is partially dependent upon the rate in which the dust is inhaled, this latter item plays an important role in predicting the relative danger of different environments. Hence the need for the evaluation of the quantity of dust in the industrial atmosphere is obvious.

Research on the problem of industrial dust inhalation has indicated that so far as their fibrosis producing qualities are concerned, dusts may be divided into three groups: (1) those composed completely of combined silica, that is silicates, such as pure asbestos; (2) those containing free silica in the crystalline form known as quartz, (granite contains approximately 35 per cent of quartz); and (3) dust containing free silica in a non-crystalline form such as diatomaceous earth. In general, it has been found that the harmfulness of a quartz containing dust is in direct proportion to its quartz content. For this reason, in attempting to evaluate the harmfulness of a dust, it is of the utmost importance to ascertain its exact mineralogical composition.

It has been our experience that to determine accurately the exact mineralogical composition of a dust one should resort to a combined chemical and petrographic analysis. By no other method have we found it possible to determine the amount of quartz present in a given sample. In certain instances, such as when one is dealing with a mixture of quartz and pure potash feldspar, it is possible to determine the amount of quartz present in such dust merely by a chemical analysis. However, most dusts which come into question are mixtures of quartz and silicates. Take granite for example. The average granite is made up chiefly of three minerals in about the following proportions: feldspar 60 per cent, quartz 30 per cent, and mica 15 per cent. Chemical analysis shows that this average granite contains 70 per cent of silica. Of this 70 per cent, 30 per cent is present as quartz (free silica) and the other 40 per cent is present as combined silica, in chemical combination with the other minerals that make up granite; it is possible to determine these proportions only with the aid of the petrographic microscope.

We find in practice that samples of dust settled out of the asmosphere at the breathing level of the worker serve admirably for both chemical and mineralogical determinations. Table 1 presents the quartz content of dusts obtained in various industries which we have studied.

TABLE 1

Percentage of Quartz Present in Various Industrial Dusts

Kind of Dust	Percentage of Quartz
Rock drilling dust (bituminous coal mine)	54.0
Granite cutting dust	35.2
Rock drilling dust (anthracite coal mine)	31.0
Brass foundry dust	19.0
Dust from raw mills in cement plant	6.5
Slate mill dust (Vermont red slate)	3.0
Silverware polishing dust	1.7
Anthracite coal dust	1.5
Bituminous coal dust	1.2
Cement dust	1.0
Slate mill dust (Vermont green slate)	trace
Talc mill dust	none
Marble cutting dust	none

It is evident from this table that rock drilling occupations in the coal mining industry and certain occupations in the granite cutting industry and in brass foundries would be in the hazardous class as judged by the proportions of quartz in the atmospheric dust.

It has been demonstrated that particles of dust of a size greater than 10 to 12 microns in longest dimension are very seldom found in the lungs. This absence of larger particles is partly due to the fact that the numbers of such particles greater than ten microns in size present in industrial air is, as compared with the lower sizes, comparatively small; furthermore, these larger particles do not penetrate to the terminal portions of the respiratory tract. Hence we need only concern ourselves with those dust particles that are less than ten microns in longest dimension.

In order to ascertain whether or not an industrial dust is capable of gaining access to the lungs, it is necessary to know something of the size of the particles in the dust under consideration. In practice the samples for particle size studies may be obtained by the use of the Owens jet dust counter. The advantage of this instrument over other devices is that the Owens apparatus projects the atmospheric dust in unaltered condition directly on a microscope cover-slip. This cover-slip may then be properly mounted and examined by any one of several methods. In another method a microphotograph of the dust is made at a high magnification; the particles revealed on an enlarged print or screen may be measured by means of a millimeter scale. No matter which method one uses for particle-size measurements the results may be treated in the customary manner. The particles may be grouped in classes according to size, from which a percentage distribution curve is easily obtained.

As poimted out earlier, a knowledge of the quantity of dust dispersed in the atmosphere is very important, since with any given dust the rate of production of the injury will be dependent upon the total quantity inhaled.

From the practical hygienic viewpoint, the particle count is at present the best quantitative index of the degree of atmospheric pollution. The decision as to the size range of the particles which should be included in the dust count is a question requiring careful consideration. Obviously the size of the smallest visible particle will depend on the magnification and type of illumination nsed in the microscope, the refractive properties of the dust and to some extent on the visual acuity of the observer. We must bear in mind that our chief interest in this problem is in the industrial hygienic aspect. Primarily we are interested in differentiating between the dust content in the ordinary normal atmospheres, not yet known to be harmful, and certain industrial dusts which are known to be associated with lung damage. This difference is sharply marked so far as the dust particles between approximately one-half and ten microns in diameter are concerned; but the difference between such normal and abnormal air is masked and lost when we include in our determination the particles of ultra-microscopic size which are present in vast numbers in all air.

So far as the upper limit of particle size is concerned it has been demonstrated by the South African studies that particles greater than ten microns in longest dimension are, as a rule, of negligible importance. The data concerning the lower size limit of potentially hazardous dust is not so conclusive. Moir of South Africa, who examined microscopically 120 dust particles obtained from two specimens of silicotic lung, found that only 13 per cent of the particles were less than 0.5 microns and about 36 per cent of the particles were less than one micron in diameter. The majority of the particles, 60 per cent, were between one and three microns in size. The median size of the dust was found to be 1.2 microns in diameter. Drinker, in comparing the size frequency of the particles measured by Moir with the particles measured by him of the dust found in the sputum of men employed in ore mills, found a close correspondence. These findings have also been corroborated by Navrogordato.

In connection with the lower limit of particle size of dust of pathological significance the following pertinent question arises: Aside from the evidence direct or indirect of the non-retention of minute particles of dust by the lungs, what