

xposure for many years. Thus far only about 10 or 12 deaths among anthophyllite and chrysotile miners have been attributed to this disease.

There is some question as to the relationship between exposure to amosite asbestos and incidence of mesothelioma. Transvaal amosite miners can not show this disease, whereas, according to I.J. Selikoff and coworkers, fourteen men exposed to amosite during World War II at a Patterson, New Jersey, factory have died of pleural or peritoneal mesothelioma (Selikoff et al., 1980b). It should be noted, however, that only one mesothelioma case was noted on the death certificates. The thirteen other deaths were recorded by Selikoff from a postmortem "best estimate." Such "adjustments" of death certificate data make it impossible to compare different epidemiological studies or to compare to "control" groups. In addition, there are two other observations relating to amosite asbestos that Selikoff does not address: (1) the very low mesothelioma rates in the Transvaal amosite miners and (2) the strong possibility that many of the Patterson factory amosite workers had previous work experience in New Jersey factories that processed crocidolite asbestos. McCullagh (1980) in a review of the Patterson workforce suggests that "something like one-third, or some 300 members, of the Patterson cohort may have been occupationally exposed to asbestos before entering the cohort."

Chrysotile asbestos, which accounts for about 95 percent of the asbestos in the present market, is much less harmful to miners than is crocidolite and probably amosite. McDonald et al. (1980) found that for men exposed for over 20 years to chrysotile dust averaging 20 fibers/cm<sup>3</sup>, the total mortality was less than expected (620 observed deaths, 659 expected deaths). Risk of lung cancer was slightly increased: 48 deaths observed, 42 deaths expected. Exposures to 20 fibers/cm<sup>3</sup> are an order of magnitude greater than those experienced now (generally less than 2 fibers/cm<sup>3</sup>); thus, chrysotile miners working a lifetime under these present dust levels should not be expected to suffer any measurable excess cancer.<sup>10</sup>

<sup>10</sup> If there is no threshold below which there is a zero risk of developing cancer from exposure to a carcinogen (many believe such a threshold exists, many do not), then even exposures to chrysotile

Epidemiological evidence does not exist to assess the health effects of tremolite or actinolite asbestos. The minerals cummingtonite, grunerite, and hornblende, which are sometimes considered to be asbestos-like, have been shown not to cause asbestos diseases in miners.

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Asbestos as low as two fibers per cubic centimeter could cause a few cancers to develop within a significantly large work force. Yet, the same also can be said of the human cost of operating heavy mining and manufacturing machinery; there will be some accidents resulting in injury and loss of life no matter how carefully the safety procedures are designed and followed. If, as some propose, society is to abandon the use of chrysotile asbestos despite the optimistic health picture for the present Quebec asbestos miners and millers, we should first be able to answer these questions:

- (1) What will the health risk be to those exposed to the asbestos substitutes?
- (2) Will the substitutes be less effective for fire protection, for braking efficiency, and for strengthening materials, resulting in increased injury and loss of life?
- (3) Will the costs of the substitutes prevent their use, for example, as replacement material for asbestos in cement water pipe and reinforced construction cement?