CHAPTER VIII.

THE ST. LAWRENCE DISTRICT

General Features of the Line - Greatest Altitude - Geographical Divisions - The Four Districts - The Engineering Staff - The St. Lawrence District - General Description - Crossing the Height of Land - Geology of the District -The River Systems - Division A, Contract No. 1 - Division B, Contract No. 2 - Division C, Contract No. 5 - Division D, Contract No. 8 - Division E, Contract No. 13 - Division F, Contract No. 14.

The Railway extends for 178 miles in the Province of Quebec. Crossing into New Brunswick at the river Restigouche, the distance in that Province is 241½ miles. At the river Missiguash it passes into Nova Scotia, to terminate at Truro, a distance or 80 miles; joining at that place, the line constructed previous to Confederation between Truro and Halifax.

The greatest altitude reached by the line is in the Province of Quebec. This is at Lake Malfait, 108 miles from River du Loup, and 743 feet above the sea. Nova Scotia ranks second to Quebec in respect of altitude, a height of 610 feet above the sea being attained at Folly Lake, in the Cobequid Mountains, 24 miles west of Truro: while the highest elevation in New Brunswick, 514 feet, is at Bartibogue, about mid-way between Bathurst and Miramichi.

At the river Restigouche, the boundary between Quebec and New Brunswick, and at the river Missiguash, the boundary of Nova Scotia, the railway is but little above tide-water; at the former, less than 40 feet; and at the latter, less than 10 feet. The levels near the extreme ends of the line - Truro and River du Loup - are not high; consequently, the line is divided, geographically, into three main ridges - one in each province. The ridges may be described as being 180, 240 and 80 miles broad, rising respectively to 743, 514 and 610 feet above the sea.

During construction it was found convenient to divide the Line into four Districts, which were again sub-divided into 25 Divisions designated by the letters of the alphabet, beginning with A at River du Loup and ending with Z next to Truro. The Districts were called the St. Lawrence, the Restigouche, the Miramichi and the Nova Scotia.

The Restigouche District embraced seven Divisions, each of the other three embraced six Divisions. The lengths were as follows:

St. Lawrence District,	129½ Miles.
Restigouche	128 Miles
Miramichi	117¼ Miles
Nova Scotia	124¾ Miles
Total,	**499½ Miles**

These four sections were each placed under a District Engineer responsible directly to the Engineer-in-Chief. Resident Engineers were appointed to each separate Division, who acted under the Engineer of the District; and the latter again had their necessary assistants. The work on each Division was carried on under a distinct contract.

THE ST. LAWRENCE DISTRICT extends from River du Loup along the shore of the St. Lawrence as far as Little Metis, where the line turns in a southerly direction to cross the highlands, dividing the waters flowing into the St. Lawrence from those flowing into the Bay Chaleur by the Metapedia, a tributary of the Restigouche. Its length is 129½ miles and it

embraces the following Divisions:

Division A,	Contract No. 1	20 miles long
Division B,	Contract No. 2	20 miles long
Division C,	Contract No. 5	26 miles long
Division D,	Contract No. 8	20½ miles long
Division E,	Contract No. 13	20½ miles long
Division F,	Contract No. 14	22½ miles long
	Total length	**129½ miles long**

For 90 miles the railway lies within a short distance of the St. Lawrence, in no place more than three miles from it. An irregular highland range extending, with but very few breaks, from River du Loup to Gaspé, dictated this location. Attempts were made to find a location further inland, but the country was rough; consequently, construction would have been expensive and the gradients steep. Along these first ninety miles the country is closely settled: besides the numerous farm-houses which assume the appearance of a continuous straggling village, there are several towns and villages, as River du Loup, Isle Verte, Trois Pistoles, St. Simon, St. Fabien, Bic, Rimouski, St. Luce, St. Flavie, and Metis.

The most favourable point for crossing the Mountain range occurs near Metis, where a depression is found in the summit, 743 feet above the sea, at a distance, on a straight line from the St. Lawrence, of about 20 miles. There is, also, at a distance of 6 miles from the St. Lawrence, an intermediate summit, 561 feet high, on a ridge overlooking the river. The country, on this mountain range is rough and rocky, and many curves are accordingly introduced, the grades being also steep. But, after descending the Southern slope, the flat country along the shore of Lake Metapedia is met, which extends to the end of the District.

There is a considerable area of good land near Lake Metapedia. It is estimated that a belt ten miles broad, in this quarter, contains 130,000 acres of good farming land.

The rock formation of the St. Lawrence District belongs principally to the Lauzon division of the Quebec group; the geological position of which is about the middle of the Silurian System. This group extends in the form of a belt parallel to the St. Lawrence, terminating in the Gaspé peninsula.

The Lauzon division is of considerable breadth, west of River du Loup, but contracts to a few miles, at Rimouski. Small outliers of the Sillery sandstone occur in this distance, one of which is met about two miles below River du Loup, and another extends between Cacouna and River Isle Verte.

Interstratified with the shales of the Lauzon division, grey sandstone and limestone conglomerates occur at Trois Pistoles, Bic and Grand Metis. The conglomerates are coarse, and consist of a sandy matrix with pebbles of white quartz and masses of limestone and diorite.

Between Rimouski and Great Metis the railway crosses a small basin of the Sillery limestone.

Near Lake Metapedia conglomerates again occur associated with shales; along the shore of the Lake, the rocks consist of limestone, sandstone shales, and diorite, with an occasional trap dyke.

From these various rocks the building material for the heavy masonry on the district was obtained.

The Rivers flowing into the St. Lawrence, although of no great length, yet rising, as they do, in the neighbouring highlands, at times discharge a great body of water. On all there is enormous water power from falls and rapids, easily made available, though hitherto but little used. At River du Loup there are three natural falls, one 100 feet high, and two about 20 feet high, almost quite unused. At the mouth of the River the water power gained by an artificial fall drives a large flour mill, and likewise the works of a foundry and machine-shop.

The District Engineer, until the close of the work, was Mr. Samuel Hazlewood, who assisted in the exploratory survey of 1864, and the location surveys of 1868-69.

DIVISION A.

CONTRACT NO. 1.

This Division, generally, is comparatively level; it traverses the table-land or terrace between the St. Lawrence and the elevated range which rises at no great distance from the line. The works are generally light, consisting of low embankments to raise the road-bed above the ordinary snow level. There are only two rock cuttings of importance, and these are near the western end. For four miles the railway passes over tracts of bog, some low-lying, with peat only a few feet deep, others lying higher, with growing peat, 20 or 30 feet deep. No difficulty attended the formation of the road-bed, the low embankments being composed of peat taken from side ditches, generally 15 or 20 feet from the embankments. The matted roots of brushwood and scrub spruce, together with moss and peaty material, formed embankments sufficiently tenacious. Although there was a slight sinking in some places, there was no breaking up of the surface, and the roadway is firm, though elastic. The surface in such cases is covered with a layer of gravelly sand about six inches thick, as a protection against fire.

The culverts on this section are unimportant, there being only three over eight feet span, two of which are twelve feet. There are three bridges, one with a span of 30 feet over the Temiscouata road, one of three spans built over the River du Loup, and the third of two spans built over the River Isle Verte. That over the Temiscouata road is close to that over the Du Loup, and may be considered as constituting parts of one bridge, the western abutment of the river bridge being the eastern abutment of the road bridge. The river bridge is on a skew, but the eastern abutment of it is on the square. The foundation is rock, on the bed of the river; and the water being shallow, having only a depth of a few inches in summer, there was no need of cofferdams.

The bridge over the River Isle Verte rests upon a rock foundation; the water, during the dry season, being so shallow as to occasion no difficulty in founding the piers.

The piers of the Isle Verte bridge are on the skew, while the abutments are square; thus, each span has a short and a long side, the longer being 100 feet and the shorter 88 feet.

All that is worthy of remark concerning the bridges of this Division, is, that they are of wood, and constitute two of the three wooden bridges erected upon the whole line. They were commenced anterior to the reversal of the Government policy in this respect, all the other bridges being of iron.

Both bridges are built upon what is known as the Howe truss principle.

In these bridges the roadway runs on the top of the girders.

There are few curves; the two longest tangents are each about six miles.

The grades are easy.

There was abundance of ballast on the Division, but the pits were of little depth.

The work of construction was executed by Messrs. George and James Worthington. The contract was entered into in March, 1869. The time for completion assigned was 1st July, 1871, but the work was not entirely finished until 1st July, 1872. In addition to the amount of the contract, $189,700, a further sum of $35,000, for extra works, was paid.

The total length of the Division is 20 miles.

The average excavation was 18,200 cubic yards per mile, and of masonry 295 cubic yards.

The Resident Engineer in charge was Mr. Leonard G. Bell, previously employed on the Surveys of 1868-69.

DIVISION B.

CONTRACT NO. 2.

This Division, for half its length, lies on land similar to the country crossed by the Line on Division A. After passing the village of Trois Pistoles, it enters the valley of St. Simon, a wide flat expanse bounded on both sides by high ridges of barren rock. Generally the works are light, but there are large culverts at the village of Trois Pistoles and an expensive bridge over the river of that name, besides heavy cuttings and embankments at the approaches. The cutting on the west side of the river was especially heavy, being at one place 56 feet deep. All the cuttings in this neighbourhood consisted of a blue clay of great tenacity, sometimes containing a small portion of fine dead sand. The ordinary pick and shovel were wholly inadequate in these excavations, spades proving more successful; yet, even with them, the work was tedious. The clay was dug out in small square blocks, and slung by means of single pronged iron forks, or spikes, into the wagons. It was so tenacious, that the slinging and the subsequent dumping scarcely altered the shape of the blocks. When acted upon by water and frost it would, however, slide away in a semi-fluid condition, carrying everything with it. On the west side, the cutting is on a side-hill, the foot of which rests on the shore of the St. Lawrence, while the top reaches to the flat ground about 200 feet above the river, and having about 8 feet of gravel lying on the surface. At the commencement of operations, the flow of water from between the gravel and clay, produced masses of mud which constantly slid down to the bottom of the cutting, seriously retarding the work. Such slips were to some extent obviated by a deep drain, some distance back, sunk through the bed of gravel into the underlying clay, thus tapping the superficial springs. Other difficulties, however, presented themselves. At the west end of this cutting, and under a low embankment, a small culvert had been built on apparently sufficient foundation on the side-hill. The culvert sank somewhat, and then remained many months without any perceptible change. It, however, eventually sank so much that it became necessary to remove it altogether and build it on another site. In a few weeks after its reconstruction a landslip occurred, carrying the culvert together with the embankment and many thousands of yards of earth, to a distance of several hundred feet, into the river, leaving a gulf about 200 feet wide. This landslip was doubtless caused by the undue presence of water in the ground; and showed the necessity of deep under-drainage. The cuttings in which these difficulties were experienced, extended over a mile on the west side and a mile on the east side of Trois Pistoles. The west side was the most

troublesome. Vertical shafts, fifty feet apart, and to depths varying from 25 to 30 feet under formation, were sunk along the uphill side of the railway, and about 15 feet distant from it. From shaft to shaft, tunnels about five feet diameter, were driven, each with an inclination to points where lateral off-take tunnels to the side-hill were provided for the discharge of the water collected. In the bottom of the tunnels a sewer pipe was placed and the tunnels and vertical shafts were filled with gravel. These tunnels have been effective in drying and solidifying the ground, more especially that portion immediately under the Railway. During last summer, a considerable quantity of fluid mud slipped from the surface of the South slope of the deep cut immediately to the westward of the Trois Pistoles River; but though it displaced the rails for a short distance, the road bed and underlying earth were wholly unmoved.

When the contract was entered into, the Engineer designed that the slopes of the cuttings should be made 2 to 1; and the width at formation level 30 feet. During the progress of the work these designs were over-ruled by the Commissioner's, who allowed the contractor to make the slop at 1½ to 1, the same as for ordinary earth. The action of the weather, however, in continuously causing surface slips, has already brought the slope to 2 to 1, or even to a flatter slope. The cutting on the east side of Trois Pistoles River was not attended with so much difficulty, not being on a side-hill, and not having any top bed of gravel draining into the cutting. Underdrains of an ordinary character, laid on both sides of the roadbed at a depth of 4 feet below formation level, were here sufficient. They keep the road-bed in good order; but the sides, from not having sufficient slope, are constantly slipping. The embankments also gave trouble owing to the slippery nature of the material when wet: but they now seem to have consolidated. In some parts, the slopes have been covered with gravel with good effect. The western embankment, in particular, caused anxiety for a time, a portion of it being in the old channel of the river. At this place the filling as it progressed sank continually, pushing laterally and upheaving the soft material at the base of the embankment. The application of cribwork for protecting the embankment from the wash of the river, was found beneficial. A timber crib, filled with stones, sheeted on the outside, was built round the projected base of the embankment; and although the upheaval within this crib was such as to raise the material 20 feet above the level, it was retained in position by the protecting work: the latter remaining uninjured except in one unimportant part.

The total width of the Trois Pistoles River, at the point of crossing, is about 1,000 feet: the bridge of 5 spans of 100 feet each, occupies the eastern half of the channel. The piers and abutments are on rock found at a little depth. Expensive coffer-dams were not necessary, the site being nearly dry at low water. The abutments are square towers built according to Figure 28. The piers were commenced for a superstructure of wood, but when the design was changed for one of iron, less breadth sufficed; and, accordingly, the piers were reduced in size, so that one portion of the pier appears forming the base of the superincumbent portion as a plinth. The iron work was constructed and erected by the "Fairbairn Engineering Company of England," who undertook the contract of all spans from 24 to 100 feet. An illustration of this bridge is given in plate No. 5.

East of the village there are two 15 feet arched culverts, built in accordance with the general designs described in a former chapter. They are in embankments of 30 feet and 44 feet deep.

The line has comparatively few curves, and the tangents are correspondingly long. The

grades are easy. Those reaching the maximum of 52 feet per mile, are not of any extent.

The contractors were Messrs. George and James Worthington. The amount of their contract was $299,000. They were, however, paid about $60,000 more than this sum, partly on account of the difficulty met in the cuttings at Trois Pistoles, and partly on account of extra work. The contract was entered into in March, 1859, and the work was to be completed on 1st July, 1871; but owing to the difficulties experienced at Trois Pistoles, it was not finished until the summer of 1873.

The length of the Division is 20 miles. The average quantity of excavation is 42,800 cubic yards per mile, and of masonry 603 cubic yards. The resident engineer, during the first two years, was Mr. W. H. Napier, who had been engaged in the location surveys of 1868-69. On his resignation he was succeeded by Mr. John R. Macdonnell. Mr. Bell was subsequently placed in charge till April, 1872, when Mr. H. Langton was appointed.

DIVISION C.

CONTRACT NO. 5

This Division runs for a few miles through the valley named in the last Division. Crossing a, low ridge, it thence traverses a second valley until it meets the face of the mountain at the head of Bic Bay.

Skirting the face of this mountain, and crossing several spurs of headlands forming the eastern side of the Harbour of Bic, it emerges on the sea shore, which it follows for several miles, keeping on a narrow belt of flat ground.

The Division has heavy work of all kinds, the principal being the rock cuttings near the village of Bic. The Line has been located along the precipitous face of the mountain, in one place in front of a perpendicular cliff, part of which had to be removed to make room for the road-bed. No part of the work was attended with any peculiar difficulty. As far as Bic village the Line is somewhat curved, but the curves are for the most part of no great length, and the general direction of the Line is straight. The heavy work may be said to end at Otty Bay, where the Line, which left the shore of the St. Lawrence at Trois Pistoles, again touches it and so continues to Rimouski. In a few places between Otty Bay and Rimouski, the works come within the wash of high tides where protection was called for.

There are three bridges; one, near St. Fabien, of 80 feet span; one at Bic, of 110 feet span; and one over the Rimouski River, with five spans, each 80 feet wide. In all cases the superstructure is of iron. At the St. Fabien bridge the river has an S curve and a diversion of the stream was made, over which the bridge was built upon ground then dry. A mill stands near this place, the dam of which was interfered with by the works; and the bridge has been so constructed as to admit the passage of water to the mill, the building of a new dam and a roadway to the mill.

The bridge at Bic is built over a rocky gorge with its two abutments on the rock, as shown on plate No. 6.

The bridge at Rimouski is built at the mouth of the river. It has all the piers and abutments on rock several feet below water level. The excavation for the foundation was through gravel, in depth from 5 to 10 feet. Coffer-dams were required, but the bed of the river was so porous that great difficulty was experienced in laying dry the foundation of the deepest pier. Concrete was resorted to in this case, upon a bed of which the masonry was commenced.

Plate No. 7 is a view of this structure.

There are numerous curves; the three sharpest are of 1,910 feet radius, and have an aggregate length of about 1,440 yards. The grades are generally easy, although several of 1 per 100 are used. There is no elevation of importance to be surmounted.

The contract in the first instance was let to Mr. Edward Haycock for $361,574; at the end of one season Mr. Haycock threw up the contract. The remainder of the work was let the following spring, at $533,000 to Alexander McDonnell & Company, after $48,762 had been paid to Mr. Haycock. The work was to have been completed by 1st July, 1871, but it was not finished until 1st January, 1873. The length of the division is 26 miles. The average excavation is 35,000 cubic yards per mile and of masonry 320 cubic yards.

The Resident Engineer until the summer of 1871 was Mr. Roderick McLennan, who had been employed on the surveys of 1868-69; but he retired from the work and was succeeded by Mr. John R. Macdonnell.

DIVISION D.

CONTRACT NO. 8.

This Division is on comparatively level ground, some miles away from the sea-shore. The elevated range bounding the Railway on the right from River du Loup trends away to the south after passing Rimouski where this Division begins; but the flat country rises towards the south; and the Railway, leaving the sea, gradually inclines toward it.

The works are lighter than on any other section of the whole Railway.

There is no bridge on this Division, but there are several culverts, very few of which required much masonry. There was no especial difficulty in executing any of the works, except an arched culvert over a stream about three miles from the eastern end of the Division. This is a twelve feet culvert in an embankment about 20 feet deep. The embankment from the westward had been carried close to the site chosen for the culvert, near the channel of the stream, during the first season's work. No change appeared to have taken place at the site during the winter; but on the opening of the following season, when the excavation for the culvert was commenced, the pressure of the embankment caused an upheaval of soft mud in large quantities, and in such a manner, that further excavation was impossible. The ground was tested by boring, when a firm stratum was discovered some 18 feet below the surface. It was then determined to construct a pile foundation. The piles were easily driven, but so soft was the material penetrated that the driving of a fresh pile would partially float those driven. Consequently, they had to be weighted until the masonry was started. The outer piles were driven perfectly close, and formed a kind of coffer-dam, the opposite sides of which were tied together to prevent spreading and in order effectively to enclose the whole space underneath the structure. A bed of concrete was placed over the piles, and on this foundation the masonry was commenced. This work was somewhat troublesome, a whole season having been spent upon it. But it was finally completed at no great cost, and has answered the purpose satisfactorily.

The line is generally straight, and nearly parallel to the direction of the St. Lawrence.

The contractor was Mr. Duncan McDonald, whose price was $100,000. The contract was dated 1st November, 1869, the work to be finished on the 1st July, 1871. It was completed in the

December of that year.

The length of the Division is 20½ miles. The average quantity of excavation is about 15,000 cubic yards per mile, and of masonry 180 cubic yards.

The Resident Engineer was Mr. John Lindsay, previously employed on the Surveys of 1868-69.

DIVISION E.

CONTRACT NO. 13.

The Railway, on this Division, crosses the water-shed between the St. Lawrence and Restigouche Rivers, and passes over an intricate, hilly country, with deep valleys, intersected and crossed by a constant succession of ridges, whose summits rise to a considerable elevation between the different tributaries of the Rivers Tortigaux and Metis. It was accordingly a matter of some difficulty to find a good location through it. The country was thoroughly explored and the best route obtained. The line, nevertheless, has numerous curves, many of them of short radius. Where the line crosses the long ridge overlooking the St. Lawrence, it sweeps round a full semi-circle, part of which is in a long deep cutting. On the entire Division there is an aggregate length of more than eleven miles of curves, and the aggregation of curvature is about 1,407 degrees.

One continuous grade, rising up to cross the ridge overlooking the St. Lawrence, is 2¾ miles long, and rises at the rate of 58 feet per mile. This is followed by another grade, ascending in the same direction at the rate of 52.80 to the mile, for a length of over 2½ miles. There is an aggregate length of over 10½ miles of grades rising 1 in 100; and of grades rising 0.8 or 0.9 in 100, a farther length of 1½ miles; so that of steep grades there is an aggregate length of 15 miles, out of a total length of 20½ miles, the extent of the Division.

The work on this Division is the most expensive, with one exception, on the whole Railway. The excavation and embankment far exceeded the quantity in any other locality. A large proportion of the excavation was in rock, and one embankment is 80 feet deep.

The quantity of embankment required was much in excess of the quantity of cutting on the line, and, therefore, extensive borrowing pits were necessary. In some spots, the material available for borrowing was so scanty that many acres of ground were stripped to furnish the quantity required. The total quantity excavated was about 1,750,000 cubic yards, of which one-sixth was rock.

There were seven tunnels, varying from 6 feet to 12 feet in diameter, for carrying streams across the Railway: and one tunnel, 20 feet diameter, parallel to the Railway, through a tongue of land round which the River Tortigaux flowed, crossing the Railway line twice. This tunnel takes the whole stream and saves two bridges across the line. It is about 500 feet long. All the tunnels are cut through rock; and, with one exception, it has not been found necessary to line any of them with masonry.

One of the clay cuttings gave some trouble, which would have been avoided by making it wider and with flatter slopes, in the first instance.

An embankment across soft, swampy ground, was laid upon a platform of trees placed side by side. The material sank *en masse*, raising the surface beyond the embankment to a height of from six to eight feet above the original level, and to the extent of 20 feet out from the slope of

the embankment. The embankment is now perfectly firm.

The Metis bridge is alone of importance on the Division, having four spans of 100 feet in with. Some difficulty arose with the foundations. The western abutment was built upon a double platform, with concrete deposited between the timbers. The eastern and western piers were built upon a pile foundation; the centre pier was built upon a stratum of gravel and boulders, the foundations being taken well down. The coffer-dam was afterwards filled with the best concrete, made of Portland cement.

In order to turn the river, and prevent its flowing between the Eastern pier and the East bank of the river, a rough wing wall was built. The piers are protected from the wash of the river by rip-rap laid round them. The total height of the bridge, from the bed of the river to the formation level, is 60 feet. Plate No. 8 shows the bridge completed.

The Contractors were Messrs. W. E. MacDonald & Company, who carried on the work almost to completion. The contract was entered into in May 1870, the work was to have been finished on the 1st July, 1872, at a cost of $934,933. But, about the end of the year 1873, when the completion of the work still required an expenditure of $126,500, it was taken off the Contractors' hands and finished by the Government late in the year 1874. The length of the Division is 20½ miles.

The average quantity of excavation is almost 85,000 cubic yards per mile, and of masonry 423 cubic yards. The total length of the tunnels for the passage of streams is 1,593 feet.

The first Resident Engineer, in charge of the Division, was Mr. W. F. Biggar, previously employed on its exploration and location. On his retirement he was succeeded by Mr. H. J. Cambie, who remained in charge until the works were taken out of the hands of the Contractors, after which, Mr. William McCarthy was placed in charge.

DIVISION F.

CONTRACT NO. 14.

At the end of the first mile the railway passes over the highest summit on the whole line. It then descends through an easy country to the basin of the Metapedia Lake and continues to run on a flat, wide, tract of land, bordering the lake, to its outlet.

The summit which is 743 feet above the sea, is at Lake Malfait, the source of the River Sayabec, flowing eastward into Lake Metapedia. It is on the dividing ridge between the waters of the St. Lawrence and those of the Bay Chaleur. At the commencement of the Division the curves are of short radius, their aggregate length, however, is not great, being little over a mile. In the first seven miles the aggregate length of grades, ascending and descending, is nearly five miles, of 1 per 100. The remaining grades, together with the curves, are light.

There are only three bridges of any importance, namely, that over the St. Pierre, near the head of the Metapedia Lake; that over the Tobegote, near the lower end of the same Lake; and that over the Amqui, at the end of the division. The spans of these bridges are respectively 80, 30, and 100 feet. The St. Pierre bridge is built on a natural foundation of gravel and boulders. At the Tobegote bridge site, soft material exists to a great depth, necessitating a pile foundation of peculiar construction, and the use of concrete. The Amqui bridge is also built on a pile foundation, protected by rip-rap. The principal part of the stone for the Amqui bridge is compact, hard, yellow sandstone taken out of cuttings on the division. A view of this bridge is

given in plate No. 9.

The contractors were Messrs. Neilson & McGaw, whose price was $245,475 and who carried on the work to completion. The work was to have been completed on 1st July, 1872, but it was not finished until the summer of 1875.

The total length of the Division is 22½ miles. The average quantity of excavation is about 21,000 cubic yards per mile and of masonry 203 cubic yards.

The first Resident Engineer in charge of the works was Mr. Henry Carre, who had been on the surveys of 1868-69. He remained in charge for about 1½ years, when he retired and was succeeded by Mr. John Lindsay, who was again succeeded by Mr. T. D. Taylor.

February 9, 1999