chrysotile (Fig. 3). There are also small deformation domains which clearly resemble the UICC standard (B) samples. These fibers are therefore deformed less than the UICC standard samples (Fig. 4), as some intact internal canals can still be seen. It is impossible to derive this conclusion from the bright-field range.

Samples of heavily deformed chrysotile fiber found in brake drum dust are shown in Fig. 6 in the bright and dark field. Whereas the effects of deformation are not evident in the bright-field image, the difference in the dark-field image is quite striking. The crystal is inhomogeneous. This is reflected in the electron diffraction pattern, now showing a number of spots (Fig. 6c). The mottled contrast of black and bright areas could arise from one of several causes: severe surface deformation leading to uneven crystal thickness, conversion (or "grain growth" under heat and deformation) to a large grain polycrystal, or transformation of local areas into a new crystalline phase (e.g., forsterite). Further investigation into carefully deformed chrysotile is required to decide which it is. It is, however, quite clear that these identifying effects are associated only with the samples found in the used brake drum dust.

Undeformed and unaltered chrysotile is also found in the brake drum dust collected after use (sample D, Fig. 7). This was confirmed by electron diffraction patterns which were indexed after the camera constant was calibrated using a co-deposited gold standard, with the following results:

Used brake dust	diameter (Å)	2.62	2.34	1.49
Yada (1967)	diameter (Å)	2.60	2.30	1.46
	hkl	130	220	005

There is also clear dark-field evidence that not all the fibers are deformed. Figure 7 shows the dark- and bright-field images of fibers found in the brake drum dust; the dark-field image resembles that of the UICC chrysotile asbestos (B, shown in Fig. 4) and those in the unused brake lining (C, shown Fig. 5), the "grain sizes" being the same as in the UICC samples. Based upon this observation, it is concluded that a variety of products ranging from almost undeformed to completely transformed chrysotile products exist in brake drum dust.

DISCUSSION AND CONCLUSIONS

It is demonstrated that high-resolution dark-field electron microscopy can distinguish the degree of deformation in chrysotile asbestos fibers. In particular, it has been shown that UICC standard chrysotile has undergone microdeformation as a result of ball milling in the preparation step. The dark-field method may then be used by environmental researchers to trace the origins of asbestos fibers.

The dark-field images suggest that there are significant changes in the microstructure of chrysotile upon deformation, the cystallographic and microstructural details of which are complex and are worthy of further study.

There are several references to the beam sensitivity of chrysotile (Yada, 1967; Langer *et al.*, 1974). The utility of using this effect to distinguish chrysotile from other non-beam-sensitive materials could be of value to environmental pollution research.