from this cause alone within a few weeks from the time they were laid. Gravel, freshly broken slag and stone are ordinarily free from this defect. Slag which is glassy does not coat as well with bitumen as do the more basic slags.

Wear-resisting Quality.—This, while a very important property, is perhaps more of a variable one than any of the other qualities mentioned. The degree required depends upon the kind and density of the traffic, the size of the particles, the type of pavement and the hardness of the wearing surface considered as a whole. We have already noted that an iron-tired traffic exerts a greater crushing action than a traffic that is carried on rubber tires and it goes without saying that a dense traffic is more severe in this respect than a light traffic. Up to a certain point, the larger the particle, the greater the liability to fracture and where the traffic is very heavy, aggregates consisting of relatively large particles will not give satisfactory service even though composed of the hardest known rocks, unless the particles are sufficiently massive to resist fracture, as, for instance, ordinary paving setts, which are, of course, outside the limit of bituminous pavements. In other words, broken stone or gravel of from ½ to 1½ inches in size requires more careful scrutiny as to its resistance to fracture than do sand or paving blocks. Resistance to fracture is, of course, only one of the elements going to make up wear-resisting quality. Hardness is also a requisite, although a very hard and at the same time brittle material would not be suitable for use in bituminous pavements. A pavement which is soft and yielding as a mass does not require as hard and tough a mineral aggregate as does a more unyielding pavement. The shock or impact, as well as the grinding action of traffic, is minimized by the plasticity of the pavement in the same way that it is difficult to break a rock of relatively small size when supported on a yielding bed. When the particles are heavily coated with a relatively fluid bitumen, fractures of the particles are to a certain extent self-healing. In this type of pavement, therefore, somewhat softer rock may be safely used than in those types in which the bitumen is harder and the coating on the particles thinner.

Size.—This property has to do not only with the actual size of any one particle or set of particles, but also embraces the question of the relative size of the different particles composing the aggregate as a whole, which constitutes what is frequently referred to as the grading of the mass. As previously mentioned, large sized aggregates will not carry excessively heavy traffic and this not only refers to the difference between broken stone and sand, but to different varieties of sand as well. For ordinarily dense and heavy traffic, sheet asphalt pavements carry from 2 to 10% of sand particles which will just pass a 10-mesh sieve and are approximately 0.027 of an inch in diameter. Where the traffic is exceptionally heavy, particles of this size are liable to fracture and the maximum size must be still further reduced. In certain heavily travelled streets in Glasgow, Scotland, the speaker was forced to limit the maximum size of the sand particles to those which would pass a 30-mesh sieve. Such particles would have a diameter of approximately 0.01375 of an inch. The ability of a very fine and comparatively soft aggregate to sustain the heaviest known traffic is perhaps best exemplified by the French rock asphalt pavements. These pavements are largely composed of particles which will pass a 200-mesh sieve and have an approximate diameter of 0.00235 of an inch. The particles themselves are composed of a soft limestone thus showing the possibility of using relatively soft materials when they are in a fine state of division. The bitumen with which they are coated is relatively quite soft, which again accentuates a point previously referred to; *viz.*, the possibility of using soft materials with a fluid bitumen. The relative size of the different particles or the grading of the mineral aggregate is perhaps one of the most important considerations in the construction of a bituminous pavement. On it much of the success of the pavement depends. The maximum size of the particles and the allowable proportion of maximum sized particles is, as we have seen, dependent upon the traffic. If all the particles were of practically the same size, they would touch at only a few points of contact and the pavement would have a large percentage of relatively large voids. The weakness of the bond due to the few points of contact would make it pick up or ravel under traffic and the relatively large sized voids would permit the bitumen to drain off the hot aggregate during transit to the street or road, leaving a very thin coating on the particles and thus still further weakening the bond. Any considerable excess of bitumen in the mixture would result in the formation of "fat spots" in the pavement where the excess of bitumen had collected. If the temperature at which the mixing took place was lowered, there would be danger of not properly coating the particles and in cold weather a mixture of this type would be very difficult to rake and would break up under the roller, and it would be impossible to compress it into a compact mass. It is, therefore, essential to fill up these large sized voids with smaller particles. If all of these smaller particles were exceedingly minute, they would present a very large surface area to be covered by bitumen, and would, therefore, increase the cost of the pavement. The mass formed by them would be very plastic owing to the relatively high percentage of bitumen necessitated by the conditions of mixing, and would not key the larger particles together as firmly as if the filling mass were partly composed of the largest sized particles which would go into the voids between the large aggregate. The French rock asphalt, while composed almost entirely of very small particles, has a very high degree of stability and contains a relatively low percentage of bitumen by which it has been impregnated by natural processes in which time was not a factor. The average time of mixing a batch of bituminous pavement does not exceed one minute and the consistency of the bitumen is usually much harder than that found in the French rock. It is therefore impossible, under working conditions, to satisfactorily coat a fine aggregate with as small a percentage of bitumen as is found in the French rock and the stability of the mixture is lessened by this relative excess of bitumen. It is, therefore, essential to first fill the voids between the maximum sized particles with the largest sized pieces that will go in them. The remaining voids should then be similarly filled and so on down to those voids which can only be filled by particles passing a 200-mesh sieve. The proportion of these particles will not ordinarily exceed 15% in a sheet asphalt pavement, the governing factor being the production of a dense surface which will not be water-absorbent and having as large a proportion of mineral aggregate as possible. Closeness of grain could, of course, be obtained by an excess of bitumen, but this would increase expense and reduce stability. Where the maximum size of the particles approaches one inch the percentage of 200-mesh material in the pavement is, of course, much lower than in sheet asphalt pavements and varies from 3 to 5% on the average. Particles of 200-mesh sand are not desirable in a pavement owing to the fact that they detract from its stability and if present to any considerable extent, tend to make the mixture mushy. All, or the greater portion of, the 200-mesh material should be finely ground limestone or Portland cement, as this materially adds to the the stability of the pavement.