

was something to think of—occasionally, anyhow, as you lay in bed after a day's work."

The last rail in the C.P.R. was laid at the point then christened Craigellachie, situated amid the lonely grandeur of the Rocky mountains. Lord Strathcona, Sir Wm. Van Horne, & others who had worked for the great venture, were there, as the sections of steel came from east to west met, & became the Canadian Pacific. Why the name "Craigellachie"? It was identified not only with a place in Scotland, but with an old Scottish clan slogan. "Stand fast, Craigellachie!" Endless difficulties had to be faced in carrying through the Canadian Pacific scheme, & on one occasion Lord Strathcona & Lord Mount Stephen had to console each other across the Atlantic about some hitch. The word which the cable flashed from the one to the other was "Craigellachie"—that is to say, the inspiring counsel, "Stand fast, Craigellachie!" This Sir Sandford told me, & it is a picturesque footnote to history.

"The joining up of the railway," he went on, "was a ceremony very impressive & suggestive in its simplicity. Afterwards our train went down to the Pacific side, & from there I remember sending a cable to Lord Mount Stephen in London. I wired that we had taken ten days to cross the continent—that I fancy was the time—but that the day would arrive when a passenger could journey from London to Vancouver in 10 days. As I speak, we have practically reached that celebrity in travelling, though when I telegraphed, some people in London regarded me as rather a wild prophet. Within a week of the completion of the C.P.R. several cars of naval stores for Esquimalt, the British depot on the Pacific, passed over it from Halifax. This was an object lesson on the uses of the road as an Imperial highway, & there have been many others since then."

Sir Sandford looks forward to seeing weekly lines of steamers leave Vancouver for Australia & Asiatic ports. He conceives them as connecting with the terminus of the Siberian railway, so forming a continuous trunk artery about the world. It is a fine conception, all the more that it will mean the possibility of going round the globe in less than half the 80 days which Jules Verne, in his daring narrative, allowed for the trip.

THE SOULANGES CANAL.

Lake St. Francis is 33 miles long; it is merely an expansion of the St. Lawrence River; a pool above the rapids between it & Lake St. Louis. The fall between these lakes is 82½ ft. at mean water, & in a distance of about 16 miles there are the Coteau, Cedars, Split Rock & Cedars Rapids. At extreme low water, there is a depth of not more than 6 ft. in the channel at some places, & it is to surmount these rapids that the Soulanges Canal has been constructed. The canal is 14 miles long, & leaves the foot of Lake St. Francis at Macdonald's Point, just below the village of Coteau Landing. For 1½ miles it runs straight, touching the margin of the river about a mile from the upper entrance, & from the end of this tangent the line sweeps round to the north-east, behind the village of Coteau du Lac, for about 3 miles, on a curve of 14,324 radius. It is then continued by a 2nd tangent, of some 8½ miles long, passing about a mile inland from the Cedars village. Thence, the line bends slightly to the north, & is led into the Ottawa River, about 2 miles from its junction with the St. Lawrence, at Cascades Point. The canal is, for all practical purposes of navigation, a straight line throughout, & is 2 miles shorter than the route by the river. The fall of 82½ ft. is overcome by 4 locks; 70½ ft. of this is at the Cascades end, where the bluff forming the right bank of the Vaudreuil branch of the Ottawa gives an oppor-

tunity of locating 3 of the locks in the 1st mile, each having a rise of 23½ ft. There is an interval of over 2 miles between the 3rd & 4th locks, the latter being about 3 miles from the lower entrance. Here the lift is variable; it is about 12½ ft. at mean water of Lake St. Francis, but, at extreme high periods, it would, if this water were allowed to enter the canal, be about 15 ft. About 1,000 ft. above lock no. 4, there are a pair of guard gates, placed for safety to the lower locks in case of accident. At the upper, or Lake St. Francis entrance, there is a guard lock, by which the surface level of the summit can be regulated, without interruption or danger to navigation. At periods of high water, this will be used as a lift lock, but, at ordinary stages of the lake, its surface level will be that of the canal. The distribution of lockage is supplemented by a series of weirs for the passage of the necessary supply.

There are 7 road bridges & 1 railway bridge across the canal, the latter of which traverses the lower wings of the guard lock, & carries the Canada Atlantic Ry. It swings over the lock & raceway, & is about 180 ft. long. At the head of this lock there is another swing bridge, to pass the main road between Coteau Landing & Cascades Point, & a similar structure will be erected at lock 3, in connection with the Quinze Chiens Road. The remaining 5 road bridges cross the full width of the canal & have been designed to permit a full & free flow for the water & so as not to impede rapid navigation. This is effected by building the pivot pier in a line with the toe of the south slope, between which & the foot of the north slope there is an opening of 100 feet. The bridges are 246 ft. long, & the south half swings partly over the land & partly over a channel formed in rear of the pivot pier to give additional water section. Thos. Monro, M. Can. Soc. C.E., Chief Engineer of the canal, from whose paper on the subject we quote, believes that this is a considerable improvement on the old method of placing the pivot in the middle of the canal, with a narrow channel on each side of it, where vessels have to slow up, & often find it difficult to get safely past.

To pass the drainage of the country, lying to the north, across the line of the canal, has necessitated a very large outlay. The first stream met with in descending is the River Delisle. This has its source some 60 miles inland. Its catchment basin has an area of about 180 square miles and during spring floods the flow is something over 200,000 cubic feet a minute. The river is passed under the canal through 4 lines of cast iron tubes, 10 ft. in diameter, laid in a trench 50 ft. wide, excavated in the rock to the depth required. The next stream is called the Rouge River, & its flow during floods is about half that of the Delisle. It is carried under the canal by 2 lines of tubes of the same diameter as those of the Delisle. The excavation for the foundation of this structure was carried down to the boulder clay, through a stratum of soft blue material, which gave a good deal of trouble, through sliding during the progress of the work. At the River a la Graise, the water is carried by a single line of tubes, 10 feet in diameter. The foundation of this structure is on piles, driven some 25 or 30 ft. to hard material. There are also 2 pipe culverts of small dimensions towards the lower end of the canal.

The canal throughout is about 100 ft. wide at bottom, & was designed to have side slopes of 2 to 1, but because of the slipping of the clay banks in some places the slope is now partially 4 to 1. The banks are first formed to these slopes, & then a notch is cut to receive the stone protection lining. This is about 3 ft. wide at the base, tapering up to about 1 ft. on top, where it is finished by a rough coping. Between this coping & the top of the bank the surface is sodded, the sodding being returned about 5 ft. on the level.

On the north side of the canal a macadam road, 15 ft. in width, will be formed throughout its entire length, the centre of which is 33 ft. from the edge of the cut or bank on that side.

At the Cascades' end the excavation is in rock of the Potsdam formation, which affords a solid foundation for locks 1, 2, & 3. The upper extension walls of the latter lock are, however, of piles & concrete. The reach between locks 3 & 4 is in clay, upon which the piers & abutments of the St. Antoine road bridge are founded. The road bridges at St. Fereol & St. Dominique are also built upon clay. The surface of the blue clay along the summit reach gradually rises towards the west & culminates at the crossing of the St. Emmanuel Road, where it is almost level with the top bank, being only covered with a thin layer of sandy soil. Wherever this clay was cut into by the canal there was danger of slides, roughly in proportion to the depth of the cutting. This danger was greater on the north side, which intercepted the natural drainage towards the river, so that in time the slope became so saturated as to break loose & slip into the canal. That is to say, by the excavation of a deep trench of such dimensions a similar condition of things was set up as that existing along the bank of the St. Lawrence between Coteau & Cascades, where from time immemorial deboulements have occurred, causing in many places a wearing away, which in some places is measured by hundreds of feet. One of these slides took place in Oct. 25, 1897, when, without any perceptible warning, the north bank of the canal, for over a ¼ of a mile in length, slid into the canal, taking with it the abutment of the St. Emmanuel bridge, which was thrown bodily forward about 50 ft. into the centre of the canal. Other slides have occurred about a mile or so to the west of the St. Emmanuel road, & one of these took place only the other day. Towards the crossing of the River Delisle the surface of the blue clay lowers rapidly. At the river itself, rock of the calciferous is encountered, & this alternates with the clays & sands of the drift formation for some 2 miles to the west. At the upper entrance the guard lock & surrounding structures are all founded upon solid rocks. There are about 6,750,000 cubic yards of clay of all sorts, & 300,000 cubic yards of rock of various kinds in the excavations for the canal.

The site chosen for the power-house, to generate electricity for the operating of the docks, bridges, etc., and the lightening of the canal throughout, is where the River a la Graise crosses under the canal & joins the St. Lawrence about 400 ft. to the south of it. The amount of electrical power required to operate the locks, bridges & other structures, & to light the canal satisfactorily throughout its entire length of fourteen miles, was carefully determined by experts, who also worked out the details of the distribution & application of this power. The power-house is connected with a regulating weir, which is intended to control the summit level of the canal, without discharging a great volume of water through the Cascade locks.

At the ordinary level of Lake St. Francis there will 189 ft. of water in the canal, equal to a cross sectional area of 2,524 sq. ft. Propellers of the type now being built on the upper lakes to navigate these canals will have a submerged midships section averaging $42 \times 14 = 588$ sq. ft., or less than ¼ of that of the water area at mean level. This will permit of a fairly high rate of speed, as full depth under the keel of a vessel is of great value, both for speed & safety. Mr. Monro believes that the single individual lock is better than the fleet lock & can be operated more quickly & the maximum facilities may be provided by duplicate locks. 'The lift of locks should be made as great as possible,' he says 'where conditions permit, as time is consumed by