In order to comprehend how the increase in fine material adds to the surface area to be covered with bitumen, let us consider a one-inch cube of stone. It has six sides, each 1 sq. in. in area, or a total of 6 sq. ins. Let us now saw it through the middle. It has now the original six sides and two more, each of 1 sq. in. in area, or 8 sq. ins. in all. Keeping the pieces together and cutting it again in a plane at right angles to the first cut we add two more square inches in surface area, making 10 sq. ins. in all, although the volume of the mass has not been increased.

In certain of the tarred slag pavements in which a very soft tar is used, the pavement as laid is very deficient in fine particles. The top layers of slag are expected and do crush to a very considerable extent under traffic and the fine particles thus produced are coated by the soft tar at atmospheric temperatures and are incorporated into the pavement; thus, in a short time forming a dense compact mass which, under light and medium traffic, gives excellent satisfaction. A large quantity of this pavement is laid on country or suburban roads in England and costs about half a crown (62½ cts.) per square yard. With any other type of bitumen which was not very fluid and which would not coat particles satisfactorily at atmospheric temperatures, such a pavement would be a very dangerous type to lay. The sharp particles of slag key very firmly together and once the sufficient amount of fine material is produced by traffic crushing, the pavement is a remarkably stable one and sufficiently close grained to keep the water out. As illustrating the grading in various kinds of pavement, the following typical examples are given:—

	Sheet Asphalt. Heavy Traffic.	Sheet Asphalt. Light Traffic.	Topeka.	Bituminous Concrete. Hot Mixture.	Bituminous Concrete. Cold Mixture.
	%	%	%	%	%
Bitumen	11.0	10.5	8.5	7.0	6.5
Passing 200 mesh..	14.0	10.5	8.5	5.0	4.5
" 100 " ..	14.0	10.0	6.0	4.0	1.5
" 80 " ..	13.0	10.0	6.0	2.0	1.5
" 50 " ..	19.0	14.0	6.0	5.0	1.5
" 40 " ..	11.0	14.0	10.0	4.0	1.5
" 30 " ..	10.0	13.0	10.0	4.0	1.5
" 20 " ..	5.0	10.0	9.0	3.0	3.0
" 10 " ..	3.0	8.0	6.0	5.0	5.5
" 8 " ..	...	...	6.0	3.0	5.0
" 4 " ..	...	...	14.0	7.0	8.0
" 2 " ..	...	...	10.0	20.0	40.0
" ¾" " ..	...	...	....	14.0	11.0
" 1" " ..	...	...	....	12.0	9.0
" 1½" " ..	...	...	....	5.0	...
	100.0	100.0	100.0	100.0	100.0

In addition to the increase in stability due to the proper grading or sizing of the different articles and the consequent increase in density, a reduction in the size of voids is obtained. The latter feature is essential in that it keeps the water out of the pavement. Any bituminous pavement which is sufficiently porous to permit the water to enter it and be retained therein will soon disintegrate due to the loosening of the bond between the bitumen and the particles by the action of the water. Another consideration involved in the selection of the size of the mineral aggregate is the kind of surface desired on the finished pavement. The larger the aggregate the rougher and less slippery the surface. We have already seen, however, that with a very heavy traffic, large sized aggregates are not permissible. A smooth, fine-grained pavement composed of small particles, if properly designed, is suitable for all kinds of traffic but is undoubtedly more slippery than the coarser type.

Cleanliness.—Many sands and gravels have finely divided clayey material adhering to their larger particles. Such sands and gravels are unsuitable for use in bituminous pavements unless first washed. When passed through the heating drum or dryer, this clayey deposit becomes burned on to the surface of the grains by the heat to which it is subjected to such an extent that it is not removed by attrition in the mixer. It thus prevents the bitumen from coming into contact with the actual and permanent surface of the larger grains and subsequently breaks loose from them, carrying the bitumen with it. This results in the disintegration of the pavement as the uncoated particles soon wear or wash away, leaving depressions in which water will accumulate. Clayey material, unless finely pulverized after drying, is always objectionable. Even if it does not adhere to the grains, it bakes into balls in the dryer, only the outside of which can be coated with bitumen and these balls readily break up under traffic, leaving similar depressions to those above described. A pat of surface mixture made of clayey sand will, when broken open, invariably show these clay balls with uncoated powdery centres. In a recent type of bituminous pavement the manufacturing process involves the pulverization of the mineral aggregate after it has been dried and heated. Under such conditions clay makes a most excellent paving material, as it readily absorbs the asphalt and clings tenaciously to it, the bond between them being much stronger than in the case of sand, gravel or crushed rock. Under certain special conditions, therefore, that which is ordinarily to be avoided becomes highly desirable. Crushed stone or gravel from which the dust has not been removed and which has been allowed to stand exposed to the weather will almost invariably have the larger particles partly covered with strongly adherent stone dust which has formed a sort of cement by the action of water, and material of this kind should be rejected. For this reason, most specifications call for freshly crushed stone. This is especially important in the case of stone for use in asphalt blocks. The bituminous cement largely used in the manufacture of these blocks has a high melting point and is therefore not very fluid at the temperatures employed during mixing. Under such conditions, the use of a clean stone is absolutely essential. A very fluid bitumen might perhaps be sufficiently absorbed by these fine particles to permit of its reaching the actual surface of the stone through capillary action during the mixing process and might even be relied on to subsequently coat the larger particles at atmospheric temperatures after their imperfectly adhering mineral coating had become detached in the pavement by the stress of traffic. With a bitumen of high melting point and low ductility this would, however, never take place.

At first sight it might appear that the addition of 5 to 20% of finely ground Portland cement or lime dust to the mixture would produce the very conditions of finely divided particles adhering to the larger ones that have just been classified as extremely undesirable. It must be remembered, however, that this filler is added to the mixture *after* it has passed through the heating drums and is in itself dry and there is, therefore, no chance of its becoming baked on or firmly attached to the larger particles.

In the practice of his profession, the engineer is frequently confronted with the problem of selecting not that which is economically the best in the long run, but what is the best that can be done with the appropriation that has been put at his disposal, and the speaker hopes that the foregoing discussion will in some degree aid him in this most difficult task. If the sand is unsuitable or very expensive to obtain and the traffic is not very heavy, and a satisfactory supply of rock at a reasonable price is at hand, rock is obviously the material to use. If the rock is unsuitable or dear and the sand good and cheap, a sand