

## ENGINEERS AND WAR.—IV.

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within proper limits. Stone and sand should be weighed separately into mixer to secure uniform mixture. Can be laid at any time of year. Rolling should be continued until maximum compression possible is obtained. Unless very carefully manufactured is more liable to shoving and displacement under traffic than is sheet asphalt.

*Sheet Asphalt:* Suitable for light, medium and heavy traffic but should not be laid on as steep grades as is permissible with coarse aggregates. Gives a smooth surface and can be laid at any time of year. Heating and mixing plant must be within hauling distance of the work. Rolling should be continued until maximum compression possible is obtained.

### PROGRESS ON THE ALBERTA AND GREAT WATERWAYS RAILWAY.

On the Alberta and Great Waterways Railway the end of steel is now about Mile 140, or 25 miles north-east of Lac la Biche. The remaining distance to Fort McMurray is 150 miles and of this distance less than 5 miles remain ungraded.

The grade from the end of steel runs in a north-easterly direction to the west end of Christina Lake, and thence in a general northerly direction, crossing the Christina River, passing west of Sharp Point and Cowpar Lakes and east of Gregoire Lake, until it reaches the confluence of the Clearwater and Christina Rivers. The banks of the Clearwater are about 200 feet high, and the valley from two to three miles wide. The road gradually descends the bank of the Clearwater on a one per cent. grade, until finally it reaches McMurray.

Grading along the bank of the Clearwater is rather heavy. Part of the bank consists of clay, and in other parts cuts have to be made through beds of tar sands, which appear to be of extraordinary extent in the vicinity. About 600 men are employed on construction work at the present time.

Between the present end of steel and McMurray, Mr. Ralph Douglas, assistant provincial railway engineer, reports long stretches of good land, particularly along the Christina River and tributary creeks, and the percentage of muskeg is not by any means so large as anticipated. The country is of a rolling character.

It is expected that the grading will be completed in about a month and that steel-laying will be resumed about that time. The road to Lac la Biche is ballasted, and in very good shape. The remainder of the road from Lac la Biche to the present end of steel will be ballasted during the next few weeks. The grade on the balance of the route, the engineers report, has been particularly well done, and a great deal of drainage work has been undertaken that will be of enormous benefit to the country.

The Victoria Falls of the Zambesi in South-Central Africa, according to the "Engineering News," are capable of furnishing 35,000,000 h.p. of electrical energy and probably not over from 25,000,000 to 30,000,000 h.p. is employed in the world to-day from the direct or indirect use of oil or coal. There are three other great cataracts which so completely surpass all the rest on the score of power available that they are entitled to be grouped with the stupendous African phenomenon which the natives call "The Smoking Waters." This quartet of great cataracts—Victoria, Niagara, La Guayra and Iguassu—aggregating something in excess of 60,000,000 h.p., represent between them from 5 to 7 per cent. of the power of all the rivers of the world.

IT is appropriate in the concluding observations on this subject to refer to the training of military engineers and the experience they often gain apart from war operation. As has already been pointed out, the professional military engineer constitutes only a small proportion of the engineers of all classes who are engaged in multitudinous ways to fit the army and the navy for active warfare. Reference has already been made to the training of the naval engineers, and there again those who design and build ships, machinery and equipment for the Royal Navy far outnumber the engineers who go to sea. The Royal Engineer officer must be proficient in mathematics, geometry, mechanics, natural philosophy, fortifications, languages, chemistry, drawing, surveying, etc., while the men are taught crafts, musketry, field work, signalling, use of plants, water supply, pontooning, sapping and mining. As they are not continually engaged in drilling, they have superior opportunities for acquiring knowledge, under a great variety of conditions, in all parts of the world, often engaged in minor military movements. They, therefore, in times of peace are able to study what would be the requirements in time of war.

The United States engineer officers hail from the engineering educational institutions of that country. As the United States have for a long period enjoyed peace, the principal campaigns since the Civil War were those at Cuba and Philippines, so that the military engineers have not been engaged in active service to put to test the quality of their training. Reference will be made to their work in peace times, and they have a good record in this respect.

The Royal Military College of Canada, Kingston, Ont., is a federal institution, and takes on the functions of the Woolwich, Sandhurst and Chatham military colleges in England. This college was established in 1876, when Lord Dufferin was Governor-General. Kingston was a naval station at the commencement of the last century, and ships were to be built there for the purpose of patrolling the Great Lakes. In 1812 money which was sent out by the Imperial Government for the purpose of building a man-of-war was devoted to building a barracks, and this incident gave occasion for the name it bears to-day—the Stone Frigate. As there were buildings available they were converted into schools and dormitories for the Royal Military College.

The training given at this college is not only for cadets, but also for officers of the permanent force. It does not necessarily follow that cadets trained at this college must follow a military career. "The original idea was not to found a purely military college, but to have an institution at which the young Canadian would receive an education which, while fitting him to take a commission in the military forces of the country, would give him a practical training in civil engineering, surveying and physics." The first two years' study are similar to those at Woolwich, but in the last year, apart from a few attendances given to military history, tactics and military engineering, the work is entirely civil engineering, physics and surveying. In addition to these, the students are taught a variety of subjects, such as the management of horses, riding, physical exercises, sport, etc.