stone, an excellent indication of the binding power of the road stone can be quickly obtained.

The speaker said that he had tested the strength of briquettes made from road stones which have been collected at various places, and had found that in general those rocks which have the lowest silica percentage when briquetted give the greatest tensile and crushing strength. With certain rocks, such as flint, he had failed to make briquettes except with the addition of a quantity of clay binder, and had found that when powdered flint is added to clay the strength of the briquette is that of the clay only. He had made briquettes from fresh road stone (Clee Hill dolerite) freshly powdered by himself, and from road scrapings taken from a water-bound road of Clee Hill stone which was well-nigh worn out, and had found that the strength of the briquette of the road scrapings is less than one-quarter that of the freshly crushed rock. He had also tried to make briquettes of road sweepings from a tar-bound road of Clee Hill stone, and was rather astonished to find that these sweepings failed to bind. Now he recognizes that spent tar and pitch belong to the class of solids which water does not wet, and from the similarity of the behaviour of powdered flint groups raw flint with these as the one common rock which water does not wet, and which, therefore, it cannot bind.

Thus far has been considered the strength of a water-bound aggregate as an absolute property which is determined by the form and composition of the particles bound. As a matter of fact, with one and the same aggregate of rock fragments mingled with different proportions of water, the strength (that is, the stress which the aggregate can accept without coming asunder) varies enormously. It is recognized that stone dust when dry has no strength, and that when fully wetter to the state of mud its strength similarly is nil. In the intermediate damp stages the strength is considerable and characteristic. This may be conveniently expressed in the form of a curve, which passes through the origin, rises very rapidly to a definite maximum, and then falls away again.

The most important characteristics of the curve are (1) the height of the maximum (i.e., the maximum strength); (2) the distance from the origin (i.e., the percentage of water) at which the maximum occurs. Powdered mica gives a high maximum very close to the origin; powdered quartz a low maximum rather far away. This curve should be determined experimentally for each road stone used in large quantity. Professor Fearnsides inferred that rocks whose strength attains a maximum with little water are suitable for use in dry climates, while those in which the maximum is far from the origin are more suited to the damp atmosphere and frequent showers of the hills; and he believed that experience on the road confirms this inference. Quartzite and flint roads are undoubtedly at their best after rain or in damp weather, at which times water-bound limestone roads become almost impassable.

The lecturer said that he had labored these details of the origin of the strength of water-bound aggregates at some length, because, both from observation and from experiment, he concludes that it is the statical strength of the road crust that determines its resistance to wear. If the passing loads distribute stresses which can be taken up by elastic deformation, there is no grinding of stone on stone within the road crust, and the work done in deformation is dissipated without altering the conformation of the road aggregate. At their best most roads are strong enough thus to carry their loads without serious internal wear, but who, in wet weather, or after a frost, has not heard the "scrunch, scrunch" of internal grinding of the stones beneath the wheels of a wagon as it passes along a road? The importance therefore of maintaining the quantity of water in a road at a proportion not far different from that required for the condition of maximum strength is considerable. To this proportion the speaker hereafter refers as the "optimum."

Potholes.

The subject of potholes is closely related. Potholes are areas where, by faulty or non-homogeneous construction of the sub-crust, or by some other cause, the road crust is maintained or remains damp for periods longer than in the areas adjoining. Hence when, after a wetting, the average of the road in drying passes from a condition of weakness to a condition of comparative strength, the place of the pothole remains weak, and the passing traffic continues to grind stone upon stone within the crust at times when over the rest of the road this type of wear has ceased.

Two years ago the professor said he came across an old road-mender on the Cambridge-London main road at his wits' end to cure a crop of potholes in front of the entrance to a patron's estate. The subsoil at the place is coarse gravel, and the road has been mended several times without remaking. It seemed, therefore, that this was a case of water standing in puddles in the sub-crust. He therefore persuaded the old man to drive a bar or spike down to the gravel in the midst of each of his potholes, and passing the place this summer rejoiced to be informed, and to see for himself, that, though the strip of road has not yet been redressed, the potholes are no more.

Allowing that explanation of potholes is correct, it follows that a uniform and complete sub-crust drainage will entirely prevent them, and that there can be no cure for existing potholes as long as water in the sub-crust distributes itself irregularly. It also follows that there can be no surer method of securing the development of potholes than to put upon a wornout and insufficiently scarified road a thin dressing of new macadam. Road surfaces, by the crushing of the surface stones, become fairly impervious, and each depression or rut which is covered by the new coating is a cup to hold water longer than does the rest of the road, and hence the over-rapid wear of the road crust above it is assured. The distribution of sub-crust water-pockets and their resulting potholes is a long and complex subject, and with the comment that over-watering in the dusty season is one of the most effective methods of keeping the water-pockets supplied with water, the speaker proceeded to other matters.

"Site-Rocks."

Not only does water give strength to macadam, but it is water which holds together the particles of which the weaker of the road "site-rocks" (or ground foundations on which the roads are built) consist.

Site-rocks from the point of view of the road-maker may be divided into three classes:—

(1) Rocks which consist of compact pieces of hard material separated one from another by joints or open spaces which are wide enough to allow water to pass freely through them under gravity. These give no trouble to the road maker, and beyond the clearing away of irregularities and the removal of soil, the sites which they afford require no preparations for the road crust coating.