

## Letters to the Editor

### The Quantitative Risks of Mesothelioma and Lung Cancer in Relation to Asbestos Exposure: The Wittenoom Data

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The Ontario Royal Commission in 1984, in its chapter entitled 'Criteria for Evaluating Cohort Studies and the Limitations of Asbestos Epidemiology', commented that 'It is therefore no accident that one of the weakest parts of all asbestos epidemiology is the quality of the quantitative exposure data' (Dupre *et al.*, 1984).

Such comments are of particular relevance to the cumulative crocidolite exposure levels used by Hodgson and Darnton (2000) in their mesothelioma and lung cancer risk estimates for the cohort of Australian Blue Asbestos workers (commonly known as the Wittenoom cohort).

It is important to realize that while Wittenoom is the name of a very remote town in the north-west of the state of Western Australia, the Wittenoom cohort in fact worked over three mining and various milling operations, and lived in two residential areas (Rogers and Nevill, 1995). The Wittenoom Gorge mine and mill, which operated from 1943 to 1958, initially hired some previously exposed miners from the 1937–46 Yampire Gorge crocidolite mine and mill. A new Wittenoom Gorge mill was constructed in 1949, and various modifications and attempts at dust control were made until its closure in 1958. The Colonial Gorge mine and mill commenced operation in the adjacent gorge in 1953, running until 1966, when it was closed for economic reasons. Throughout the 23 years of employment of the 6500 male Wittenoom cohort, various upgrades were made in production and dust control, but overall the three mines and mills were always extremely dusty. In addition, there was considerable general environmental exposure in several residential areas associated with the crocidolite mining activities.

Dust monitoring was conducted by the Mines' Inspectorate using a konimeter to determine compliance with the general particulate (non-fibre) standard of the day. Many hundreds of such measurements were recorded for the early 1950s until 1966. The vast majority of the results were recorded as 1000+ particles per cc, indicating overloading of the konimeter, and research has found consequently that these data were never suitable for estimating airborne fibre concentrations.

The only attempt at fibre level monitoring was made in the Colonial Gorge mine and mill by one of us (G.M.) in 1966 over 12 shifts, when the then modern mill was operating at full capacity. During this time, some 38 'static' samples were collected using two Casella Long Running Thermal Precipitators. In addition, three 'clean air' samples were taken ~100 m outside the mill which, when recounted in 1986, indicated levels between 0.5 and 2.0 fibres/ml. The only reporting or documentation of the results from this survey were made in a generalized manner at a 1968 conference. The complete extracts of exposure results are presented below (Major, 1968).

Miner and Scraper operator: 'about 1,500 ppcc of a size greater than 0.5 microns . . . about 20 particles per cc were fibres greater than 5 micron long and about 100 particles per cc were fibres less than 5 microns long.'

Ross ore feeder: 'about 100 particles per cc of which only about 10% were fibre, most less than 5 microns long.'

Picking Belt and Drier area: 'about 200 particles per cc, about 10% of which was fibre, nearly all being less than 5 microns long.'

Plant Operator Control Platform: '3,000 ppcc respirable including 270 fibres longer than 5 microns and 400 fibres less than 5 microns.'

Hand bagging: '3,000 particles per cc of which 100 were fibres longer than 5 microns and 500 fibres less than 5 microns.'

Mechanical Bag Press Operator: '2,000 particles per cc of which 80 were fibres longer than 5 microns and 250 fibres less than 5 microns long.'

This scant and generalized exposure information from 12 shifts reported in 1968 has been modified by others to produce median estimated time-weighted fibre concentrations of 50 fibres/ml for 'ever mill workers', 12 fibres/ml for 'ever mine but never mill workers' and 5 fibres/ml for 'other' categories of work. These values seem somewhat low to us compared with the dust levels observed in 1966. Further, they have been applied to the 23 years of the various locations and stages of mine and mill operation, resulting in estimated mean exposures of 34 fibres/ml for lung cancer cases and 26 fibres/ml

for other workers in the control group (De Klerk *et al.*, 1989). These estimates have also been incorporated into other studies, which are quoted by Hodgson and Darnton.

As occupational hygienists experienced in the investigation of occupational exposures in epidemiological investigations for mesothelioma, we have attempted without success to assemble exposure data and dose estimates for the Wittenoom cohort because of the 'quality of the quantitative exposure data' (Dupre *et al.*, 1984).

We have made inquiries of some of the original miners, millers and mines inspectors regarding exposure conditions and knowledge of how this changed over the 23 years of various operations, and are of the opinion that there is insufficient exposure information to calculate the asbestos fibre dose in a scientific manner. The basic information simply does not exist. At best, the exposure values reported in the literature and used by Hodgson and Darnton should be recognized as 'guesstimates', made by people who have not been trained in occupational hygiene and who have no experience in asbestos dust monitoring.

Further, we deny the statements by De Klerk *et al.* (1989), that the ranking and exposure estimates used in the original epidemiological studies 'have been verified by the industrial hygienist who conducted the original survey'. In response to this suggestion we have objected to the misuse and improper representation of the raw data whenever it has been presented at conferences, such as the 1987 International Conference on Occupational Health held in Sydney and the 1996 BOHS Inhaled Particles VII held in Cambridge.

We agree with the comments of Hodgson and Darnton that the risk slope is very sensitive to the exposure levels chosen. However, the use of poor exposure estimates produces only inaccurate risk analysis and assists in the promotion of bad science.

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## Reply

Mr Rogers is correct in pointing out the difficulties encountered in understanding the exposure histories of the members of the Wittenoom cohorts and the inadequacy of the dust monitoring data resulting from the sampling strategies and instruments that were used. Unfortunately this is a common experience when endeavouring to use exposure data collected for compliance with various standards for epidemiological purposes.

In trying to understand the health effects of crocidolite, it has been disappointing that despite the expertise of the industrial hygienist who conducted the 1966 survey and the logistics of going to such a remote town in the Pilbara region of Western Australia, only 38 'static' samples were collected during the visit, and that the only reporting or documentation of the results occurred in a conference in 1968. The Wittenoom workers and township residents are unique in that they were exposed exclusively to crocidolite, and their employment histories have been well documented. Follow-up of the cohorts has been undertaken over the past 25 years throughout Australia and also in Italy. In Australia, assessment

of mesothelioma incidence has been complete as a result of mesothelioma registries, cancer registries and pathology records, as well as mortality records accessed in all states since the 1940s. Vital status, cancer incidence and certified causes of death are therefore well established for the cohorts.

In 1983 we endeavoured to make the best use that we could of the available dust measurements in order, at least, to look at internal dose–response relationships, in addition to documenting disease incidences and mortality ratios for the workforce as a whole. In 1991 we carried out similar work on a cohort of residents of the township of Wittenoom who were known not to have worked for the Australian Blue Asbestos Company. Mr Major was of great assistance in helping us understand the relative exposures of the various job categories in relation to those job categories for which sampling had been carried out by him in 1966. We never stated that Mr Major agreed with exposure estimates, as reading of the cited paper clearly indicates (De Klerk *et al.*, 1989). We also engaged the assistance of the mine and mill supervisors, the company management and govern-