when the land became irrigated. There was a complaint sometimes of want of rain, and yet if they had the rain they would not have the bright sunny climate that ripened the fruit. In speaking to Colonel Mann a few years ago, he had said that he came from a country where they did not have to irrigate. "I told him he had my sympathy, and told him why. He wanted me to go through the country that his railway runs through. I have lately done so. It is a great country, but it does not take the place of the country where you can control the water and have such conditions as you have here."

The Storage Question.

You know the conditions in British Columbia better than I do. You have a series of rivers here that every irrigation State might envy, but they are nearly all in a position in which they are of no use to you. Take the Fraser, the Thompson and the Columbia. They are nearly all low down with high banks so that they are of no use to you for irrigation. Then your land is scattered about in patches so that the big ditches of the foothills are also impossible. This brings you down to irrigation by small ditches. The canal system of irrigation would not be possible. It does not seem that you will have any conflict between irrigation and navigation. You have many mountain streams and these are your source of supply. That is what you are using and your experience will be as in Colorado, where it takes from four to six acres of watershed to supply water for one acre below. Your streams have low heads and are subject to very rapid fluctuations. That brings up the extreme necessity of storage, which you have only begun to discuss here. The logic of events will drive you to consider these things more and more. The whole amount of your irrigable area needs to be dotted with dams and reservoirs.

It struck me last year that your local mountains were unexplored and there was a lack of information about your waterheads. The mountains are difficult to get through, but you must consider how valuable that water is. If some of your dams could be built on the other side they would be built at once.

Problems of Irrigation.

This increase in the value of water is going to have an important effect in many regards. Owing to conditions of gravitation you will have the problem of pumping, with plenty of water at a lower level needed at a higher level. Your problem is that of every other country, to get the greatest value out of the resources you have. Well, at times you will have many problems and difficulties, but they will not be such as to cause any Anglo-Saxon community to hesitate. If we expect to avoid troubles we ought not to be born. Every one who touches water will have troubles, but, fortunately, they come one at a time. In Colorado we have had a great deal of litigation. I like to speak of Colorado. It was a pioneer country with no experience to guide it, and it had to find its own way out. It is very difficult for human beings to adopt a new line of thought, and we were all the time trying to make our irrigation laws conform with riparian laws, and that country spent years in trying to find what should constitute the rights to irrigate and it led to litigation. When Mr. Dennis and Mr. Leach visited Colorado in 1902 it was about the end of that period of litigation, and since then there has been very little of it. We have gone through the development you are going through, but you will shorten up the process more than we and other States did. If you could produce to-day a code of laws that would meet your conditions, in 20 years it would not be adopted. You may be able to fix the main principles of legislation but not all the details.

It leads to this condition, that as affairs change, you will have to change your code. I have heard criticisms of the code in Colorado, as I heard criticisms of your Water Clauses Act. Yet when these laws were made they met conditions at the time, and credit is due to those who put them there.

There are so many things connected with irrigation that naturally only a few can be touched upon in an address like this. I want, however, to emphasize the value of your water. Your efforts will not be confined to this portion of the Province. You will have the same problems in the north, in the Peace River Valley and other places, though perhaps not for fruit culture, and it behooves your Government and you individuals to take steps to store the water, and bring, with the coming years all these valleys under cultivation."

ALLOWABLE LENGTH OF FLAT SPOTS ON CAR AND LOCOMOTIVE WHEELS.

E. L. Hancock.

The following analysis is the result of an attempt by the writer to develop formulæ showing the relation between velocity of train and the allowable length of flat spots on car and locomotive wheels. The flat spot, as is well-known, subjects the car and rails to considerable impact even at slow speeds. At high speeds, even very slight flat spots endanger both wheels and rails. There should be, then, some criterion that could be used as a guide by the inspector to enable him to decide whether or not any wheel is too flat to be continued in service. It is believed by the writer that the formulæ given below represent the relation between length of flat spot and velocity of train as nearly as this can be determined theoretically.

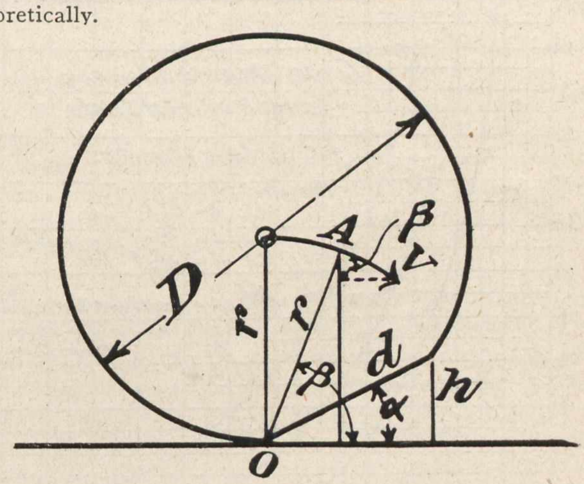

Fig. 1.

Let Fig. 1 represent the wheel of radius r and length of flat spot d. Represent the velocity of train by v. At any instant it may be considered that the kinetic energy of the wheel, with the weight it carries considered as rotating about the point O, is the same as if the mass supported by the wheel was concentrated at its center, that is, its kinetic energy is $Mv^2/2$. When the flat spot is in contact with the track the center of the wheel is at the point A, distant below the original position, approximately, h/4 equal to $d^2/4D$, where d is the length of the flat spot and D is the diameter of the wheel. At the point A the mass M has a downward velocity equal to v cos B*. But cos B* equals d/D, so that the kinetic energy with which M strikes the rail is

$$\frac{Mv^2 \cos^2 B^*}{2} = \frac{Mv^2d^2}{2D^2}$$

where v is the velocity of train in feet per second, d the length of flat spot in feet and D the diameter of the wheel in feet.

The allowable impact on a rail of any weight is given by the specifications of the Master Car Builders' Association, as that of a weight G^1 falling freely from rest through a distance h^1 upon the rail. The kinetic energy of the impact of the wheel should not be greater than that of G^1 falling through the distance h^1. We have, therefore,

$$\frac{Mv^2d^2}{2\ D^2} = G^1h^1$$

so that

$$(1) \qquad d = \left(\sqrt{\frac{2\ D^2\ G'h'}{M}}\right)\frac{1}{v}$$