equivalent to a tracheal flow of approximately 100 ml per second.

The most straightforward procedure to establish the relationship between aerosol persistence during breath holding and the size of the airspaces is to study the same lungs using aerosol persistence and morphometric measurements on histological sections. This has obviously not been done on any of our subjects, but recently Matsuba and Thurlbeck (1971) measured the number and average diameters of small (less than 2 mm) nonalveolated airways in the lungs of 20 normal cadavers after carefully controlled inflation, fixation, and sectioning. Figure 2 shows a cumulative frequency diagram comparing the results of Matsuba and Thurlbeck with the aerosol data on estimated airspace diameters. It can be seen that they found an average diameter of 0·68 mm and a coefficient of variation of 24%, while our value for the average effective airspace diameter, as estimated by aerosol persistence, was 0·54 mm with a 21% coefficient of variation. We do not believe that a strict comparison of average sizes by the two methods is justified, because the aerosol method is looking at alveolated airspaces as well. Nevertheless the similarity of the coefficients of variation for the two sets of values, 24% versus 21%, is highly suggestive that there is considerable variability in the average size of similar anatomical units in normal human populations when estimated by either technique.

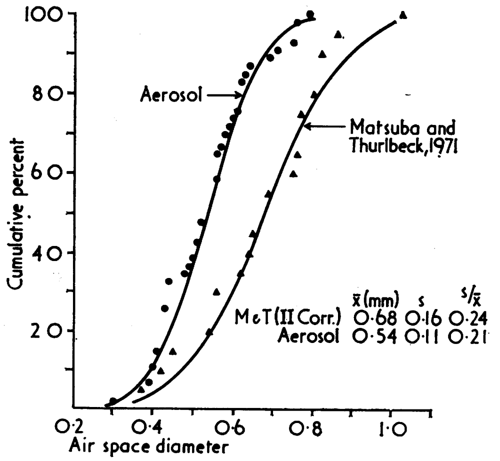

FIG. 2. *Distribution of airspace diameters determined by aerosol persistence compared with diameters of small (<2 mm) nonalveolated airways found by Matsuba and Thurlbeck* (1971). *The ordinate refers to the percent of airspaces less than the stated diameter.*

It should also be noted that previous investigations by Thurlbeck (1967), and more recent ones by Angus and Thurlbeck (1972), on the number and dimensions of alveoli in the normal human lung also suggest wide variations between subjects of similar heights. These workers found that although the total number of alveoli and, consequently, lung volume were positively correlated with body length (height), the mean linear intercept (average interalveolar distance) was independent of body length and lung volume.

This type of distribution in normal populations has profound implications for lung models, whether one considers either gas transport and distribution or aerosol distribution and deposition. Treating the airspace diameters as if they were approximately equal for all normal subjects makes it possible to arrive at elegant models for estimating aerodynamic characteristics, but the models fail to take into account variability in airspace size within normal subjects and the difference in aerosol behaviour which would result from this variability. One of the models for aerosol deposition in wide use is that of the International Committee for Radiation Protection (Morrow, 1966). This model is used to estimate total and regional aerosol deposition for each particle size in a single anatomical model made up of tubes of a series of fixed sizes. Similarly, Weibel's regular model of the lung (Weibel, 1973), which is also widely used to explain aerodynamic behaviour, certainly does not suggest such wide variations in the anatomy of the airspaces between subjects as we or Matsuba and Thurlbeck (1971) have detected.

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