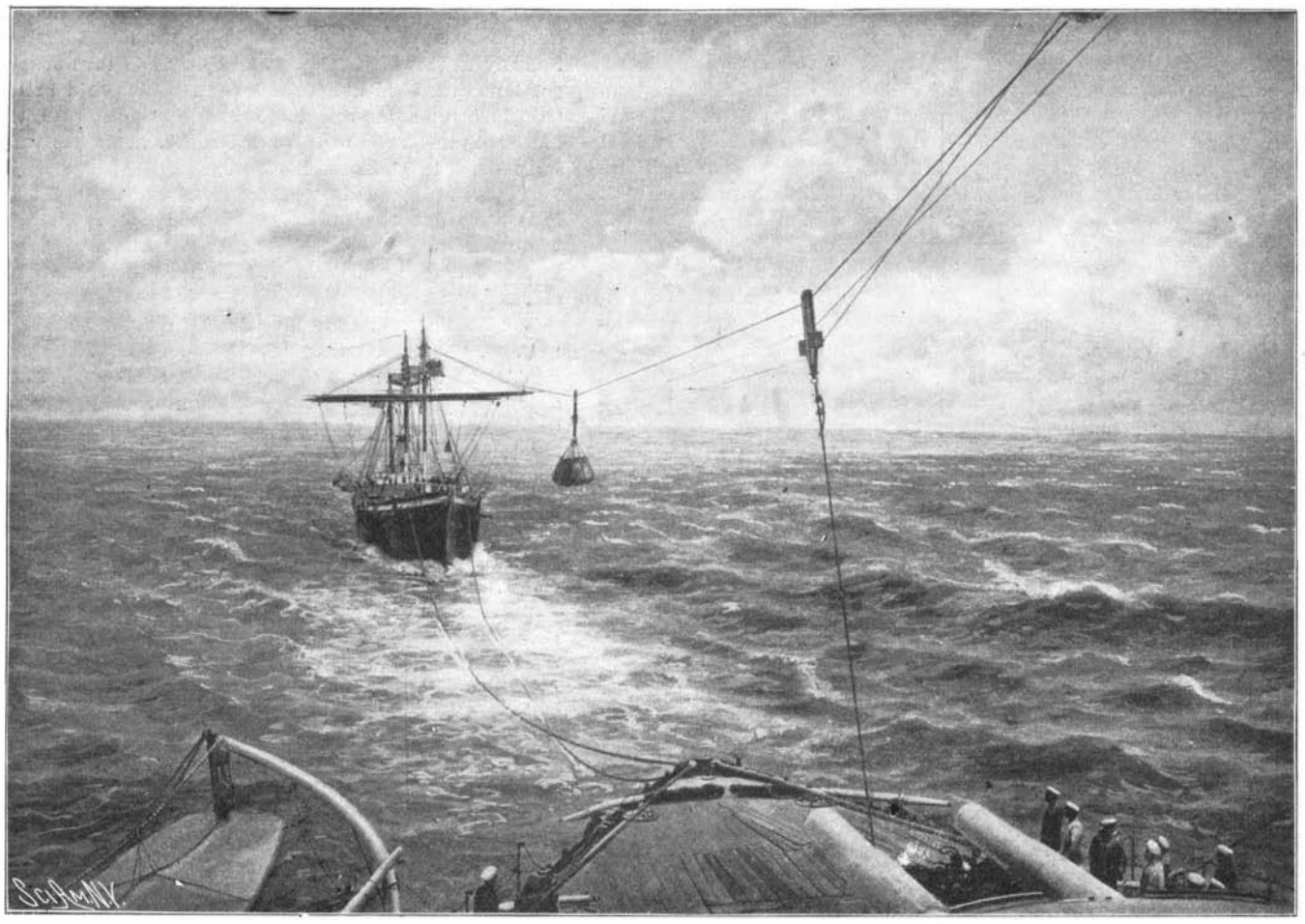
washing the air in its tortuous passage through the filter, removing all dirt and floating organisms. Radiators at the air inlet serve to furnish heat if required, and a refrigerating room at the other end of the attemperator serves to reduce the temperature when necessary. Two large suction-fans throwing 2,000 cubic feet a minute draw the tempered and purified air through large flues to the various germinating floors, and it is only to this air that the barley is exposed.

Now, if the heat of the steeping grain reaches the danger limit, a valve underneath the perforated floor large perforated metal floors, through which heated air is drawn by large exhaust fans. The kiln consists of four floors, and the green malt is introduced on the top floor, and gradually descends from floor to floor by gravity, the dumping taking place by the operation of shutters, which constitute the floors and which can be manipulated from outside. As the grain drops from floor to floor, the heat becomes greater and greater, until the barley can be compared to a baked loaf of bread. It is as tender as a cracker, and it has a pleasant aroma. The drying takes about forty-eight hours. To insure the specific character of the malt for various beers, the kilning is conducted in two stages. The malt is then cleansed, and the sprouts removed by shaking in machines, and is stored in dust and moisture proof bins, where it is held in reserve for use in the brew house.

In a subsequent article we will treat the process of brewing.

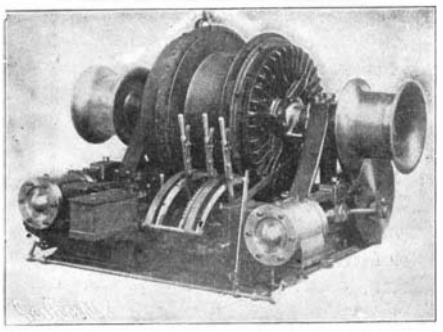
RUSSIA'S LAST HOPE ON THE SEA.

Things are in a pretty bad way with the Russian fleet in the Far East. About as bad, indeed, as they could possibly be. Unless the genius of Makaroff can devise some brilliant strategy that will render the still formidable remnant of the Czar's ships effective, it does not take the eye of an expert to foresee the inevitable catastrophe. As the result of the inexplicable carelessness or lack of forethought of Alexieff, the opening of the war found the armored fleet of Russia divided by about a thousand miles, the armored cruisers being at Vladivostock and the battleships at Port Arthur. The strength of the battleship division was reduced, as we all know, by the Japanese night attack until it was hopelessly inferior to the blockading fleet. For either the Port Arthur or Vladivostock fleet to come out and engage the enemy, would be nothing better than a forlorn hope—so greatly are they now overmatched. At the same time, the mining of the harbors makes it out of the question for the Japanese to enter. For the present the plan of the naval campaign, as far as Japan is concerned, is to maintain the blockade of the two ports so closely, that neither squadron can emerge without being forced to

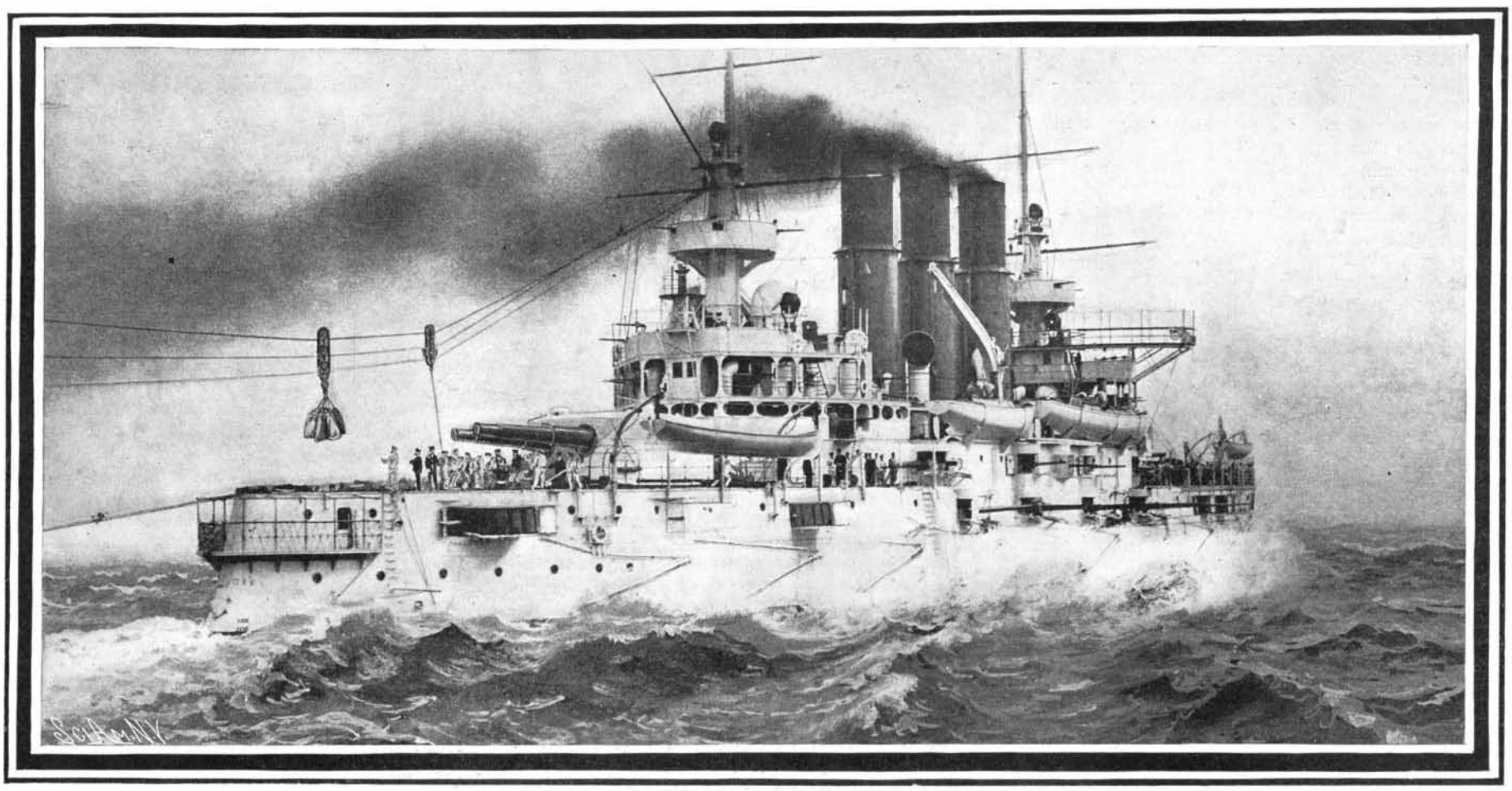


Looking Aft from a Warship Coaling from a Collier Towed Astern.

Elevating Truck Loading Bags on the Deck, Ready for Hoisting to Masthead.



Cableway Winches.



The "Retvizan" While on Her Way to the Far East Coaling from a Collier Which She is Towing Astern.

COALING WARSHIPS AT SEA.

Germany's pavilion at the World's Fair is under roof. The building is a replica of the castle at Charlottenburg. The plans were revised by Emperor William.

give battle, and at the same time endeavor by a long-range bombardment to destroy the fortifications and, if possible, shell the ships as they lie in the harbor.

Notwithstanding the many reports as to the havoc wrought by Japanese heavy guns on Port Arthur's fortifications, we doubt if any serious injury has been done. The modern method of mounting coast defense guns *en barbette*, or on disappearing carriages behind massive concrete protection, renders the chance of dismounting guns exceedingly remote. The shelter for the gun detachments also is such that fatalities should be very rare; and unless the Russians have been remiss in laying in stores of ammunition and food, Port Arthur's forts should be able to withstand these bombardments for many months. What the chances would be of taking the place by combined sea and land attack is another question, which can only be answered by those who are fully conversant with the conditions. All things considered, it is probable that both at Port Arthur and Vladivostock, the effective remnants of the Russian armored fleet, consisting of probably five battleships and four armored cruisers, can remain in comparative safety under the protection of the forts and the submarine mines for many months to come. At Port Arthur the ships will, of course, be exposed to the chance of being hit by the plunging fire of long-range bombardment; but such individual hits will be more a matter of "luck than good shooting," and in spite of reports to the contrary, we are inclined to think that they are extremely rare.

Evidently, then, if any relief is to come to Russia in her naval campaign, it must come from without. In other words, the only hope of saving her Far Eastern fleet is for Russia to dispatch a second fleet to the rescue, which, by its approach, will raise the blockade, release the fleet now contained in Port Arthur, and reverse the situation by obliging the Japanese admiral to fight against a fleet numerically more powerful than his own.

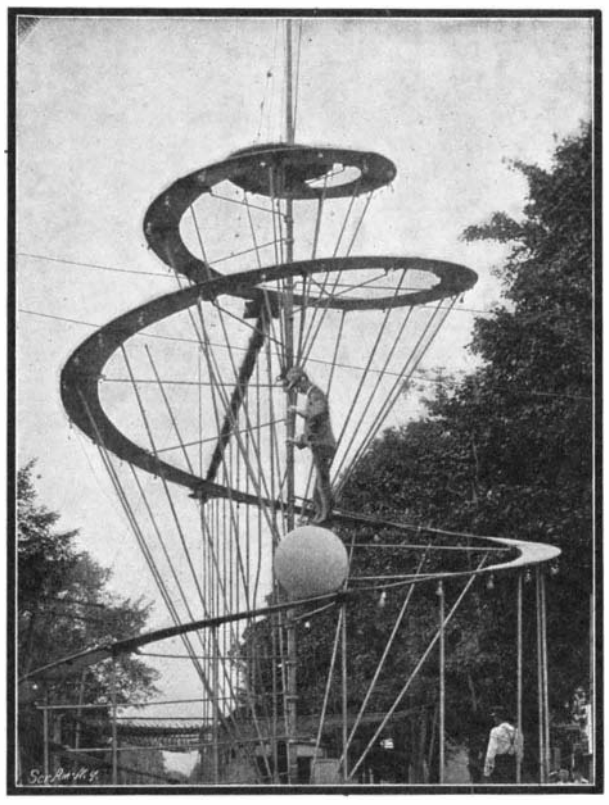
That Russia will bend every nerve to save the naval situation is morally certain; for the loss of her fleet in the Pacific would have a far wider significance than the disastrous effect it would have upon the Eastern campaign. It would mean the absolute extinction of the very flower of her navy, including seven of the best of her battleships, all of her modern armored cruisers, eight protected cruisers, including the best and latest of that type in her navy, and a fleet of thirty or more destroyers and torpedo boats, the loss representing a total value of not far short of $100,000,000. Now, it is a fact that these vessels represent the very cream of her navy; and it is no exaggeration to say that by such a disaster, the Russian navy would be reduced, temporarily at least, to second rate. Moreover, because of the slowness of warship construction and its great cost, coupled with the long lead that would be thus secured by rival nations, it is probable that Russia would never again regain her former position. Henceforth, her interests in Europe would demand that new accessions to her navy be retained in European waters. Thus would her dreams of naval supremacy in the Far East be dispelled for many a decade to come, if not, in view of Japan's ascendancy, for good. With these considerations in mind, it will be understood that by the Russian official mind in St. Petersburg and, indeed, by all farseeing and intelligent Russians, it is realized that some supreme effort must be made to rescue the beleaguered fleets, and avert the impending disaster.

Is there any such relief in sight? There is; and it is to be found in the five very effective and powerful warships known as the "Borodino" class, some of which must be by this time in commission and others nearing completion in the Baltic yards. If these five ships can be commissioned and dispatched to Port Arthur during the present summer, picking up the battleship "Osliabia" in the Mediterranean, it is possible that they might reach Port Arthur by the early fall in time to raise the siege.

The excellent qualities of this fleet, both for defense and offense, coupled with the fact that the vessels are of the latest design and are exactly identical, would render it, with the help of the "Osliabia," practically a match for the fleet of six battleships of Admiral Togo, which latter would by the autumn surely be feeling the stress of an unbroken war service of eight or nine months' duration.

Let us look once more at the character of these vessels. On a displacement of 13,566 tons they are designed to mount a main armament of either four 12.4-inch or of four 12-inch guns. The former is a new piece of great power, which these vessels are to carry if it is ready for them. These guns will be mounted in 11-inch-armor turrets. The intermediate battery consists of twelve 45-caliber, 6-inch guns, carried in 6-inch-armor turrets, while the secondary battery is made up of twenty 3-inch rapid-firers of the extraordinary length of 60 calibers, with corresponding increase in range and flatness of trajectory; twenty 3-pounders and eight 1-pounders. They carry two broadside submerged torpedo tubes and two above-water tubes, one in the bow, another in the stern, each protected by Krupp armor. The defensive qualities are finer, we think, than those of any ship afloat. They consist of a 9-inch belt tapered to 4 inches and 2½ inches at the ends; a secondary belt of 6-inch armor above the main belt, extending like the main belt entirely around the ship, and two protective decks, the lower one at the level of the top of the main armor belt, and an upper armored deck 2 inches in thickness at the level of the top of the upper armor belt. The space between these two decks is filled amidships entirely with coal. Furthermore, as a protection against waterline armor-piercing shell fire, and against torpedo attack below the waterline, a vertical wall or bulkhead of 4-inch armor extends longitudinally from the bow to the stern, at a distance of about 6 feet inboard from the sides of the ship. Add to this that the bases of the gun turrets, and the armored tubes leading up to the same, are armored with from 10 inches to 5 inches of Krupp steel, and it will be seen why the total amount of armor worked into a vessel of the moderate displacement of 13,566 tons reaches the high total of 4,000 tons. Of the five ships, the "Borodino," "Orel," and "Imperator Alexander III." were launched in 1901, and are undoubtedly completed by this time. The "Slava" and "Suvaroff" were launched in 1903, and twelve months ago were announced as to be completed in the present year. It is probable that in view of the coming Eastern complications, work has been rushed on these vessels, and that everything is working in the Baltic yards at high pressure to complete them. It is quite within reason to suppose that they will be ready, as announced in St. Petersburg, by the summer.

But even with the ships completed, there still remain the two serious questions of manning and coaling on the long journey to the Far East. The first would probably be accomplished by drafting the most experienced officers and men from the vessels of the Baltic and Black Sea fleets; and for giving them the necessary familiarity with the new ships, reliance would have to be placed upon the incessant drill in gun practice and maneuvers, which the fleet would undergo on the long journey to the seat of war. The problem of coaling is not so difficult a one as is popularly supposed. The successful introduction of the apparatus for coaling at sea, which is shown in the accompanying illustrations, in the Russian navy, has made it possible for an active fleet to carry its coaling stations with it, and coal up while under way at any time that it pleases, except, of course, in the heaviest weather. That this is contemplated by the Russian Admiralty is proved by a very significant dispatch which appeared recently in the daily press, to the effect that five vessels of the volunteer fleet (transport ships) have received orders to proceed to the Baltic, where they will be put in condition to serve as colliers for the Baltic squadron, which is to sail for the Far East in June. It is noteworthy that the number of vessels coincides with that of the five vessels now building. Now the latest and largest of the vessels of this volunteer fleet are of from 9,000 to nearly 12,000 tons displacement, with speeds of 19 to 20 knots an hour. By making the necessary structural alterations, these ships would be able to load up with 25,000 to 30,000 tons of coal, and with their good speed they would easily be able to keep up with the fleet of new battleships (all of which can do 18 knots) at a cruising speed of, say, as high as 15 knots an hour. The fleet would be fitted with the apparatus for coaling ships of war at sea, which is shown in the accompanying illustrations, which represent the Russian battleship "Retvizan" when she was taking coal while under way. The method of operation, briefly stated, is as follows: The collier is towed astern of the battleship, and an overhead cable is stretched from the after mast of the battleship to the foremast of the collier, on which is a traveler provided with hooks to which the buckets of coal are attached. Arrangements are provided for taking up the slack of the cable or paying out, as the distance between the ships varies in the seaway. The full buckets are hauled from the collier, and the empty buckets returned in the same manner as the ordinary overhead cable conveyer is operated in excavation work, as seen recently on the Rapid Transit Subway in this city. As much as 35 to 40 tons of coal per hour has been delivered from a collier to a battleship in a moderate sea and a heavy gale of wind, the battleship meanwhile towing the collier at speeds varying from 8 to 11 knots an hour.



AN INTERESTING BALANCING FEAT.

It would also be possible to adopt the method used in taking out the monitor "Monadnock" to Manila, when the monitor, with fires banked, was towed the whole distance by the collier, thus avoiding the trouble of coaling at sea.

The Baltic fleet, conveying its own coaling stations with it, should easily make the passage to the Far East at an average speed of 15 knots an hour; for our own "Oregon," a 16-knot vessel, made the trip around Cape Horn at about 14 knots an hour, and the new Baltic ships, as we have said, are 18-knot vessels. If the fleet is able to get away, as announced, in June, it should reach the Far East by August. If, on the arrival of the fleet, Port Arthur and Vladivostock are still holding out, the naval war will take on an interest, for which it will be scarcely possible to find a parallel in naval history. Will Admiral Togo, realizing that the approaching fleet is more powerful than the one which he has been blockading these many months, gather his eight armored cruisers before Port Arthur, and go with his battleships and destroyers to meet the Baltic fleet; or will he dispatch his torpedo fleet, bidding his captains risk everything in a desperate night attack in the open? Or will Makaroff make the first move by a determined dash from Port Arthur, to effect a junction with the relieving force? Should a junction be made, Russia would have eleven battleships against Japan's six.

It is evident that, as far as Russia is concerned, the fate of Russia's navy depends upon the ability of Makaroff to hold Port Arthur for the next few months. Should it fail and the blockaded battleships be destroyed, there would be nothing left for the Baltic fleet but a prompt return to European waters; for without the naval bases of Port Arthur and Vladivostock to fall back upon, it would be merely a question of time before this fleet would be run down and overpowered by the victorious enemy.

AN INTERESTING BALANCING FEAT.

An interesting feat in equilibration is performed by William Sprengel, a Western cowboy. Upon a spiral tower with a runway 160 feet in length and 16 inches wide he ascends and descends, standing upon a large wooden ball. This ball he rolls with his feet, keeping it in the center of the runway. The runway is veneered wood and perfectly flat. The greatest incline is 4½ feet in 20. The ball is 28 inches in diameter and weighs 80 pounds. In ascending, Mr. Sprengel is said to be pulling 150 to 160 pounds, and in coming down is holding back from 75 to 80 pounds. After reaching the top of the tower, before descending, he rolls the ball out and back upon a perfectly flat imitation cable 50 feet in length. At all times his eyes are kept steadily upon the ball. Ten minutes are required to make the entire trip up the tower, out on the cable, and back to the ground. The feat has also been performed in Europe and in Cuba by Achille Philion, the originator of the act and the owner of the paraphernalia. Sprengel is his successor, and has been doing the act about a year.—W. Frank McClure.

The Problem of Columbus.

H. W. Chapman in Phil. Mag. determines completely the motion of an egg-shaped body (symmetrical about an axis and with a hemispherical end) on a perfectly rough horizontal plane. The results show: (1) That the axis of an egg-shaped body would not rise toward the vertical unless, when its axis is horizontal, it receives not only a spin about the vertical, but also a rolling motion round its axis; (2) that even when so spun, it is very improbable that its axis would rise to the vertical. The rising observed in the case of smooth wooden eggs is connected with the phenomenon of limiting friction, and a rough cement egg rose only with difficulty, and usually remained oscillating between two cones, as required by the theory for a perfectly rough egg.

A canal is to be cut between Lake Onega and the White Sea at the estimated cost of 12 million rubles.