There are three mechanisms which prevent dust, secretions and cells from accumulating in the airway lumen: coughing, the mucociliary transport system and phagocytosis by macrophages and polymorphonuclear leukocytes. Where these mechanisms fail some airways are likely to become blocked, giving rise to poor ventilation to parts of the lung. In extreme cases there is extensive bronchial and bronchiolar plugging and patients may die from ventilatory failure. This is seen most commonly in those who die from asthma: at post mortem the conducting airways contain extensive plugs of a material which consists of mucus, plasma exudate, fibrin and cellular debris (Dunnill, 1960). There is growing evidence that patients who suffer from milder asthma may also accumulate lesser quantities of such material in their conducting airways. Dunnill (1975) has shown that, in a small series of patients who died in traffic accidents while in remission from their asthma, there was partial occlusion of many airways by secretions and cellular debris.

It is worth considering the consequence of partial airways obstruction by material within the ring of bronchial smooth muscle. A minor accumulation would cause only a small increase of airway resistance in the relaxed airway, but once the smooth muscle of the airway constricted the uncleared material within the lumen would sharply exacerbate the rise in resistance (Freedman, 1972). Fig. 1 gives an example of this effect. This is likely to be one of the factors which causes bronchial hyper-reactivity, the severe increase in airways' resistance in asthmatic subjects who are exposed to a bronchoconstrictor stimulus which, in normal people, would cause only a trivial increase in airway resistance.
The effect of bronchoconstriction on the resistance of an airway with an unimpeded lumen (a) and an airway of the same size but with its lumen partly blocked by uncleared secretion (b). $R = $ resistance; $r = $ radius of the airway lumen. The calculation of airway resistance, in arbitrary units, assumes that Poiseuille's law applied ($R \propto \frac{1}{r^4}$). It can be seen that a smear of uncleared secretion which doubles airway resistance in the relaxed airway increases it profoundly in the constricted airway.