is a most wasteful way of using this material, and gravel is disappearing from many parts of Ontario because of the wasteful way in which it has been used.

To use gravel properly, the material should be spread evenly, and while a 3-in. thickness is a good start, it is only a start. In order to get something that will stand up under the heavier traffic that will go over the road, the gravel must be made thicker from year to year; but each year when you put it on, spread it in a thin coat and keep it in shape and see that your patrol men drag it as fast as it gets uneven. That is the function of the patrol man,—to see that the gravel becomes consolidated evenly and smoothly.

Crown Can Be Reduced

By having it spread out wider, it is not necessary to have as great a crown on the road. If you have only a single-track road, it is necessary to have a sharp crown, because the wheels track continually in two lines, whereas if it is spread more flatly and uniformly, the rigs can go all over the road and they do not have to track, and it should be the duty of the patrol man to see that they do not track. He can put obstacles to compel them at times to spread out over the road. That is why a thin crust, widely spread on a comparatively low grade, will stand up under more traffic than will a heavier thickness piled up in the centre of the road.

Stone roads have been spoken of, and from what has been said one would question whether we should construct stone roads or not. Should we always use some bituminous material in the top instead of having a great deal of water-bound macadam road? I consider that where we are putting in macadam of any importance, that we should put it in as a foundation for a future bituminous surface. No greater mistake in my opinion has been made than where stone roads are constructed indiscriminately, and they immediately put in the bituminous material, because a bituminous surface in order to stand up fairly uniformly and stay that way should be free from depressions that will hold the water. If you put macadam over a new earth foundation, unequal settlement is certain to take place and pockets will appear, and there is no more fruitful source for failure in a bituminous pavement than these depressions appearing in the surface of the road.

The future of macadam, as I see it on the more important highways, is as a foundation for a bituminous top; but, for a few years perhaps, maintained by use of oil or some other material which will keep the surface as fair as possible. Other speakers have said, "Don't oil gravel roads; don't oil stone roads." There are gravel roads and there are stone roads, and there are oils, and you can use them in proper combination. We have used oil on gravel that is a continuous pleasure to the people who have to use that road. We have used it on other gravels where it was a complete failure due to the particular quality of the gravel and the foundation of the road; for instance, there was a certain sandy substratum and a peculiar quality to the gravel; when the traffic commenced to go over that road. the sand shifted underneath and pockets inevitably appeared in the surface. In other cases we have had a firm gravel oil surface which has given excellent service.

Oiling That Is Satisfactory

There are certain macadam roads in Ontario, in the fruit country, under the control of our department, which must be oiled at a certain hour on a certain day, or there is trouble. If you get the macadam at a certain time when the fine material is swept off and when the coarser stone has shown up, and if you get your oil over that clean stone, you will have something that will stand.

I think that the provincial highways will do good in various ways; I think that they will put into practice some of the principles that we have tried to emphasize and spread over Ontario. I feel that they will have a good influence on the county and other roads. I do not expect that we will do all this work without some mistakes. In starting this organization, we have to get new men and we have to train men, and we have to get men of good judgment, but perhaps not always with the mature experience that they will ultimately have. I want some mistakes, because I find that an engineer who makes no mistakes never makes anything else. He has to make some mistakes.

We are going to do a good job in Ontario on the provincial highways. We are going to do the best we can, and we are going to give Ontario something they have never had before, and they are going to be satisfied with it when it is finished. In the meantime, while the job is being done, don't kick too hard.

BITUMINOUS PENETRATION SURFACES*

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THIS subject, "Bituminous Penetration Surfaces," readily divides itself into two classes or groups: (1) The superficial; and (2) the other more permanent. Under the superficial class comes all surface treatments such as dust palliatives, while the more permanent class are bituminous-bonded roads and pavements.

One of the most disastrous happenings to a road is the loss of the dust or binder in it, and one of the most disagreeable conditions to the travelling public is the dust nuisance. If it is possible to remove one evil, both are removed. Up to date, possibly the most efficient means to this end has been the use of road oils. Road oils are indeed a blessing, though sometimes a rather expensive blessing.

First of all, make sure that what you are buying is the true quality represented; and further, apply the proper quality to the proper type of road. Every quality of oil is neither economical nor useful to every type of road. It may be taken that the harder and cleaner the road, the higher the bituminous content that may be used with impunity.

Should Use Mechanical Distributors

For satisfactory practice the road should be in good condition as to crown, grade, etc., and cleaned as free from dust as possible. The road should be warm and dry and the oil applied with the better class of mechanical distributors, evenly and in sufficient quantity that the road will absorb. To secure the best results, the oil should then be covered lightly with sharp sand or clean stone chips. In time, and after a number of applications, if the road is not knocked to pieces with traffic, a covering of this bitumen and stone will be formed that is impervious to water and satisfactory in the prevention of dust.

Turning to the more important bituminous penetration pavements, we have a subject that deserves close attention.

The economic development of any country demands road improvements. Traffic demands development of roads. Every country by evolution passes from one state to another,—from the original clay road to the finished pavement. This country has now reached the state of development when its rural as well as urban roads require more than the lesser types of permanency on its main highways, and yet may not have so far advanced to stand the expensive pavement. The bituminous penertation pavement is one of the types that bridges the two extremes. The advent of the automobile in all its forms is doubtless the chief visible propagandist of improved roads backed by the real demand for improvement as an economic necessity. The idea of the bituminous penetration road is to get something of a more permanent nature—something with a bond more enduring than water and stone dust—something that will prevent the very life of the road from being thrown over the neighbor's fence every time a motor car passes, without the bankrupting cost of the expensive pavement.

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