

WATER POWERS OF PERU.

Possible Electrification of Steam Railroads—Some Notes Concerning Utilization of Natural Resources.

[In view of the great potentialities of the water powers of Canada, the following article will be of exceptional interest to our readers.]:—

Mr. Emil Guarini, professor of physical and electrical science at the Escuela de Artes y Oficios, Lima, Peru, sends us some particulars of Peruvian water powers and their development. He says that the present developments are insignificant, being limited to 1,000 horse-power installation, furnishing light and power to Arequipa, and a very modest private lighting plant in the Tambo Valley.

At Mollendo there is no power plant of any description. The Peruvian Corporation is about to install a steam plant to furnish power for industrial purposes and harbour work during the day, and for public lighting at night. The high cost of fuel and the uninterrupted demand for a power during the 24 hours, however, make the advantages of a water-power installation apparent.

Possibilities of Water Powers.

In the immediate vicinity of Mollendo, in the Tambo Valley, there are a number of small streams capable of developing several hundred horse-power, which can be easily utilized and transmitted electrically. The supply of power available from this source is so much greater than any demand in sight for it at Mollendo, that a primitive wooden water-wheel of local manufacture, in connection with a dynamo and a few kilometres of copper wire, would amply suffice for present requirements, and would represent a great saving in first cost and in operating expense over the proposed steam plant. The utilization of the city's water supply to operate a wheel before entering the distributing mains suggests an alternative source of power.

Mollendo gets its water from the mountains at an elevation of 2,300 metres above sea level, whence it is conveyed a distance of 140 kilometres through pipes, 20 centimetres in diameter at a velocity of 20 litres per second, according to chief engineer Bustamante y Raneda, in his recent report and project for increasing the water supply of Mollendo. Friction losses would average 5 millimetres per metre of pipe, or 700 metres for the entire distance, not including loss of head from short turns, bend and angles.

On the basis of 1 horse-power = 175 kilogramme metres, net available, and allowing 75 per cent. as the efficiency of the wheel, the theoretical available power would be 320 horse.

In practice, however, this result could not be obtained for two reasons: first, because the present pipe line could not resist the attendant pressure of 219 atmospheres, and second, because the entire theoretical head is not available owing to the fact that the line is sectioned off in several separate reservoirs at different levels, serving to supply intermediate towns and villages, and also to relieve the pressure on the line.

How to Solve Power Problem.

The power problem would consequently have to be solved by either of the following methods: 1. By installing a water-wheel and alternating-generator set at the mouth of each reservoir, feeding a single cable carrying the current to Mollendo and furnishing power to different localities on the way. Under existing conditions, at least 250 horse-power could be delivered in this manner at Mollendo, during 24 hours, supplying 3,000 standard 16-candle-power lamps = 48,000 candle power, or 3,000 special-filament 32-candle-power lamps = 96,000 candle-power.

This output could be further increased by installing a storage battery at Mollendo, which could be charged during the daytime.

2. By building two reservoirs at Mollendo, at different levels; the lower one to be used as the supply reservoir proper for distribution, and the other as a water-power

storage basin, which would empty into the lower reservoir during lighting hours.

Under present conditions, each reservoir would have a capacity of 900 cubic metres (that being the capacity of the existing basin) and a difference of mean level of 220 metres (that being the actual difference between the Mollendo reservoir and the last section basin). This would give a flow of 10 litres per second for 24 hours, or 40 litres per second for 6 hours, or an equivalent of 88 actual horse-power, sufficient to supply 1,000 special 32-candle-power incandescent lamps for six hours, which would be fully adequate for the immediate needs of the little town of Mollendo.

The Tambo Valley abounds in small water-powers, which could be easily developed to supply power to run the machinery in the sugar mills that dot the valley, during the day, and to light the many estates and farms, at night.

To-day, the only application of these natural forces is to be found on a plantation, where a miniature electric-lighting plant is run by a very primitive and inadequate water wheel of native design.

At Arequipa, the "Sociedad Electrica de Arequipa" owns and operates a hydro-electric central station at a place called Charcani, about 11 kilometres from the town, the motive power for which is supplied by the Chile River, with a maximum capacity of 1,000 horse-power. Current will be delivered at Arequipa over a three-phase line, at 5,400 volts, for power and lighting purposes, as soon as the installation is completed.

Some Electrical Statistics.

Arequipa to-day uses ten 1,000-candle-power arc lamps, and 4,391 incandescent lamps of different ratings, aggregating 77,972 candle-power. The lighting service is, however, most unsatisfactory, owing to the insufficiency of the present equipment to meet requirements. As a result, the streets are half the time in the dark, and complaints from private subscribers are constant—the company being unable to support the current contracted for and give satisfactory service, on the one hand, and the consumer trying to get even with the company, on the other, by using lamps on their circuits of double the rating that they are entitled to, in an effort to get a modicum of brilliancy.

The Sociedad Electrica de Arequipa, it must be admitted, is now installing an additional 500-horse-power equipment which should suffice for present requirements, although, as a matter of fact, an entirely new hydro-electric plant would be advisable in order to bring the light and power service up to the standard expected in a first-class city of the importance of Arequipa.

Chile River Should be Made Useful.

Another source of supply should be the Chile River which is amply capable of furnishing all the motive power necessary for the purpose, representing, as it does, a colossal hydraulic force, hitherto overlooked.

Mr. Habich, director of the Technical School of Lima, in an article published in the bulletin of the Mines of Peru, in its issue of July 31, 1901, pointed out that Peru, with its rivers descending from elevations of 3,000 to 4,000, and 5,000 metres, possessed incalculable sources of power, and showed that the Rimac River alone was capable of developing at least 100,000 horse-power.

Returning to the River Chile itself, and basing calculations from a point a little above the location of the present station at Charcani, about 3,000 metres above sea level. It is estimated that this stream carries a volume of water of 6 cubic metres per second, equal to a theoretical force of 240,000 horse-power. By properly damming the Chile between Charcani and sea level it would be easy to develop a minimum effective power of 100,000 to 120,000 horse-power.

Not to Interfere With Irrigation.

The objection to such a scheme would be the fact that the water thus taken from the stream could only be used for irrigation after passing through the water-wheels, which, if installed at sea level, would render such utilization impossible, whereas the Peruvian Government is unequivocally