tion required. Usually, too, this information, which is so valuable, is required very quickly. There is no time for a long series of gauging, and the engineer must estimate as best he can the minimum flow from whatever information is available.

So many factors enter into the question of stream flow—the drainage area, the character of the soil, rock and vegetation on that area, the contour, the elevation and the location—that the problem is too intricate for the private individual to fully solve.

After watching with considerable interest the support given by municipalities and Provinces to public ownership ventures, and noticing the effect such movements had upon the individual initiative, we venture the opinion that if more attention and more money had been given to experiment, if the Governments had conducted investigation as to stream flow, rate of evaporation, effects of ponding on stream-flow, percolation and other elements that enter into this problem, they would have done a greater service to the people.

So many of the questions require years of study and careful observation that the consulting engineer cannot undertake the work. His clients want a report now—not three years hence. It is true that in the Northern States of the American Union much good work has been done under somewhat similar conditions, and using their conclusions fair results may sometimes be secured. But conditions here are not altogether similar. The months of frost and snow are longer, the vegetation and summer temperature more varied, and the rate of evaporation and percolation very uncertain quantities.

This work is all the more necessary because of the many blue books and reports that have been issued, and are being issued, in which **estimates** (?) of Canadian water powers are given. The statistics are compiled to attract capital, to make known our great wealth of water power—and rightly so. But too frequently descriptive figures are taken for exact calculations, with unfortunate results.

Mr. R. S. Lea, M. Can. Soc. C.E., in Quebec, and Mr. W. H. Breithaupt, M. Can. Soc. C.E. in Ontario, have done good work in bringing the attention of governing bodies to these questions, and if Canadian water powers are to be developed—and not exploited—the Government should employ a permanent staff to investigate and report upon matters affecting stream flow. It is done in Alberta and Saskatchewan. Why not in the other Provinces?

EDITORIAL NOTES.

For several months we have been busy compiling a complete list of manufacturers of contractors' supplies and equipment for engineers. On page 6 of this issue appears an index to catalogues devoted to machinery and equipment of many kinds. If you require new machinery or new equipment, we can put you in direct communication with reputable manufacturers, if you will send us the index number. We want to be of service to you.

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The next few years will see the linking up of the Peace River and Athabasca districts to commerce and its markets. The men who have waited twelve years for the railroad, the railroad men themselves, and those who see into the future any distance at all will obtain the primary benefits.—The Monetary Times of Canada.

LOCOMOTIVE COUNTERBALANCING.*

By Mr. H. H. Vaughan,
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The counterbalancing of locomotive engines is one of the few problems in connection with that apparently simple yet exceedingly complex machine which are capable of an exact theoretical determination.

When the weights, locations, and movements of the various parts of an engine are known, it is possible to calculate accurately the forces which they cause at any speed of rotation, and apart from some practical considerations, such as the engine being constricted in its lateral movements by the wheels which support and guide it on the rails, and the fact that it is connected in a more or less imperfect way with a tender, the movements which result from the action of these forces can also be exactly ascertained; this subject has consequently been very thoroughly treated by a number of writers, and I shall therefore endeavor to discuss, as shortly as possible, the theoretical principles which underlie it.

The disturbing forces which necessitate the counterbalancing of any reciprocating engine are those required to start and stop the mass of the reciprocating parts at each

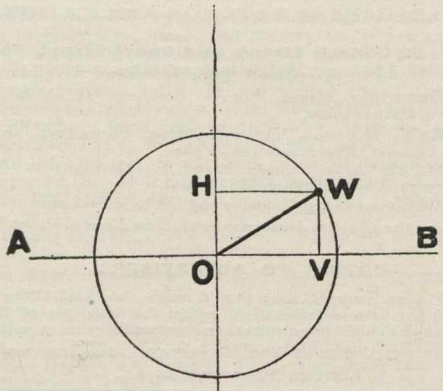

FIG. 1

end of the stroke; neglecting the disturbance caused by the obliquity of the connecting rod, which is unnecessary to consider in any existing type of locomotive, these forces are identical with that caused by a corresponding mass at the crank pin, with the exception that they have no vertical effect.

In Fig. 1 let the weight W be rotating round the centre O, at a velocity of V feet per second; then what is known as the centrifugal force, which is really the force that is required to make W. move in a curved line instead of in a straight line, as it would do if left to itself, acts along the line W O, and equals $\frac{W V^2}{32.2r}$ when r is the radius in feet.

This force W O can be resolved into two components W H and W V, the first acting entirely in a horizontal, and the other in a vertical direction; it will be seen that when W is on the vertical diameter W H is nothing, while W V equals W O, and when it is on the horizontal diameter W H equals W O while W V is nothing. Now, if the weight W moved backwards and forwards along the horizontal line A B in such a way that its position on that line was always vertically under or over the position of W when rotating uniformly

*Read before the Central Railway Club.