NEW CONCRETE ARCH BRIDGES AT NIAGARA.

BY ORRIN E. DUNLAP.

The new concrete arch bridges built on the New York State Reservation at Niagara Falls to connect the mainland with Goat Island have been completed, and are numbered among the prettiest structures in that locality, where grace and beauty, as well as utility, form the features of the notable bridge work. These bridges are two in number. One of them extends from the mainland across the turbulent upper rapids to Green Island, while the other, the shorter of the two, connects Green Island with Goat Island. To many Green Island is better known by its old name of Bath Island, and the knowledge of the fact that the name of the island has been changed will aid many who have not been recent visitors to the Falls better to locate the position of the new bridges. It will be recalled that the bridges were commenced in the summer of 1900, and a reference to the SCIENTIFIC AMERICAN of September 22, 1900, will show the early stages of the work. While strenuous efforts were made on the part of the contractors, W. H. Keepers & Company, of New York, it was found impossible to complete the bridges last year before winter set in.

With the completion of the temporary bridge the trusses of the old bridge were removed as desired. The piers being in place, timber forms were erected for the arches as shown in the illustration. The placing of this lagging was a tedious task. The lagging was surfaced with a coat of plaster, and on this cheese-cloth was pasted, an operation necessary in order that a clear separation be obtained between the lagging and the concrete of the soffit of the arch. The steel ribs were then placed, the flat bars being held together by bolts, and spaced two feet apart. The iron bars extend into the concrete three inches at the top and bottom, while the bars have three-foot centers. The arches are partitioned off longitudinally into sections 9½ feet in width, four of these sections to a span. In laying the concrete, one of these sections constituted a day's work for the night and day shifts. A very clear idea of how the first section of concrete was placed may be obtained from the illustrations. The work progressed with rapidity, and the structure was opened early in July.

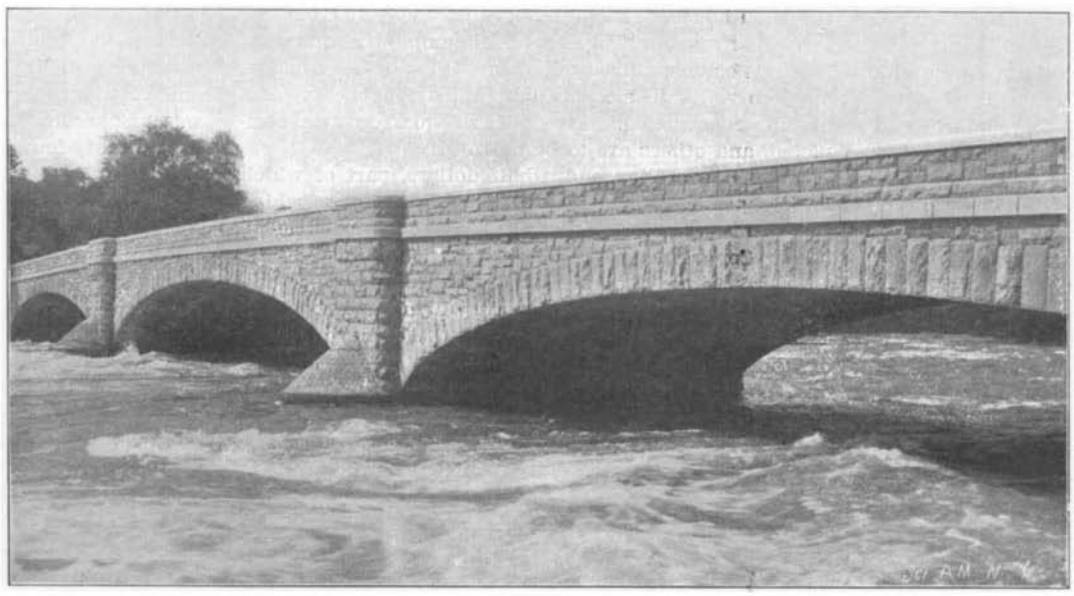
The bridge between the mainland and Green Island is 371 feet long, which length includes the finishing panels. It has three spans, each of the end spans having a length of 103½ feet, and the center span being 110 feet long. The rises of the end spans are 10 feet, and the rise of the center span 11½ feet. The piers have a width of 13½ feet and a length of 53½ feet. On the upstream end of each pier is a granite nose or ice breaker, which is expected to serve as protection to the bridge during the heavy flow of ice from Lake Erie in the springtime. The width of the roadway of both bridges is 20 feet, and on each side of the roadway is a granitoid walk 9½ feet wide for pedestrians. The space between the spandrel walls is filled with cinders and earth, the roadway on top being composed of about a foot of bank gravel.

The bridge connecting Green Island and Goat Island also has three spans. The length of the end spans is 50½ feet, while the center span is 55 feet long. The piers of this bridge have a width of 8 feet, and they are 50 feet 5 inches long. The upper ends of these piers are also fitted with granite ice-breakers The general finish of this bridge in the matter of walks, roadway parapet walls, etc., is identical with that of the bridge between Green Island and the mainland. Neither of the bridges will have an iron railing on the side walls.

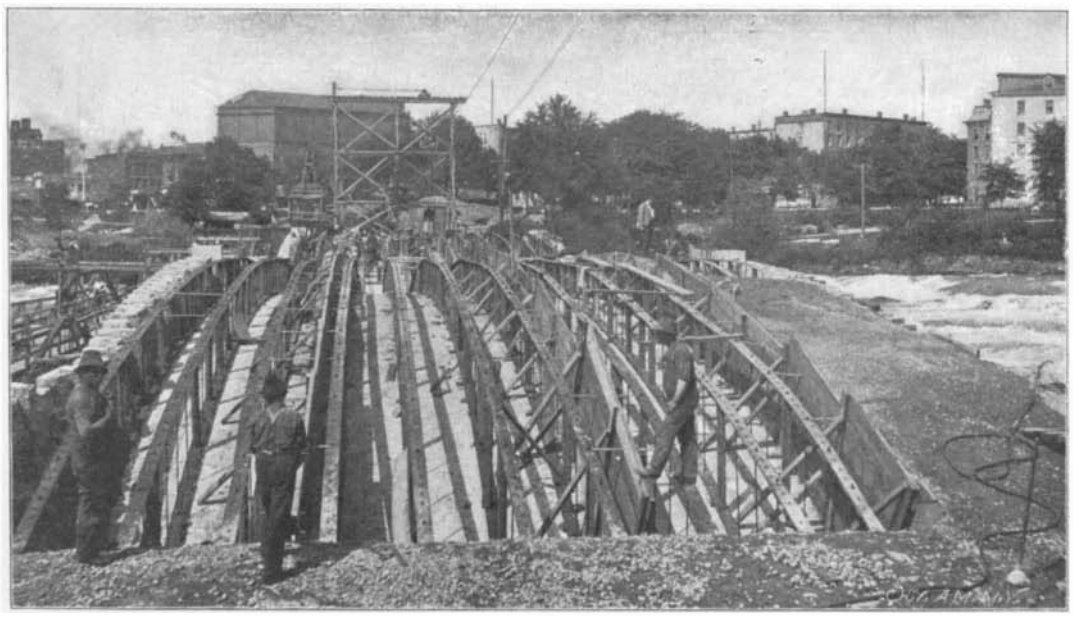
In the construction of the bridges two grades of concrete were used. For the arches between skewbacks the proportions were one part Portland cement, two parts sand and four parts broken stone or gravel which would pass through a 1¼-inch ring, including the total product of the crusher between 1¼ inch and ¼ inch. For the foundation abutments, piers and spandrels, the specifications called for one part Portland cement, three parts sand and six parts broken stone or gravel, which would pass through a 2-inch ring, including the total product of the crusher between 2 inches and ¼ inch. It was also provided that in the last-named portions of the structure large stones containing not less than 1½ cubic feet each might be placed in the body of the piers and abutments, each stone to be placed on its broadest bed and not nearer than 8 inches to another stone or to the face of the work.

The stone facing covers the entire structure, including the piers and abutments below water, the exceptions being the intrados of the arches between the ring stones on each face and the portion of the abutments concealed in the banks. There are pilasters over each pier with a projecting belt course at the top, on top of which is placed the coping. The ring stones run from 18 to 24 inches in the bridge between Green Island and Goat Island to 36 to 42 inches in the bridge between Green Island and the mainland. Every fifth stone is a header and extends into the work 18 inches. Drainage for the bridges is provided by wrought-iron pipes laid in the concrete and running from the center of each space over the piers to the soffit of the arch near springing line. Over the piers the concrete is so formed that all water that seeps through the filling will be drained to the pipes.

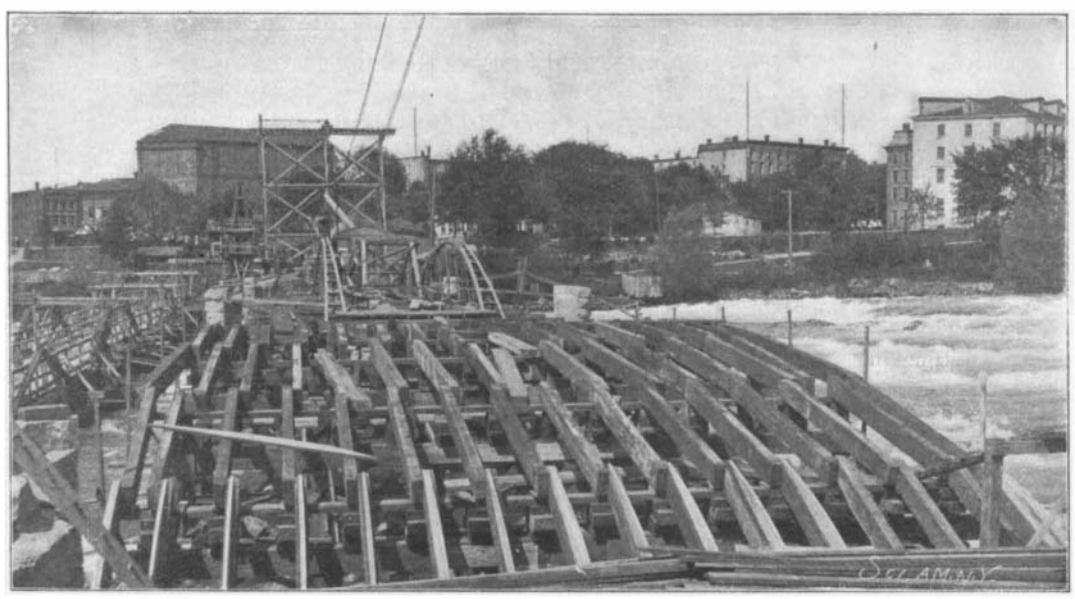
In making comparisons and in seeking the general beauty of the structures it is probable that the bridge between the mainland and Green Island will have favor. The spans of this bridge are much longer and they add a grace that is pleasing. However, both of the bridges are handsome structures, and portray a construction which it would seem is destined to become exceedingly popular, especially in such scenic places as Niagara, where harmony with nature is essential to the general beauty. When it is recalled that the location of the bridges is within about 500 or 600 feet of the brink of the American Fall, and that they have been erected right over the upper rapids, the fact that they have been completed without loss of life in the wild waters is to the credit of the care of the contractors and men engaged on the work.



THE CONCRETE ARCH BRIDGE FROM THE MAINLAND TO GREEN ISLAND, NIAGARA FALLS.



SHOWING THE STEEL RIBS AND METHOD OF LAYING THE CONCRETE.



TIMBER FALSEWORK FOR NIAGARA CONCRETE ARCH BRIDGE.

Dry Washing.

It is a familiar boast of English people that we are above all others a washing nation, says The Lancet. Soap-and-water is a standing dish in Great Britain, but so little were we disposed to credit the habitual cleanliness of foreigners that a piece of soap in the valise was till recently the habitual companion of an Englishman on his travels. Nowadays such an item is scarcely a necessary part of the traveler's impedimenta, though there are still fair-sized hotels on the Continent where soap may be searched for in vain in the bedrooms, while the smallest inn in this country would blush to the roof at such a deficiency. All kinds of theories have been raised to account for this national tendency to ablution, and most diverse qualities have been attributed to its possession. The familiarity of islanders with water, and the use of it occasioned by the national custom that led the ancient Britons to paint their bodies, are solemnly urged as the foundation of the English proneness to washing; and the fresh complexions and smooth skins of young Englishmen are held to replace the more dusky and hirsute countenances of the Latin races because of their closer and more frequent acquaintance with the articles of the washstand. With fanciful theories we have naturally no concern, and we believe that clear ruddy cheeks are a national inheritance for the same, if equally indiscernible, reasons as a tendency to roam or a dull ear for music. If, however, we do not attempt to explain the presence of a widespread habit and leave it to idle imaginations to determine why Englishmen wash, it is nevertheless our concern that such habits should be for the general welfare and should not be carried to injurious excess. It is quite obvious that even in England there are people who wash too little. It is not so generally recognized that some people wash too much. The skin is not well adapted to frequent applications of water accompanied by even the least irritating of soaps. A tendency arises to maceration of the superficial part of the epidermis, which is too frequently removed and occasions probably too rapid a proliferation of the cells of the Malpighian layer. There is no doubt that

many cases of roughness of the skin of the face come from the frequent applications of water. It is a good thing to rub the face with a soft, clean, dry towel two or three times a day. If, in addition, water is used in the morning and at night the skin will be kept in a sounder, smoother, and healthier state than if, as is often the case, soap and water are used three or four times a day. Men are not often offenders in this respect, most men sparing little time for the refinements of the toilette. Women and children, whose skins are the most easily affected by superfluous ablution, are the very persons in whom such excess is too common. They should be taught that there are dry methods of cleanliness as well as wet ones.

THE PUGET SOUND NAVY YARD.

BY A. B. WYCKOFF.

In 1878 and 1879, while engaged in the hydrographic survey of Puget Sound, the writer tried to interest the naval authorities in having a naval reserve of two hundred thousand acres of government timber lands made. A bill was introduced in Congress, but the writer was ordered to China and the matter was dropped. The timber on such a reservation would now be worth several million dollars.

In 1888 Congress authorized the President to appoint a commission of three naval officers to select a site for a naval station north of the forty-second parallel of north latitude. After an exhaustive examination it selected 1,572 acres of land on Port Orchard, an arm of Puget Sound. Congress did not act upon this report, and in 1890 authorized a second commission of two civilians, two naval officers and one army officer, to select a site for a drydock north of California. It selected virtually the same location, embracing over seventeen hundred acres, which could have been bought at an average price of about twenty dollars per acre.

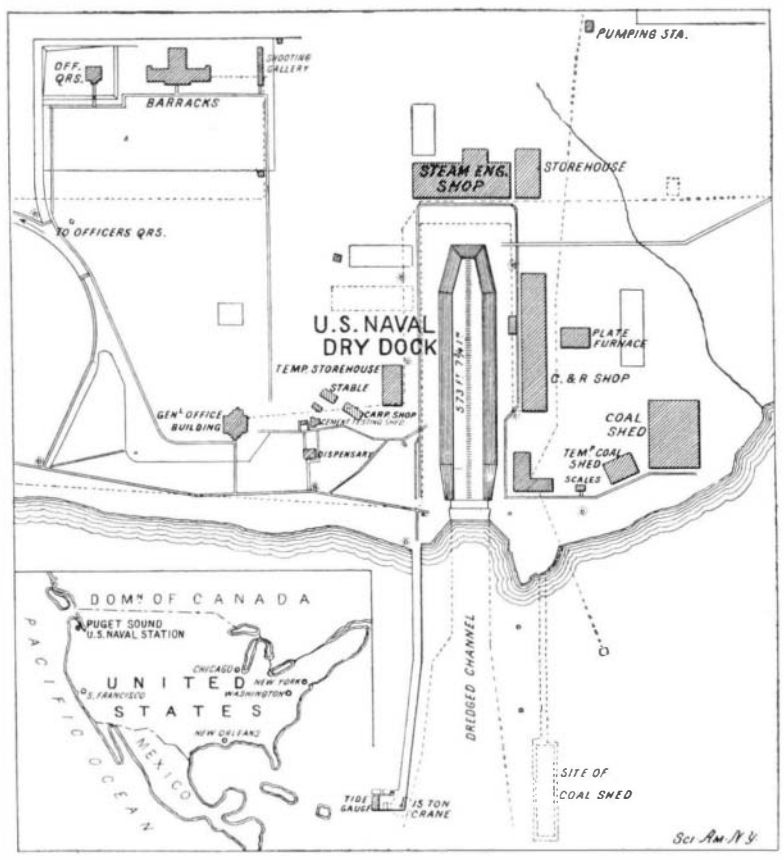
Through the personal popularity of the delegation from the new state of Washington, and by a narrow majority, the naval bill of March, 2, 1891, appropriated $10,000 for the purchase of a site, not to exceed two hundred acres, for a drydock, and authorized a contract for a dock not less than 600 feet in length, 70 feet in width at the bottom, and capable of receiving vessels drawing 30 feet of water, the total cost not to exceed $700,000. At this time most of the navy yards on the Atlantic coast were closed, and Congress did not desire another one. The restriction upon the amount of land purchased will probably prove a very expensive mistake.

March 17, 1891, the writer was ordered out from Washington to select the lands for the drydock. Owing to some legal complications it was June 2, 1892, before the final report was made. For the sum of $9,512.50, 190 acres was secured, and the "Puget Sound Naval Station," was established, with the writer as first commandant. Subsequently, in September, 1891, the name was changed to "Puget Sound Navy Yard."

October 29, 1892, the contract for the drydock was let to Byron Barlow & Co., of Tacoma, for $491,465. The plans were afterward somewhat changed, making the dock 650 feet long and extending the wing walls, which increased the total cost of the completed dock to $610,000. The drydock was begun December 19, 1892, and completed April 23, 1896, when the U. S. S. "Monterey" was docked. The drydock is located in a level basin with the entrance just inside the high-water mark. The strata show glacial deposit and the bottom is above a layer or bed of coarse gray sand. The entrance for about 70 feet is constructed of Sucia Island sandstone, while the remainder of the dock is of wood. The piles in the bottom could only be driven on an average about 8 feet. Although the "Oregon," "Iowa," and "Wisconsin" have spent six weeks at a time in the dock, it has not settled a quarter of an inch, and no repairs at all have been necessary. It was a fortunate action on the part of Congress to authorize this drydock, for otherwise our battleships built at San Francisco could not have been docked nearer than Japan. The "Oregon" was docked here and had her bilge keels put on just before starting on her race to Santiago. She is now again in this drydock to receive repairs to her bottom, which will take several months to complete.

The Puget Sound navy yard occupies a mile of water front on the north shore of Sinclair's Inlet, and is fourteen miles west of the city of Seattle. One-half of its area is embraced in two level basins just above high-water mark at the ends of the yard, while the intervening land rises in natural terraces to a height of over 200 feet, furnishing admirable sites for residences, hospital, chapel, barracks, etc. The drydock is at the eastern end of the yard, and all the working plant has grown up around it. The construction shop and pump house occupy the eastern side, the steam engineering plant the north end, and the ordnance and equipment buildings, for which appropriations have been made, will have the west side. The other shops and storehouses are in the immediate vicinity. A careful plan has been followed in arranging and locating all the working plant in close proximity to the drydock, so that work can be carried on with the greatest efficiency. The construction and steam engineering shops are complete in every respect, with foundries attached. They have the most recent and expensive tools, and any repairs can be made to a battleship. The large tools have their own electric motors, so that they can be run independently. There is a large pier or wharf, built on protected piles, near the dock, which will accommodate two battleships. Another pier extends out to the receiving ship "Nipsic," and farther still to the westward is the ordnance pier in front of the shell house. The present water-supply is from two large springs and wells and is ample in quantity. There is complete fire protection with salt-water mains, and the railroad, electric light and telephone systems are all constructed. Five officers' quarters are completed, and others are to be built.

About one million and a half dollars, part of which is unexpended, covers all the appropriations which have been made for this yard. As an influential member of Congress remarked, after a careful inspection: "The government has received full value for every dollar expended here, and no work will have to be done a second time." Until recently the development of the yard has been very slow, largely because of lack of knowledge of its great natural advantages upon the part of Congress and naval officials. This has now been largely remedied, as several of the Bureau chiefs of the Navy Department and many Senators and members of Congress have recently visited Puget Sound, and, without exception, have expressed themselves as greatly pleased with the navy yard. The present able and energetic commandant, Capt. W. T. Barwell, U. S. N., is very enthusiastic over the wonderful natural advantages it possesses. The Secretary of the Navy has recommended to the next Congress appropriations approximating a million and a half dollars for its further development.



PLAN OF PUGET SOUND NAVY YARD; BREMERTON.

There is no lack of excellent mechanics and workmen. Several hundred are employed in the yard, and a large proportion of them have their cottage homes in the adjacent villages of Bremerton, Charleston, and Sidney. A railroad can be easily and cheaply constructed to a connection with the transcontinental roads. But it seems hardly necessary, as the navy yard has terminal rates and loaded cars can be towed on barges across the Sound, as is done at the adjacent Port Blakely lumber mill, the largest in the world.

The developments during the last three years and its favorable geographical situation seem to assure that Puget Sound will have a larger ocean commerce and greater population than any other harbor on the Pacific Coast. For these and the following reasons the Puget Sound navy yard should be made the principal naval establishment of the Pacific.

It is the nearest point of the United States to Alaska, Japan, China, and the Philippines. It is situated on a perfectly land-locked harbor, where all the fleets of the world could ride in safety at single anchor. It is perfectly defensible and can be made impregnable by forts, torpedoes, and submarine mines. It is easy of access either day or night by the largest vessels afloat. It has over a mile of water front, where the tidal current is almost imperceptible. There is no sediment in the water, and consequently no dredging has to be done a second time. There is a good supply of fresh water from local springs, and a large fresh-water lake, only three miles distant, with an elevation of 146 feet. It is in proximity to the line of outer defenses of Puget Sound and accessible by disabled vessels, where they can repair in perfect safety. It is within seventeen miles of Lake Washington, where all the naval vessels of the Pacific can be laid up when out of commission as soon as the government canal, now being built, is completed.

A Remarkable Clock.

One of the most wonderful horological curiosities of the age has just been accomplished by a poor German watchmaker. It is a combination of an astronomical and calendar clock. The idea was suggested to the watchmaker by the famous clock at Strasburg Cathedral twenty-four years ago. The ingenious achievement of the poor German artisan represents no less than nineteen years' continual labor, and it is stated to be more wonderful than the horological monument at Strasburg, which prompted him to the effort. He was severely handicapped in his work by the lack of funds, but he devoted the whole of his savings to the task, completely ruining himself. The clock is inclosed within a glass case, so that every movement can be seen. It consists of 2,200 parts, 112 of which are wheels. The clock indicates the seconds, minutes, hours, dates, the days of the week, months, and the seasons of the year, the pictures of the signs of the zodiac, the sun, moon, and stars, and their rising and setting, as well as the exact position of the celestial bodies. It shows besides the moon's phases, and the eclipses of the sun and moon. The calendar is the most remarkable feature, since it is perpetual with perfect accuracy. At the beginning of the year it adjusts by itself the statements of the astronomical practitioners in explanation of the everlasting calendar, as well as Easter and the changeable festival days of the coming year. A glass ball, representing the spherical globe exactly, shows the movements and position of the planets Mercury, Venus, earth and moon, Mars, Jupiter, Saturn, and Uranus. The work is enhanced by over one hundred movable pictures and figures. Every quarter of an hour the figure of a guardian angel appears on the left side of the principal field. The striking of the quarters is done by two angels standing in the recess on the left, while in the sixth recess two figures at a time, representing the four ages of man, are changing alternately. On the right side of the principal field the Angel of Death advances, pointing with his scythe to the dial plate. When the full hour strikes, the center angel of the second recess appears holding an hour glass, while the angel on the right side above is sounding a trumpet. Under the roof an allegorical figure represents symbolically the right season of the year, while above in the principal field the guiding star of the year appears. On the left side of the clock cabinet stands a cock, which five minutes before noon beats its wings, stoops its neck, opens its bill and crows three times.

When the picture shows "Spring," there appears a cuckoo above; "Summer" is represented by a quail, which issues forth on the left side, both calling seven times. A bull lying at the feet of St. Luke the Evangelist roars to symbolize "Autumn," and "Winter" is indicated by a lion lying close to St. Mark. Every time the clock strikes twelve, Christ, bending his head, appears with his twelve Apostles, and a monk standing in the portal above rings his "Ave."

The clock contains a small chime which plays for five minutes after the striking of an even hour, the melodies changing and each lasting one minute. The work has twelve little bells, and on the roller there are 997 pins, which make the music.

A New African Railway.

A dispatch to The London Times from Brussels says the decision of the Government of the Congo Free State to construct 1,000 kilometers (621 miles) of railway in the Upper Congo region marks an important stage in the development of the colony. The railway will bring the thickly populated banks of Lakes Albert and Tanganyika into direct communication with the Congo River, through a country exceptionally rich and capable of rapid development. The new line, unlike the Lower Congo Railway, will remain the permanent property of the Congo Free State.

The Shell Line, Limited, an English corporation, have eighteen of their vessels fitted to burn both oil fuel and coal; the change from one to the other in case of necessity being made in thirty minutes, the engines not being entirely stopped during the change.