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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PORT ARTHUR.

The center around which revolves the whole complicated naval and military situation in the Far East is located at Port Arthur. The key to the situation is held by that heroic commander, Stoessel, and in a sense it may be said that by his stubborn defense he has locked up three of the most important elements in the war, namely, the Russian fleet within Port Arthur, the Japanese blockading fleet without the harbor, and the Japanese army of investment of 60,000 men. Incidentally, it may be said (still keeping to our metaphor) that Stoessel also holds the key to the deadlock into which the opposing armies of Kuropatkin and Oyama have fallen before the walls of Mukden.

There is, therefore, much more of method than of madness in the heroic stand taken by Stoessel and his gallant troops. At the present juncture there is no doubt that the Russian forces, and indeed the whole Russian plan of campaign, are in an exceedingly critical condition. It is also certain that if they can maintain the *status quo* for two or three months longer, the position may be entirely reversed, and the opportunity for a successful prosecution of the war by Japan be let slip forever.

As matters now stand, the last two great battles of the Manchurian armies seem to prove that they are so nearly matched that, in spite of her successes, it is impossible for Japan with her present forces to win an absolutely decisive engagement. It needs no intimate knowledge of strategy to understand that a decisive battle can be won by the Japanese only if they succeed in outflanking the Russian army and securing a strong position across the railroad, cutting off the Russians from their base of supplies. In the two great battles that have occurred at Liao-Yang and the Sha-Ho, flanking movements were made by Kuroki and by Kuropatkin, and in each case they failed for the reason that the flanking army was not powerful enough to cut loose from the main body with any hope of successfully effecting its object. There is no doubt that in planning the campaign, the Japanese strategists expected that by the time their Manchurian armies effected a junction before Liao-Yang, Port Arthur would have fallen, and the army of investment would have been available to give Japan the numerical superiority necessary for a great turning movement. It is the unexpectedly-stubborn resistance of Stoessel and his troops that has saved the situation for Kuropatkin. Every day that Port Arthur can hold out means the addition of so many thousand men and so many scores of guns to the Russian forces, and the more complete development of a successive system of entrenchments to which the Russians can retire, should it become necessary to fight a series of rear-guard actions.

Furthermore, judging from the slow work that has been made in reducing the outer line of forts at Port Arthur, it begins to seem fairly possible that the Baltic fleet, on its arrival in Chinese waters, may find the remnant of the Port Arthur garrison still holding the line of forts to the southwest of the city, on what is known as the Tiger's Tail and the Liau-Tie-Shan Peninsula; and although such possession would not enable the Baltic fleet to use Port Arthur for refitting, it would involve the retention of a large portion of General Nogi's troops that are badly wanted elsewhere. Moreover, it cannot be doubted that a certain amount of repair work is being done on the five battleships that were driven back into Port Arthur after the sortie of August 10. When the fall of the fortress itself is imminent, and these battleships are in danger of being sunk by Japanese high-angle fire, it is safe to say that they will make another desperate effort to break through Admiral Togo's fleet, and reach the sheltering port of Vladivostock. Every day that Stoessel can hold out is another day gained for putting these ships in condition for a running fight; and it is scarcely possible, even if the Russian fleet should be scattered or sunk, that Togo's battleships will come through the fight without more or less serious injury. If the dash for Vladivostock can be delayed for a few weeks longer, it will take place when the Baltic fleet is within a month's or even less than a month's steaming of Port Arthur—all too short a time for the Japanese navy, worn as it is with the stress of a long blockade, and just emerging from a fight against a superior number of battleships, to enter the drydocks in Japan and get in shape to meet a fleet of seven battleships, most of which are fresh from the builders' hands in the Baltic yards.

It has lately transpired that in June last the "Yashima," one of the Japanese battleships, was sunk by a mine off Port Dalny. This leaves the Japanese with but four available battleships to oppose the five battleships in Port Arthur and the seven that are included in the Baltic fleet; and the longer that Stoessel can hold out at Port Arthur, the more will these four ships (all too few for their work) stand in need of refit and repair. If, on the other hand, Port Arthur should fall to-morrow, Nogi's troops would be rushed to Mukden, and the Russian Manchurian army would in all probability, be driven back beyond Mukden, if not into Harbin itself, in a succession of flanking movements. Port Arthur would be closed to the Baltic fleet, and the ships that it shelters scattered or sunk, while the Baltic reinforcements, should they determine to continue on their mission, would find Admiral Togo's and Admiral Kamimura's combined fleets, fresh from a thorough overhauling at the Japanese dockyards, settled down to the blockade of Vladivostock—the only port in which the newly-arrived relieving fleet could hope to find harborage. One would have to search far into the history of naval and military wars of the past to find a situation where the fate of a whole campaign on land and sea depended so immediately and utterly upon a beleaguered fortress, as does the issue of the present war upon the brave troops and indomitable commander at Port Arthur.

HYDRAULIC JET PROPULSION.

It sometimes happens in the world of engineering, that a system is condemned in the earlier stages of its exploitation on the ground that it is wrong in theory when, as a matter of fact, it is the mechanical appliances through which it is endeavored to render the system practicable that are at fault. It would seem as though a case in point were that of the jet propulsion of vessels, which was so uniformly unsuccessful in its earlier attempted applications as to lead to the general belief that it was inherently wrong in theory. Vessels were propelled by the hydraulic jet; but under such low efficiency as to render the system useless for commercial purposes. The improvements which have been made of late years in hydraulic apparatus, and the better understanding of hydraulic principles, have led an English firm to make an extensive series of tests, which have enabled them to install a system of jet propulsion, whose efficiency, according to figures given by our esteemed contemporary the Yachtsman, rival the performance of the screw propeller. The firm in question, in designing the motive power of a small auxiliary yacht, directed their attention expressly to the question of suitable propellers; and among other methods that seemed to offer a satisfactory solution for the vessel in hand, the hydraulic jet propeller received careful attention. The British naval authorities, it was found, had twice already made practical tests of the jet. The first was made half a century ago in a small gunboat, and the second in 1883, in a second-class Thornycroft torpedo boat. In both cases the results were discouraging because of the low efficiency secured, which, in the latter case, amounted to only 0.32, as compared with a similar screw-propelled boat which gave an efficiency of 0.50.

Apparently these results settled the fate of jet propulsion forever; but in examining the experiments more carefully, it was found that the inefficiency was not in the type of propeller, but in the faulty machinery employed. To explain more fully, it should be understood that hydraulic jet propulsion involves the use of a water pump (generally of the centrifugal type) which draws in water through an inlet in the bottom of the vessel and expels it astern as a jet, the reaction of the water driving the vessel ahead. In the jet propellers tried in the British navy there was a loss of efficiency, first, at the inlet of the water, second, in the pump, and thirdly, in the jet. In the Thornycroft experiments the pump losses amounted to 54 per cent, and the loss in the jet to 30 per cent. In view of the great improvement that has taken place in pumping machinery, the low efficiency did not seem so very discouraging, as the latest types of centrifugal pumps were known to show a much higher efficiency than 0.46, while it seemed certain that the loss of 30 per cent in such a simple matter as a jet could be considerably reduced. Inquiry among the leading makers of the world showed that several firms were prepared to supply pumps of 10 horse-power and upward of a guaranteed efficiency of not less than 80 per cent.

The study of jet efficiency was carried on by utilizing different forms of jets, connected by flexible rubber tubing to the supply pipe, and held in the direction of the flow of water by a spring balance, which recorded the jet reaction. In this way efficiencies ranging from 0.65 to 0.90 were obtained. The latter striking result was given by a jet which has turbine guide blades inserted in the discharge orifice, whereby the issuing water is accelerated in velocity and deviated in direction, and discharged in a number of thin, broad jets, each equal in propelling power. In this form of propeller an efficiency of 85 was easily obtained, and over 90 per cent was actually recorded. Comparing these results with those obtained in the Thornycroft torpedo boat of 1883, in the latter case the efficiency of the pump of 0.46 and of the jet of 0.7 gave a total efficiency of 0.32, whereas the results of the 1904 experiments gave a pump efficiency of 0.80 and a jet efficiency of 0.85, making a total efficiency for the jet propulsion of 0.68. This seems to bring hydraulic propulsion, in the sizes thus experimented with, well up to the level of the efficiency of screw propulsion. It is claimed by Mr. Rankin Kennedy, the engineer by whom the experiments were carried through, that the data given above is borne out by experiments with water jets made at the Massachusetts Institute of Technology, in which, by improving the forms of the jets, an efficiency of 99 per cent has been observed. If such jets could be applied as propellers, with pumps of 80 per cent efficiency, it is argued that taking, say, 95 per cent as a practical jet efficiency, a total efficiency of 0.76 would be secured, as against an efficiency of 0.71, which, according to this authority, is the highest efficiency observed in tests on the best screw propellers under most favorable conditions. The results obtained by the jet in these experiments are certainly very remarkable, and show a great advance on previous performances; but we think it is doubtful if the same efficiency will be obtained under conditions of actual service.

THE VAST RAILROAD SYSTEM OF THE UNITED STATES.

Although the total mileage of the railroads of the United States exceeds 200,000 miles, the building of new roads shows no signs of abatement. The total length, on December 31, 1903, according to Poor's Manual for 1904, was 206,886 miles. This represented a net increase on all railroads, during the year, of 4,774.61 miles. The liabilities were made up of capital stock, amounting to over $6,000,000,000, a funded debt of $6,000,000,000, and other smaller items that served to bring up the total liabilities to about $15,000,000,000. The principal assets consisted of $11,000,000,000, representing the cost of the railroads and equipment, and over $2,500,000,000 representing investments. On this huge system there were carried over 696,000,000 passengers, and about 1,300,000,000 tons of freight. The earnings derived from passenger traffic amounted to $429,000,000, while the earnings on freight reached a total of $1,338,000,000, other items bringing up the total traffic revenue to $1,908,857,826. The net earnings reached a total of $592,000,000, and other receipts brought up the total available revenue to $682,000,000.

The operation of the system requires the services of 44,529 locomotives, 28,648 passenger cars, over 10,000 baggage and mail cars, and no less than 1,524,150 freight cars. The growth of this stupendous system, with the exception of two or three periods of stagnation, has been remarkably even. In the year 1830 there were 23 miles of railroad in operation, in 1850 there were 9,121 miles, in 1860 the total had risen to over 30,000 miles, and in 1880 to over 93,000 miles. Fifteen years later, or in 1895, the trackage had doubled to 181,065 miles. The largest annual increase of mileage was in 1887, when 12,876 miles of new track were built. The next largest increase was in 1882, when 11,569 miles were added. The increase in the twentieth century seems to have settled down to a steady rate of between 4,000 and 5,000 miles each year. The growth of the equipment presents some interesting figures. In 1880 there were 17,949 locomotives, 12,789 passenger cars, and 539,255 freight cars. Fifteen years later these figures had more than doubled, the total number of locomotives in 1895 being 36,610, of passenger cars 26,419, and of freight cars 1,230,798. The full significance of the above statistics can only be realized, when it is borne in mind that with the increase of mileage and equipment, there has been a steady improvement in the quality of roadbed, structures, cars, and engines. The best of the railroads of the United States are fully the equal in most respects of the best European roads. In some respects they are superior, and in others not so good. In comfort of travel our cars are acknowledged to be unsurpassed; but there is still room for improvement in respect to the number and speed of our scheduled express train service. It is not, however, improbable that this country will be the most active in the extensive practical application of