dust levels experienced at different times into measures of exposure are given in the Appendix.

If the factory medical officer suspected that a man had asbestosis, then he would recommend transfer to a less dusty job. Such a modification to a man's exposure based on medical signs is of relevance to the methods used to relate these signs to dust exposure; an unbiased analysis can be made only by using the times at which men with positive signs first reached this stage. The observed dose-response relationship is obtained using life-table methods.

RELATIONSHIP OF SIGNS TO CUMULATIVE DUST EXPOSURE

The simplest measure of exposure is the integrated dust concentration over the period of exposure. This measure, which is the one used previously (British Occupational Hygiene Society, 1968), gives equal weight to a given concentration without taking into account when the exposure occurred. The data are first presented in terms of this measure of dust exposure, and for all the men in the study.

The dose-response relationship (British Occupational Hygiene Society, 1968) was based on the assumption that the distribution of exposure at which a sign first occurred was log-normal. A similar approach has been followed, except that the logit transformation has been used instead of the probit transformation, and the relationship fitted to the signs (crepitations, possible asbestosis, and certified asbestosis).

In the 1968 analysis, it was estimated that 1% of those exposed would have crepitations after a dose of 112 f-yr/cm^3 with 90% confidence limits of 51 and 153 f-yr/cm^3. In the present analysis the response at a given dose is higher, and a prevalence of 1% is estimated at 43 f-yr/cm^3 (90% confidence limits, 34 and 52). For possible and certified asbestosis the 1% prevalences are estimated at 55 and 72 f-yr/cm^3 respectively. These figures are given as illustrations only, and not as suggested standards; other points have to be taken into account in setting standards.

There are three reasons for the differences in the dose-response relationships for crepitations between 1966 and 1972. First, the dust exposures are now known more accurately and, in particular, it is known that some men spent part of their time in less dusty jobs than the job category defined in 1966. The effect of this extra information is that the average cumulative dose up to 1966 is now estimated as about two-thirds of what it previously was thought to be. Thus the figure of 112 f-yr/cm^3 originally calculated represents about 75 f-yr/cm^3. Second, crepitations were recorded more frequently than previously (82/379 = 22% compared with 16/290 = 6% in 1966). This is attributable both to the longer follow-up and to a difference between observers; the factory medical officer changed in 1967. Third, the 1966 data were taken entirely from men still working at the factory whereas in the present study this selective effect, although still present, has been reduced by including men who left the factory between studies. As an indication of the difference this makes, if the analysis had been carried out only on those still employed at the end of 1972, then the prevalence of crepitations would have been 17% (42/241) instead of 22%. This selective leaving appeared not to be caused by crepitations as such, but may have followed certification which was correlated with crepitations; 29 out of 34 workers with certified asbestosis were not employed at the factory at the end of 1972.

DATE OF FIRST EMPLOYMENT

Dust conditions in the factory were measured only from 1951 onwards. The above analysis depends on assumptions of the dust conditions in the period 1933–50, but an analysis restricted to men first employed from 1951 onwards does not. In addition, such an analysis largely eliminates the bias caused by the exclusion of those who left the factory before 1966. For this reason, the analyses have been repeated for the group of men starting at the factory after 1950 (Figure 1). Figure 4 shows the observed and fitted relationships between the three signs and cumulative dose for men first employed after 1950. The exposures giving 1% prevalences were 37, 46, and 63 f-yr/cm^3 for crepitations, possible asbestosis and certified asbestosis respectively; again, these figures are given as illustrations only.

LIMITATIONS OF CUMULATIVE EXPOSURE

Relating the prevalence of disease to the dust concentrations weighted by duration of exposure to them is unsatisfactory because this ignores the probability of developing disease after exposure has ended. This disadvantage may be overcome by using a measure of exposure which weights the dust concentration at any moment by the time that has elapsed since exposure (Jahr, 1974). Such a measure attaches more importance to exposure a long time ago than to more recent exposure, and continues to increase after exposure has ended. When applied to men first exposed after 1950 it gives quite different interpretations from those of Figure 4; for example, 1% crepitations occurred at a dose of 163 f-yr^2/cm^3 which represents the dose accumulated by the end of 50 years' uniform exposure to a concentration of 0·13 f/cm^3. (Using the unweighted cumulative exposure, the same risk occurred at the dose from 50 years' exposure to 0·74 f/cm^3). For possible