tary valleys and the development of "hanging valleys" in the latter, where water-powers can be developed. Many of the side streams entering both Lillooet valley and the various valleys occupied by the railway, plunge over falls or through narrow rocky canyons for a depth of sometimes several hundred feet, providing in many cases good sites on which to develop electrical power at comparatively low cost. When mining development is carried to the point of actual production of metals, some of these sites will no doubt be used. The following data, compiled largely from the reports of the Water Powers branch of the Department of the Interior, give the principal localities at which power could be developed:—

Volume and Fall

Brandywine Falls.—On Brandywine river, 40 sec. ft. minimum volume, 200 ft. direct fall, 600 h.p.

Cheakamus Canyon.—On Cheakamus river, 400 sec. ft. minimum volume, 400 to 500 ft. fall in three miles.

Nairn Falls.—On Green river, 230 sec. ft. minimum volume, 170 ft. fall in 400 yards.

McGillivray Falls.—On McGillivray creek, small minimum volume, 60 ft. direct fall.

Roaring Creek.—On Roaring creek, small minimum volume, several hundred feet of fall per mile.

Mission Mountain.—On Bridge river, 500 sec. ft. minimum volume, 1,200 ft. direct fall by tunnel through Mission mountain, 100,000 h.p.

Three Miles above Mouth.—On Cayuse Creek, 150 sec. ft. minimum volume, 90 ft. direct fall.

Half Mile from Mouth.—On Portage creek, small minimum volume, two direct falls of 200 ft.

Because of the ruggedness of the topography, the scenery along the line of railway through the Coast mountains is particularly wild and impressive and from the point of view of the tourist will stand comparison with many of the other widely advertised railway routes in the mountains of the west. This is particularly true at the deep, narrow, granite gorge of Cheakamus river below Watson and at Anderson and Seton lakes, along the shores of which the railway runs for many miles.

A Mountainous Route

On leaving tidewater at Squamish, the railway follows the valley of Squamish river and that of its tributary, the Cheakamus. The divide between Squamish and Lillooet rivers is crossed at Mons at an elevation of 2,000 feet above the sea, after which the railway descends Green river valley to Pemberton and crosses Lillooet valley at an elevation of 700 feet. East of this it ascends Birkenhead river and at Birken station, 1,650 feet above the sea, crosses the divide between Lillooet and Fraser rivers. Beyond this it descends the valley of Gates river to Anderson lake and for 30 miles follows the high, precipitous shores of this and Seton lakes before entering Fraser valley at Lillooet through a deep narrow notch cut into mountains which rise 6,000 feet or more on either side.

The Montreal Branch of the Engineering Institute of Canada this evening will continue the discussion on proposed legislation. An interesting feature of the meeting will be the welcome to some members who have returned from overseas, and especially to Lieut.-Col. A. E. Dubuc, D.S.O., Officer of the Legion of Honor, commanding officer of the 22nd Battalion.

Justice Maclennan at Montreal last week reserved judgment in the case of Bank of Hochelaga vs. Canadian Inspection and Testing Laboratories, Ltd. The bank sued the company for $46,647, money advanced to Damien Lalonde, Ltd., on what purported to be vouchers issued by Damien Lalonde, Ltd., for alleged delivery of munition boxes to the Imperial Munitions Board. The board refuses to reimburse the bank on the ground that the boxes were not delivered. The bank's suit against the inspection company is based upon the delivery vouchers which they claim were presented by Damien Lalonde, Ltd., as collateral security.

THRUST BEARINGS

Their Development for Hydraulic Turbines—Description of the New Gibbs Bearing for Vertical or Horizontal Shafts

BY EUGENE U. GIBBS
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WITH the advent of the hydraulic turbine, the displacement of the old overshot and breast wheels was very quickly made, when the advantages of the turbine became apparent and accepted. The Fourneyron turbine, of French origin, was first installed on a vertical shaft and supported by a thrust bearing or step, which was copied by the first turbine builders on this continent.

This step, or thrust bearing, was first made of hard wood (maple or oak) on which fitted a concave step shoe. In some cases this shoe was made of cast iron as a separate casting and in others the shaft swelled on the end and the concave was turned in the end of the shaft. The thrust step in all cases, being under the wheel and in the tail water, was lubricated by the water.

In the early development of the turbine on this continent, all the builders adopted this type of thrust step or bearing; and as the power and speed of these early turbines were very low as compared with those of to-day, the thrust to be taken care of was comparatively small and there was no difficulty with these bearings unless the water in which they operated contained a considerable amount of sand or grit.

The advent of lignum-vitæ was also found to be an improvement over the native hard woods and has been universally used for this work. In a few isolated places, manufacturers endeavored to use metallic thrust bearings and were partially successful, but these were plain ring types and had to be very carefully made; for this reason, they did not come into general use. One engineer made a thrust bearing in which he made the supporting ring of glass, but it was found that at varying temperatures the glass faces did not expand and contract evenly, and this bearing had to be abandoned on this account.

With the advent of the horizontal shaft turbine in the seventies, lignum-vitæ thrust steps were used to a great extent; but in a few years, owing to the possibility of using the marine type, or collar, thrust bearing, the lignum-vitæ thrust bearing for horizontal shaft turbines was soon replaced by the marine type, which was generally a part of one of the bearings supporting the shaft.

Collar Bearings

Sometimes these collar bearings had four collars, one on each end of the bearing and two between, and sometimes they only had two collars, one on each end of the bearing. They were lubricated by means of oil-rings as in the ordinary ring-oiling bearing. These bearings operated very well on a horizontal shaft when there were two turbines on the shaft so placed that the thrust was practically balanced and the thrust bearing had very little work to do.

When single-runner units were used, the collar thrust bearing had to be very carefully made, with various refinements as to oil feeding and adjustments, so that until within the last ten years it was impossible to sell them, owing to their high cost. However, the purchasing public had learned that the thrust bearing was as important as the turbine itself, and consequently saw the responsibilities of the thrust bearing and were willing to pay for a reliable device to take care of the end thrust.

The development of the hydraulic turbine in this country in the last ten years has been phenomenal. The tendency has been toward increased power and speed with increased efficiency. These have all been brought about by careful study of the application of scientific principles to the design and construction of these machines; and in the development, it was demonstrated that the single runner, vertical shaft turbine offered the best solution for high efficiency when installed in a setting properly designed and constructed.