, two 8-inch, thirteen 6-inch B. L. rifles, fourteen small rapid-fire guns, three machine guns. **Torpedo Tubes**, 7. **Complement**, 525. **Date**, 1888.



10.—Armored Cruiser "Dmitri Donskoi."  
**Displacement**, 5,882 tons. **Speed**, 16.5 knots. **Normal Coal Supply**, 400 tons. **Armor**: Belt, 6 inches; deck, 2½ inches. **Armament**, two 8-inch B. L. rifles, four 6-inch rapid-fire, ten 4.7-inch rapid-fire, sixteen smaller rapid-fire guns, four landing guns. **Torpedo Tubes**, 4. **Complement**, 510. **Date**, 1883.

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pound armor on belt and barbettes and is armed with four 12-inch, four 6-inch rifles, and eighteen small rapid-firers.

The other two battleships of the total seventeen that are ten years old or less are the "Navarin" (1891), of 10,206 tons and 16 knots, with 16 and 12-inch armor and carrying four 12-inch, eight 6-inch rifles and eighteen smaller guns, and "George the Victorious" (1892), of 10,280 tons and 16.5 knots, with 16-inch belt, 12-inch barbettes, and armed with six 12 inch and seven 6-inch rifles, eight 3.9-inch rapid-fire guns and several smaller rapid-firers.

The latter ship is an improvement on the three well-known battleships of the "Sinope" class (1886), the "Sinope," "Catherine II.," and "Tchesne." The distinguishing characteristics of these vessels is the large number of guns in the main battery (six 12-inch) and the peculiar triangular redoubt within which they are carried. The belt armor, 16 inches in thickness amidships, is continuous from stem to stern. At the level of its upper edge is a protective deck, 3 inches in thickness, and upon this is built up a huge redoubt with walls protected by 14 inches of armor, which rises through two decks to a vertical height of 18 feet, the upper edge of the redoubt being 3 feet above the main deck. In each angle of this central fort is placed a pair of 12-inch guns mounted on disappearing gun-carriages. The guns are loaded and trained below the shelter of the redoubt, rising to fire over the main deck as a glacis. These are the only battleships in the world which carry more than four guns in the main battery. But although the main battery looks formidable on paper, it is not more so than the four-gun battery placed in the usual two turrets, fore and aft. The concentration of fire on the broadside or aft is no greater, and while it is true four guns can be fired ahead, the system adopted in the late "Maine" allowed a concentration of four guns both ahead or astern. The fact that the Russians have not repeated the type is proof that it has not the merits of the standard two turret system. The chief objection is that one big shell entering the redoubt might disable the elevating mechanism of all six gun-carriages.

The three ships just mentioned come in the class of ships "10 to 20 years old." The other two battleships in this class are the "Alexander II." and the "Nicolai," the particulars of which are given beneath the cuts of these vessels. They are later vessels than the "Sinope" class, and great changes have been made as compared with their predecessors. Four of the 12-inch guns are thrown out and the remaining pair are placed in a single turret forward. The four 12-inch are replaced by four 9-inch rifles which are carried at the four corners of the broadside battery on the gun deck, and are capable of being fired dead ahead and dead astern. The secondary battery of eight 6-inch guns is carried in broadside between the 9-inch guns.

The modern character of the Russian navy is shown by the fact that among 23 battleships there is only one vessel in the "old battleship" class, the "Peter Veliky," of 9,891 tons and 14.5 knots, launched in 1872. She has 14 and 8-inch armor and carries four 12-inch 40-ton guns as her main battery.

**COAST DEFENSE VESSELS.**—The newest of the 14 coast defense vessels are the four ships of the "Admiral Oushakoff" class (1893-94), which are of 4,126 tons and 16 knots speed, are protected by a 10-inch belt, and a 3-inch deck, and have their four 9-inch guns protected by 7 to 8 inches of armor. Each is provided with four torpedo tubes. They carry 400 tons of coal and the complement is 318 officers and men. The names of the other ships are the "Admiral Seniavin" and "Admiral Apreaie," while a new vessel of the class is being built. These excellent little fighting ships constitute the best part of the coast defense flotilla. Next to them in value are the four modern armored gunboats of the "Gremiastchy" type (1890-95), of 1,500 tons and 15 knots speed, armed with one 9-inch, one 6-inch, and eight smaller guns, and protected by a 5-inch belt and a 1½-inch deck. Each gunboat carries two torpedo tubes. The above eight vessels are the best of the coast defense fleet, the other half dozen ships being old vessels of from 25 to 30 years of age. The most notable of these is the circular floating fort "Admiral Popoff" (1875), of 3,590 tons, which mounts two 12-inch guns and has a speed of 8 knots.

**ARMORED CRUISERS.**—The Russian navy includes 11 of these very useful and all around fighting ships. The best known of these are the "Rurik" (1894) and the "Rossia" (1896). The former, on account of her unprecedented size and fighting powers, created a great sensation at the time of her completion, and was no doubt the direct cause of the British Admiralty building the "Powerful" and "Terrible." She is of 10,923 tons displacement, is protected by a 10-inch belt, but has the moderate speed of only 18 knots. Her armament is, or was, the most sensational feature of the ship (we are familiar with mighty batteries now), comprising four 8-inch rifles carried in sponsons forward and aft on the main deck on the beam, with a fore and aft axial fire; sixteen 6-inch slow-fire guns, carried in broadside on the gun deck; six 4.7-inch rapid-firers carried between the 8-inch guns on the main deck, and

18 small rapid-firers. Another valuable feature of these ships is the large coal capacity of 2,000 tons. The weak feature of the "Rurik" is that her large armament is but poorly protected, none of the guns being provided with casemates and the shields being comparatively light and ineffective against the more powerful rapid-fire guns. The guns, moreover, are nearly all of the slow-fire pattern. The "Rurik" was followed by the "Rossia," an improved "Rurik." She is 1,200 tons larger, the same protection, practically the same battery, except that the six 4.7-inch guns are replaced by a numerous battery of 3-inch guns and all the weapons except the 8-inch are rapid-firers. The speed is raised to 20 knots and the coal capacity to 2,500 tons. Another change is the entire removal of the sails and yards, which are a conspicuous feature in the "Rurik." Critics complain that the same defect of limited protection for the guns exists in the "Rossia." The "Gromoboi" and another ship, both of the "Rossia" type, are now under construction.

Another well known armored cruiser is the "Pamyat Azova," of 6,675 tons, 18.8 knots, whose particulars will be found under the illustration of the ship. She is provided with full sail-power, the Russians showing a greater reluctance than any other nation to part with this relic of the days of wooden frigates and battle ships. The "Pamyat" has one peculiarity which will be noticed in the "Rossia," namely, a 6-inch gun firing through a port directly in the bow. This is also seen in several of the French ships. The "Admiral Nakhimoff" (1885) is another fine ship of this class. She is brig-rigged, and with her single elliptical funnel presents a very handsome appearance. In her main armament she closely resembles the "Brooklyn," having the same number of 8-inch guns similarly disposed, two forward, two aft, and two on each beam. These guns, however, are not so well protected, firing as they do from a barrette, whereas the "Brooklyn's" guns are in turrets.

The other six armored cruisers are of an average displacement of 5,754 tons and an average speed of 15.6 knots. The most modern of them is the "Dmitri Donskoi" (1883), a sheathed vessel, bark-rigged, of 5,882 tons and 16.5 knots speed, which will be familiar to many of our readers as having figured in the Columbian Naval Review at New York. Our cut is made from a photograph taken as the vessel lay in the North River. The "Vladimir Monarch" (1882), of 6,061 tons and 15.2 knots, carries five 8-inch and twelve 6-inch guns; the "General Admiral" is armed with six 8-inch and two 6-inch, while the remaining two carry four 8-inch as the main armament.

**PROTECTED CRUISERS.**—It is only during the last two or three years that Russia has paid much attention to the protected cruiser class, in which she has only some half-dozen of over 2,000 tons built or building. One of these, the "Korniloff," 5,000 tons, 17.5 knots, two 8-inch and fourteen 6-inch guns, was built in 1887 and refitted in 1895. Three others, the "Bogatyr," "Askold," and "Novik," 6,630 tons, 20 knots, carrying six 5.9-inch and six 4.7-inch rapid-firers, are being built in German yards, while two vessels of 6,500 tons and 23 knots speed are being built in France and the United States, one at Toulon and the other at the Cramps' yard in Philadelphia. The Cramp vessel, which will be named the "Waryag," like the others of her class, in addition to her high speed will have a powerful armament, consisting of twelve 6-inch, twelve 3-inch, and six 1½-inch rapid-fire guns, besides four torpedo tubes. A full description, with illustrations, of this ship was given in the SCIENTIFIC AMERICAN of November 5, 1898. Other cruisers that can steam above the 15 knots per hour adopted as a limit in these comparative articles are the "Merkuriya," 3,050 tons, 16 knots, carrying six 6-inch guns, and the "Svietlana," 3,828 tons, launched in 1896 at Havre, a vessel of 20.2 knots, armed with six 5.9-inch rapid-fire Canet guns, and ten 1.8-inch, and carrying a maximum coal supply of 1,000 tons.

**SMALL CRUISERS AND GUNBOATS.**—This class in the Russian navy is made up of thirty-two ships of an average displacement of 1,250 tons and an average speed of 16.6 knots. The four gunboats of the "Donetz" type (1887) have the following dimensions: Displacement, 1,224 tons; speed, 13.5 knots; armament, two 8 inch, one 6-inch, and seven small guns. There are nine gunboats of from 1,200 to 1,300 tons, built of iron and wood between 1878 and 1882, having a speed of 13 knots, and armed either with two 8-inch or three 6-inch guns. The most recent vessels in this class are half a dozen gunboats of from 400 to 500 tons, which show speeds of from 20 to 23 knots, and are armed with 1.8 and 1.4-inch rapid-fire guns.

In concluding our review of the Russian navy, we wish to emphasize the fact that it is essentially a fighting navy, the bulk of its tonnage being made up of heavily armed and armored ships. High speed is not a characteristic feature, and the Russians appear to have been satisfied to sacrifice this quality in favor of armor and guns. As Great Britain has elected to set up the combined strength of France and Russia as the standard which she must at least equal, if not surpass, it is interesting to compare the relative strength of the "Dual Alliance" and the "Mistress of the Seas," as shown by our system of comparison by displacement.

COMPARATIVE FIGHTING STRENGTH.

DESCRIPTION OF TYPE.	GREAT BRITAIN.		FRANCE AND RUSSIA.	
	Number of Ships.	Total Displacement, in Tons.	Number of Ships.	Total Displacement, in Tons.
Battleships, 10 years or less.	34	476,272	31	3,0798
Battleships, 10 to 20 years.	11	104,314	14	141,850
Battleships, Old or Refitted.	9	79,848	13	99,675
Totals.....	54	660,434	58	592,362
Coast Defense Vessels.	25	157,100	28	91,730
Armored Cruisers, 9,000 tons and up.	8	108,000	11	115,753
Armored Cruisers, 7,000 to 9,000 tons.	2	16,800	4	31,624
Armored Cruisers, Below 7,000 tons.	7	39,200	16	90,304
Totals.....	17	164,000	31	237,681
Protected Cruisers, 10,000 tons and up.	10	116,400	.....	.....
Protected Cruisers, 7,000 to 10,000 tons.	11	85,550	4	32,056
Protected Cruisers, 4,000 to 7,000 tons.	30	150,000	17	87,717
Cruisers, 2,000 to 4,000 tons.	46	134,510	22	66,438
Totals.....	97	496,460	43	186,211
Small Cruisers and Gunboats.	97	89,628	70	77,554
Grand totals.....	200	1,557,522	230	1,185,538

Great Britain, evidently, is holding her own with a safe margin to spare, having about twenty-five per cent more ships and thirty per cent more total displacement than France and Russia combined. To this must be added the incalculable advantage that comes from having ships built upon identical lines, with the same maneuvering qualities as to speed and helm (turning movements), and the same arrangement of batteries. If to this be added the gain resulting from the fact that the personnel is of one race and language, the actual superiority must be increased from thirty per cent to fully forty or fifty per cent.

Comparing the French and Russian navies, we are inclined to think that the greater homogeneity of the Russian ships, their heavier armaments, the fact that they are, as an average, of later construction, and the more stubborn fighting qualities of the Russian sailor considerably offset the numerical superiority of the French navy. The total numbers and displacements are for the French navy 144 ships and 731,629 tons and for the Russian navy 86 ships and 453,899 tons.

Character of the Tagales.

A writer in the Neuesten Nachrichten, Munich, describes the Tagales, the dominant race in the Philippines, in the main as follows:

They are not incapable of adopting civilization in the modern sense, as they are a very mixed race. The admixture of Chinese blood has produced very good results. The number of mestizos whose father was white is also very large, and it is these descendants of the Spaniards who fight the battle of freedom. Nor are the Tagales themselves without civilization. They have shown much natural strength, have advanced from their original home in central Luzon to every part of the Philippines and assimilated many Malay tribes. Two enemies they have, which are more dangerous than either the Spaniard or the Americans. They are indolent and their morals are lax. The Spaniards have done much to civilize them, but to this day many return to the life of a hunter after some years' residence in towns and villages. They were, nevertheless, in a pretty advanced state of civilization when the Spaniards came. This is easy to see in the Igorrotos, a kindred race, which remains heathen to this day. The Igorrotos live in fine villages of well-built houses, and their agricultural system is really worthy of admiration. The Tagales themselves are ardent Catholics, but they retain many heathen customs. Their highest aim is to get a son into the church, but they do not observe celibacy very strictly. Many of the mestizos, Chinese as well as white, are wealthy men, and as these lead in the movement for independence, it will be difficult to conquer the islands.—Translation made for The Literary Digest.

Collapse of a Grand Stand.

The steel grand stand at Monmouth Park race course was recently destroyed by a storm. It was the largest structure of its kind in the world. The total length of the building was 700 feet and its width was 210 feet; the seating capacity was 12,000; 1,000 tons of steel, 1,000,000 feet of lumber, and 500,000 bricks were used in its construction. The cost, including dining rooms, furnishings, etc., was \$180,000.

**A New Form of Photographic Telescope.**

Prof. E. C. Pickering, of Harvard, has made a strong plea in favor of certain new methods of conducting astronomical work. A great number of very large telescopes of nearly the same form, he says, have been given to observatories during the last few years. Although such instruments are indispensable, in a limited number of investigations, yet when the latter are divided among so many telescopes the results obtained by each are often disappointing to the donors. These instruments have been erected, with two or three exceptions, in places selected from local or political motives, and without regard to meteorological or astronomical conditions. For this reason, the great observatories of the world are near large cities or universities where the very conditions that have rendered the countries great have rendered them unfit for the most delicate astronomical research. Nine-tenths of these instruments are in the temperate zone in Europe and the United States, while the southern hemisphere has been entirely neglected and many of the most interesting parts of the southern sky have not yet been examined by a modern telescope of the largest size.

This duplication of expensive instruments in unsuitable localities is rendered still more objectionable by another condition. All the telescopes are similar in form, their focal length being from fifteen to eighteen times the aperture, and, therefore, all are best adapted to the same kind of work. In view of these numerous precedents, it was a bold step to deviate from it. But this step was taken, and taken by a woman, Miss Catherine W. Bruce, of New York, who gave \$50,000 to the Harvard College Observatory to construct a telescope of 24 inches aperture, in which the focal length should be only six times the aperture. Fortunately, this experiment succeeded, and the Bruce photographic telescope is mounted in Arequipa, Peru, in a climate unsurpassed, so far as is now known, for astronomical work. Its immediate results are charts, each covering a large part of the sky and showing such faint stars that 400,000 appear upon a single plate. By its aid, many new stars of the peculiar fifth type have been found in the Large Magellanic Cloud, showing an additional connection of this object with the Milky Way. A group of forty nebulae, hitherto unknown, has been found in another part of the sky. The most important work of the Bruce telescope, however, is that every year it sends hundreds of photographs to the great storehouse at Cambridge. Besides the immediate discoveries made from these plates, they doubtless carry with them many secrets as yet unrevealed, and many images of objects of the greatest interest yet to be discovered. A striking example of this kind is found in the recent discovery of the planet Eros, which, next to the moon, is sometimes our nearest neighbor in the heavens. Calculation showed that this planet must have been near the earth, and therefore bright, in 1894. An examination showed that this object, although not discovered until 1898, had not escaped the Harvard telescopes. Two images of it were found upon the Bruce plates, fifteen upon the Draper plates and three upon the Bache plates. It can thus be followed through nearly half a revolution. Six images were also obtained in 1896, when it was more distant and much fainter.

These examples show the advantages of trying new forms of telescopes instead of duplicating those now existing. The Bruce telescope is well adapted to investigations in which the focal length is small. It will therefore be interesting to try the effect of a great focal length. It is proposed to build a telescope with an aperture of 12 to 14 inches and a focal length of 135 or 162 feet. This telescope would probably be placed horizontally and the star reflected into it by means of a mirror. The motion of the earth would be counteracted by moving the photographic plate by clockwork. It would thus become a large horizontal photo-heliograph. This method of mounting a telescope for use on the stars was advocated by the writer in 1881, and has been used here since then with successive telescopes of 2, 4, and 12 inches aperture. The instrument here proposed would be adapted to investigations for which a great focal length would be needed, as the latter would be more than a hundred times the aperture. Several such investigations may be suggested, any one of which, if successful, would amply justify the construction of such an instrument.

Prof. Pickering says the best instrument now in use for photographing the sun is the horizontal photo-heliograph. It is a small instrument of this form. Under favorable atmospheric conditions finer details on the sun's surface could be obtained with a large instrument than have yet been photographed. It could also be used in photographing the protuberances, and it should not be forgotten that preparations must be soon made to observe the solar eclipse of May 28, 1900. The new instrument might be useful in photographing the spectrum of the reversing layer and in showing the details of the inner corona. Images of the moon obtained with such a telescope would be more than a foot in diameter, even if printed without enlargement. These would probably surpass the best photographs yet taken. It is possible that good results could be

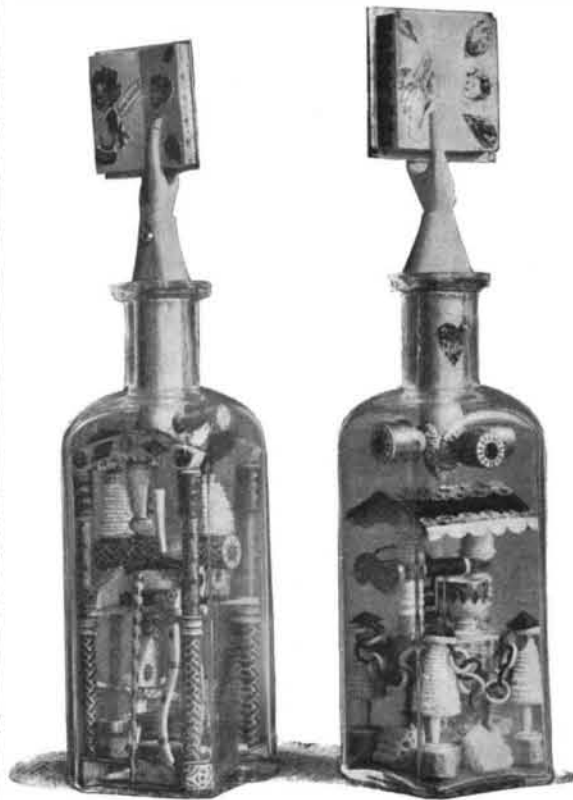
obtained with Jupiter, Saturn, and perhaps Mars. The planet Eros approaches the earth in 1900. This will be a more favorable time for observation than any other until 1927. Careful preparations should, therefore, be made for observing Eros when east and west of the meridian, since the distance of the sun can probably be determined with more accuracy in this way than by any other method of observation yet attempted. This is one of the greatest problems of astronomy, although it was supposed to be solved in the eighteenth century, but it will probably be left until the twentieth century for a satisfactory solution. It is expected that the positions of the adjacent stars could also be determined with this instrument, with an accuracy approaching that of the heliometer.

**A CONVICT'S INGENUITY.**

Not infrequently it happens that the inmates of prisons display a degree of ingenuity not always possessed by their more fortunate fellowmen. How dextrous prisoners are, even in the making of trifles, is



**METHOD OF LOCKING THE STOPPER-ARMS.**



**CURIOUS BOTTLES MADE BY A CONVICT.**

well exemplified in two little bottles which have been sent to us by an inmate of the State's Prison at Windsor, Vt., who has built up a small trade in selling his products. The small price at which these bottles are sold is hardly proportionate to the time and labor spent in making them.

In these bottles there have been inserted a number of objects of a size and structure which would apparently preclude their entrance through the bottle-neck. To carve over seventy-five pieces of wood, to put those pieces into a four-ounce medicine bottle, and to combine and fasten them together so that they shall assume the form of utensils employed in everyday life, is assuredly a task which requires no little skill.

Within one of the two bottles in question a little carpenter's shop has been fitted up. Here may be seen a small shaving-bench with its draw-knife, a gayly colored chopping-block with a latchet half-embedded in the wood, and an ax ornamented with glittering tinsel, propped against the bottle-wall. Upon a saw-buck in the upper half of the bottle a motley-colored log, nearly severed by a cross-cut saw, is mounted. At its inner end the bottle-stopper is provided with two

projecting arms held in sockets by means of elastic strips of rubber.

Within the second bottle a miniature well, with its windlass and bucket, is arranged; and upon the edge of the well there stands a wooden goblet. In each corner of the bottle a delicately whittled tree has been placed. From tree to tree runs a little chain formed of colored pieces of wood, the cutting of which was no doubt the work of days. The stopper of the bottle is provided with four projecting arms. The manner in which these arms are locked in place is shown in one of our illustrations, and certainly constitutes one of the most remarkable features of the work. To the inner ends of the arms strings have been attached and passed up through a central passage running longitudinally through the stopper. By pulling the strings the arms would naturally be forced against the stopper; after having been thus pulled into place, the arms were permanently held by gluing or cementing the strings to the stopper.

One naturally asks, How were all these numerous pieces inserted? The pieces of wood are all smaller than the neck of the bottle, and only the ingenious manner in which they have been combined and fastened together gives to each object its peculiarly large size. The separate pieces were first dipped in glue and then put in place by means of a long and slender pair of wire pliers.

These curious bottles are remarkable for the great patience required in fashioning each piece and for the delicacy of touch and deftness necessary in placing the parts in their proper positions.

**March Number of Our Building Edition.**

The March number of the Building Edition of the SCIENTIFIC AMERICAN is the handsomest number of this journal which has ever appeared, and it is certainly one of the most artistic numbers of any periodical which we have ever seen. The cover consists of a beautiful colored plate representing a residence at San Rafael, Cal. The house is an adaptation of the Moorish "mission" style that is coming into great favor, not only in the Southwest, but also in the North. The style is an evolution of the "adobe" and is one of the most picturesque houses imaginable, being located upon a side hill, the mountain in the rear forming an appropriate background. On opening at the first page we find the courtyard of the Mattei Palace, Rome, illustrated by an exquisite half-tone. There are also thirteen pages of engravings of modern residences, including colonial and gambrel-roofed houses, a casino, and a modern stable. The literary matter in the number is of more than usual interest. It includes a critical review of the exhibition of the Architectural League, and it also contains considerable matter valuable to not only builders, but to those interested in the building of a home. Those of our readers who are not acquainted with the Building Edition should purchase a copy of this unique number, which gives them an admirable idea of the scope of this publication.

**The Current Supplement.**

The current SUPPLEMENT, No. 1210, contains a number of articles of prime importance. "How to Make a Sewing Machine Motor Without Castings" is an article by Cecil P. Poole. This article is accompanied by no less than twenty-five working drawings, which will enable any mechanic of average ability to complete a highly efficient motor for operating sewing machines or light machinery. This is another article in the electrical series which we are publishing. "Nernst's Electric Light," by James Swinburne, is a very important paper read before the Society of Arts. The Nernst light appears to have an enormous future in store for it. "Trade Suggestions from the United States Consuls" occupies another page and is a new department of the SUPPLEMENT which will be continued regularly. "Transcaspian Railway" is an illustrated article. "An Abstract of the Report of the Commissioner of Patents for the Year 1898" gives a valuable summary of the work and needs of the office and desired legislation. Dr. Howard's "Economic Status of Insects as a Class" is completed. "Nutrition Investigations at the University of Tennessee" is an elaborate paper.

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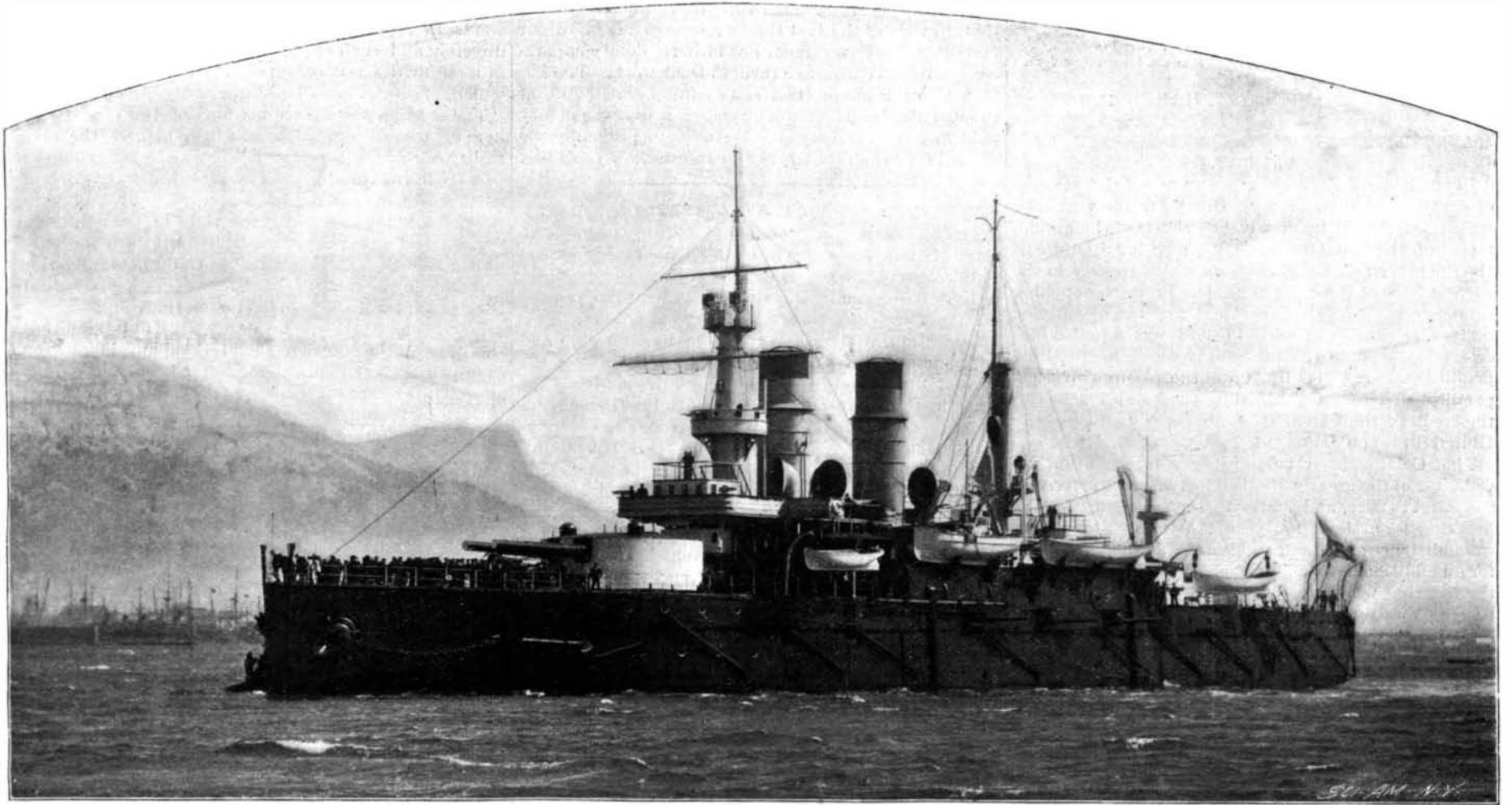
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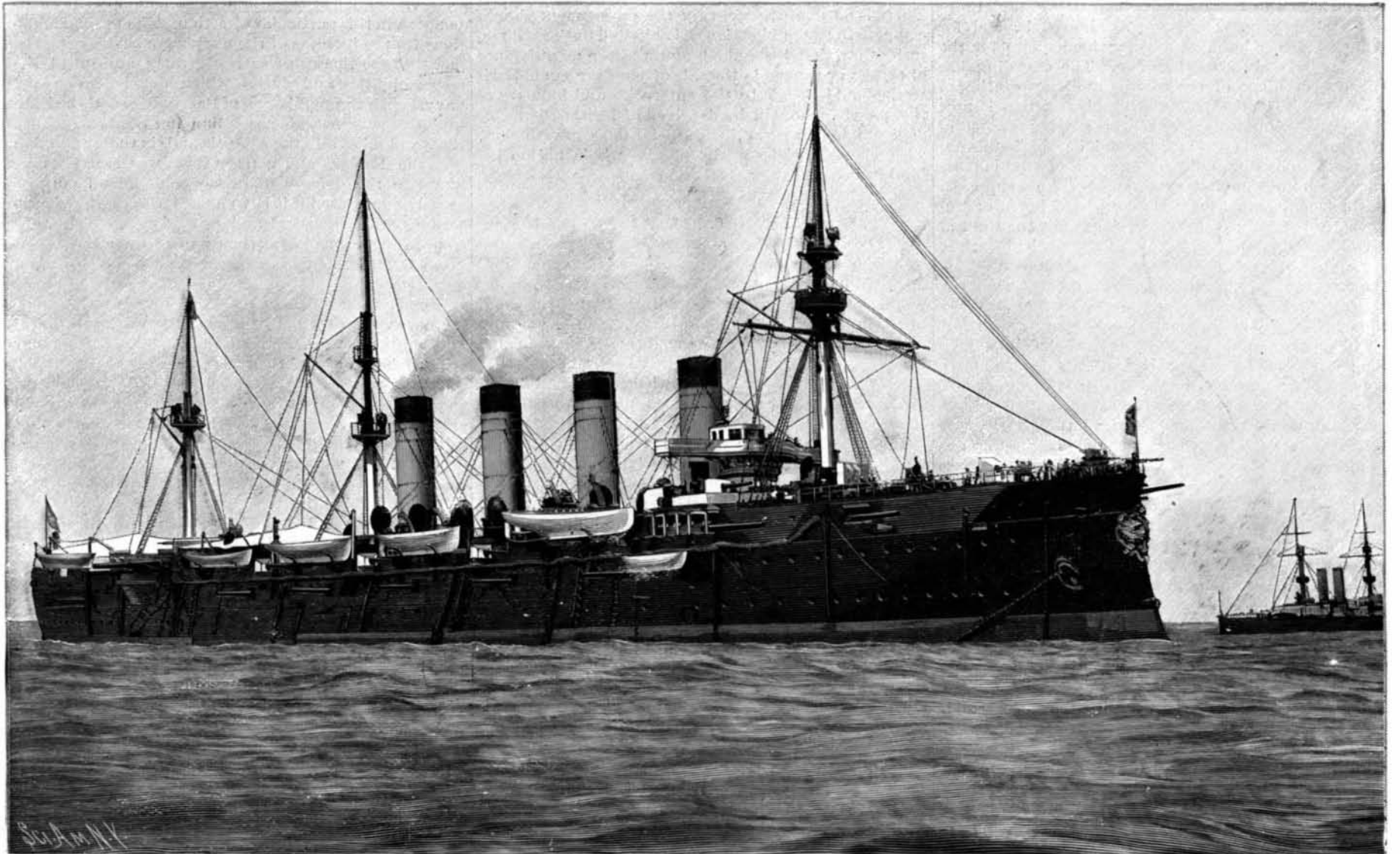
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1.—First-class Battleship "Sissoi Veliky." Also with modifications, "Twelve Apostles" and "Rostislav."

Displacement, 8,880 tons. Speed, 16 knots. Normal Coal Supply, 550 tons. Armor: Belt, 15 $\frac{3}{4}$  inches; deck, 3 inches; gun positions, 15 $\frac{3}{4}$  inches. Armament, four 12-inch B. L. rifles, six 6-inch rapid-firers, twelve 1 $\frac{1}{8}$ -inch and four 1 $\frac{1}{4}$ -inch rapid-firers, two machine guns. Torpedo Tubes, 6. Complement, 325. Date, 1894.



2.—First-class Armored Cruiser "Rossia." Class of Three Ships.

Displacement, 12,130 tons. Speed, 20 knots. Maximum Coal Supply, 2,500 tons. Armor: Belt, 10 inches; deck, 2 $\frac{1}{4}$  inches; bulkheads, 9 inches. Armament, four 8-inch B. L. rifles, sixteen 6-inch rapid-firers, twelve 3-inch rapid-firers, eighteen 1 $\frac{1}{8}$ -inch and 1 $\frac{1}{4}$ -inch rapid-firers. Torpedo Tubes, 5. Complement, 725. Date, 1896.

NAVIES OF THE WORLD—IV. RUSSIA.—[See page 152.]