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NEW YORK, SATURDAY, NOVEMBER 27th, 1909.

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.

PRESENT CONDITIONS ON THE PANAMA CANAL.

A careful reading of the Annual Report of the Isthmian Canal Commission, now before us, warrants the statement that, save for some extensive and troublesome slides in the Culebra cut, the whole of this great work of engineering and administration is prosecuted without mishap, and with every prospect of its completion by the year 1915.

During the year the designs for the upper locks at Gatun and the locks at Pedro Miguel were completed. The locks are built in pairs, separated by a solid wall 60 feet thick; they are 110 feet in width, and have 1,000 feet of usable length. They will be emptied and filled through lateral culverts under the floors, connecting with large longitudinal culverts in the side and center walls operated by Stoney valves. In all plans for the canal, it has been laid down as a fundamental feature of design that at each pair of locks there must always be two barriers separating the high level from the level next below. The extra or collision barrier consists of a set of hinged, vertical, mitering gates, and a massive chain barrier controlled by capstans in the walls. As over 95 per cent of the vessels of the world are less than 600 feet long, intermediate gates have been introduced, dividing the lock chambers into two parts, suited to vessels 550 and 350 feet in length respectively. The intermediate gates are also protected by a chain barrier. An emergency dam, which will cut off the flow of water in the event of a gate being carried away, will be provided at the head of the locks. The design consists of a swing bridge, from which girders, supporting specially designed wickets, are lowered, the bottom of the girders resting on sills at the bottom of the lock.

The various materials of the foundations for the locks have been tested by trial loads, and found to have sufficient resistance to carry safely the greatest loads that will be brought upon them by the structures. Curtain walls will be built to stop any underflow; and to prevent the concrete floors being lifted by the pressure of any water which might gather below them, they are being thickened and anchored down to the underlying sandstone by the old rails left from the French administration. The plant for the rock crushing and the mixing of the concrete is installed and in successful operation. Concrete laying has commenced, and by the last of October 41,236 cubic yards had been put in place.

Reference is made in the report to the sensational rumors of bad slides which were sent out at one time from Panama. They were occasioned by a subsidence of no consequence whatever, which occurred to one of the rock fills at the toe of the Gatun dam. It is admitted that the most practical question in the construction of the dam is the sliding of the material underneath and in the body of the dam. The question of its sliding depends upon the slope of its outer face; and since the dam, which has a height of 115 feet above sea level, has more than a mile of horizontal thickness at its base, the Report is certainly justified in stating that the stability of this great work goes far beyond the limits of what would be considered sufficient and safe in any less important structure. The excavation for the spillway in the center of the dam is completed, and the channel below the dam, 960 feet long and 285 feet wide, is being concreted.

The dredging fleet has removed from the channel between the Gatun dam and deep water in the Caribbean Sea, a total of over 6,000,000 cubic yards, and at the present time some three miles of the channel from deep water (41 feet at mean tide) have been completed. Limon Bay, through which the entrance to the canal will be made, is exposed to strong winds and heavy seas. To protect the entrance channel, two breakwaters, one 10,000 and the other 3,500 feet in length, are to be built.

In the central division, including the basin at Gatun Lake and the great Culebra cut, progress has been very satisfactory. Although the Report covers the year only up to June 30th, we may add that on October 23rd, when 39,022,299 cubic yards had been excavated, the work that remained to be done in the Culebra cut when the Americans took over the work was half completed. Including the work done by the French, this means that two-thirds of the whole work has been done. Slides in the Culebra cut continue to be a source of annoyance. One of these measures 2,700 feet along the cut, and involves about 27 acres of moving material. Already 677,000 yards have been removed, and as much more is still in motion. There are smaller slides which bring up the total amount of material in motion to 1,000,000 cubic yards. These slides will necessitate easier slopes to the cut at the points where they occur, and will add to the total yardage; otherwise they will have no effect upon the canal.

In the Pacific division, the locks at Pedro Miguel are founded on durable rock of such excellent character that a part of it will be left in place to form the separating wall between the lock chambers. The excavation for the locks is practically complete. The West dam is being constructed of rock and earth with puddled clay as a center, and the material underlying the dam is impervious. At Miraflores about one-half of the excavation for the lock has been completed, and the general plans for the dams have been approved.

Excellent progress has been made on the entrance channel on the Pacific, from which during the year 8,475,931 cubic yards was removed. The channel has been carried to full depth for about five miles from deep water.

Due mainly to the great increase in the dimensions both of the prism of the canal and of the locks, and to the higher cost of labor and materials, the estimate of the total cost of the completed work shows an increase over the original estimate of nearly fifty per cent. The total cost of engineering and construction will be $297,766,000, and if the purchase price and the cost of sanitation and civil government be added, the total final cost will be brought up to $375,201,000.

THE TRIALS OF THE BATTLESHIP "NORTH DAKOTA."

The government acceptance trials of the battleship "North Dakota," of which we gave a preliminary account in our issue of November 13th, have now been successfully completed, with results which are gratifying alike to the Navy Department and the builders of the ship.

When the question of installing turbines in place of reciprocating engines in the new warships of our navy first came up for discussion, the attitude of the Bureau of Steam Engineering was decidedly conservative. The Department felt that sufficient experience was not available with the turbine, at least under battleship conditions, to warrant its immediate adoption at the time it was proposed. Ultimately, however, it was decided to install the Curtis turbine in one of the two battleships authorized by Congress in March, 1907, and to equip the sister ship with standard marine reciprocating engines.

Now that the trials both of the "Delaware" and the "North Dakota" have been completed, it is possible to make a reliable comparison of the two types of engine, and it is gratifying to know that on every point of comparison, except those of water consumption and propeller efficiency, the turbine has shown its superiority. In the standardization trial the "North Dakota" ran her fastest mile at a speed of 22.25 knots, and made an average speed for the five runs of 21.83 knots. She showed a maximum horse-power for one mile of 35,150. In these trials she exceeded the mean speed of the "Delaware" by 0.39 knot, and her turbines developed over 5,000 more horse-power. The results of the three hours' full-power trial, and the runs for twenty-four hours respectively at 19 knots and 12 knots, as herewith given, are highly satisfactory. Aside from the fact that she attained a full-power speed of 21.64 knots against the contract requirement of 21 knots, the most satisfactory feature is the remarkably low coal consumption of the ship, particularly at low speed—for one of the most serious charges formerly made against the turbine was that of its extravagance in coal consumption under low-speed conditions. The coal per horse-power per hour for the total horse-power worked out at 1.68 pounds at full speed; at 19 knots speed it was 1.58 pounds; and at 12 knots it was 2.34 pounds. The coal per horse-power per hour of an equivalent indicated horse-power (the power was taken by torsionmeter from the propeller shaft) works out for the three speeds, respectively, as 1.55, 1.46, and 2.15 pounds per horse-power per hour. With the ship at her maximum displacement, the steaming radius of the "North Dakota" would therefore be 3,000 knots at 21½ knots, 4,600 knots at 19 knots, and 9,000 knots at 12 knots speed. Compared with the reciprocating-engine-driven "Delaware," the turbine-driven "North Dakota" required only 295 as against 315 tons of coal per twenty-four hours on the 19-knot trial, and 105 as against 111 tons on the 12-knot trial.

OFFICIAL TRIALS OF THE "NORTH DAKOTA."

	3 hours of full power trial.	24-hour trial at 19 knots.	24-hour trial at 12 knots.
Actual average speed	21.64	19.24	12.05
Revolutions per minute.....	280.4	231.9	143.2
Shaft H.P. of main turbines.	31,400	16,710	3,800
I.H.P. of engineer's auxiliaries	1,100	660	400
Water rate of main turbines only	13.6	14.2	20.5
Water rate for all engineer's purposes based on total H.P.............	13.96	15.29	22.3
Coal used, pounds per hour	54,400	27,550	9,820
Coal used, tons per 24 hrs.,	583	295.3	105
Coal per hour per shaft H.P. of turbines	1.74	1.65	2.58
Coal per hour per shaft for total H.P.	1.68	1.58	2.34
Coal per hour per shaft of equiv. I.H.P.*	1.55	1.46	2.15

Based on 8 per cent friction for reciprocating engine.

	Specified in Contract.	Actual.	Saving, Per Cent.
3 hours of full-power trial..	15.1	13.96	7.5
24-hour 19-knot trial.......	16.1	15.29	5.0
24-hour 12-knot trial.......	23.2	22.3	3.9

The "North Dakota" is driven by two Curtis turbines, the pitch diameter of whose moving buckets is 144 inches. There are nine stages for going ahead and two for going astern. The shaft diameter is 30 inches, and the bearings at each end of the turbine are 21 inches in diameter by 42 inches long. The steam, superheated fifty degrees, enters the steam chest at a pressure of 280 pounds absolute. Here it passes through twenty nozzles, where it is expanded and acquires a velocity of 2,000 feet per second, its pressure falling to 75 pounds absolute. It then passes through another set of nozzles between the first and second stage, where it acquires a velocity of 1,070 feet per second, leaving the blades with a velocity of 155 feet per second. The pressure in the second stage is 49.4 pounds absolute. From the second to the eighth stage the entrance velocity of the steam remains at 1,070 feet per second, and the exit velocity at 155 feet per second. The pressure, however, drops from 75 pounds in the first stage to one pound absolute in the ninth stage, at which pressure it passes to the condenser, where a vacuum of 28½ inches is maintained. It can thus be seen that as the steam traverses the successive stages, there is a continual drop in pressure, the energy of the steam being delivered to the moving blades in the form of impact, the velocity of which is developed by expanding the steam in series of nozzles forming the entrance to each stage. The number of nozzles increases from 20 in the first stage to 360 at the sixth stage. The buckets in the first stage are 1¼ inches in length, and they increase to a length of 12 inches in the last stage.

In the two stages of the reverse turbine, it has proved possible to develop about 60 per cent of the power that can be developed on the go-ahead turbines, and thus the objection which has been raised against the turbine that it provides insufficient maneuvering power may be considered to be pretty well met. In this connection it may be mentioned that in the trials of the Japanese cruiser "Ibuki," which is equipped with turbines of this type, when the ship was steaming at 20 knots, it was possible in reversing to stop the starboard turbine in 32 seconds, the port turbine in 25 seconds, and bring the vessel to absolute rest in two minutes.

The ancient Romans commonly wrote with a metal point (stylus) on wooden tablets covered with wax (tabulae), but permanent records were written on parchment with a reed pen and liquid pigment, or ink. At Haltem in Westphalia, near the site of the Aluso fortress erected by Drusus in the year 11 B. C., was recently found a bronze vessel containing a dried black mass, which Prof. Kassner has decided to be Roman ink. The mass was found to consist chiefly of soot and tannate of iron. It also contained smaller quantities of ferric oxide, copper oxide, clay, magnesia, gypsum, phosphoric acid, carbonic acid, alkalies, and sand. These ingredients probably represent chiefly accidental impurities which have found their way into the old inkstand, but some of them may be due to the chemical action of the ink on the bronze vessel. The presence of an aromatic substance suggests that the ink was imported from Italy, where the use of perfumed ink was common.