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Scientific Knowledge Concerning Neighborhood and Household Exposure To Asbestos And Disease - 2007

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Asbestos-related diseases can occur at virtually all levels of exposure. Higher exposures result in higher risks and lower exposures result in lower risks of developing disease. At the current OSHA standard the risk of death is 3.4 per 1,000 at 0.1 fibers/cc over a working life-time. Even at this new limit it can be clearly seen that the risk for dying from cancer is not zero. The World Health Organization has stated that "[T]he human evidence has not demonstrated that there is a threshold exposure level for lung cancer or mesothelioma below which exposure to asbestos dust would not be free of hazard to health." This continues to support what the industry representatives reported in 1965 at the New York Academy of Sciences Conference on the Biological Effects of Asbestos, that the only safe level to prevent disease is zero.[1] All commercial forms of asbestos, including chrysotile, amosite, crocidolite, tremolite, and anthophyllite can cause asbestosis, asbestos pleural diseases, lung cancer, and mesothelioma.[2] By 1964 there were more than 700 articles in the worldwide medical literature dealing with health effects associated with asbestos exposure.[3] By 1964 all of the major asbestos related diseases,

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[1] Commenting on the effectiveness of asbestos guidance concentrations S.A. Roach of the University of London stated that ". . .5 million particles per cu. Ft., are simply standards, although I hope I did not use the word 'safe.' These are standards which are actually used, although they are not ever expressed as being safe standards." Roach further went on to state that even if this was dropped to 2 million particles per cu. ft. that this would not necessarily be a "perfectly safe level of dust" (Roach, 1965). It is interesting to note that a worker would not be able to see this concentration of dust in the ambient air and would not see any dust until a concentration of between 20 to 40 mppcf was reached (Hemeon, 1955). Warren Cook in 1942 said "This [5 mppcf] is a very small concentration, so small in fact that the condition may look good even to a critical eye and still present an exposure greater than this low limit (Cook, 1942). The 5 mppcf guidance concentration remained in effect until the 1960s (DOL, 1960). Cooper (1967) states the 5 mppcf recommendation for protection, from asbestos exposure, proposed by the ACGIH since 1946, rests on shakier evidence compared to other such recommendations.

[2] World Health Organization, 2006. Elimination of asbestos-related diseases (draft). Geneva; Institute of Medicine, 2006. Asbestos Selected Cancers: Committee on Asbestos: Selected health Effects. The National Academies Press, Washington, DC; Dupre JS, Mustard JF, Uffen RJ, 1984. Report of the Royal Commission on Maters of Health and Safety Arising from the Use of Asbestos in Ontario. Ontario Ministry of the Attorney General Toronto, ON, Canada: Queen's Printer for Ontario; IARC, 1976. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man – Asbestos Volume 14. International Agency for Research on Cancer, World Health Organization, Lyon, France.

[3] Ozonoff, D., 1988. Failed Warnings: Asbestos-Related Disease and Industrial Medicine. In: The Health and Safety of Workers - case studies in the Politics of

including asbestosis, lung cancer and mesothelioma, had been established by the epidemiology literature.[4]

Because asbestos-related diseases are dose-response diseases, each exposure to asbestos has the potential to increase the overall risk of developing an asbestos-related disease. As reported by Brodkin and Rosenstock "While it is likely that there is some exposure threshold, none has been demonstrated convincingly, such that individuals with low exposures or higher exposures of short duration (e.g., for a period of days to weeks) are not at risk. This pattern is probably different from the relation between exposure and asbestos-related malignancies, in which even low-level or brief exposures may confer at least some increased risk."[5]

There is also a marked enhancement of the risk of lung cancer in persons exposed to asbestos who also smoke. However, there is no evidence that smoking enhances the development of mesothelioma, as it does with lung cancer.[6]

Professional Responsibility. Ed. Ronald Bayer, Oxford University Press, New York, Oxford.

[4] Merewether, E.R.A., and Price, C.W., 1930. Report on the effects of asbestos dust on the lungs and dust suppression in the asbestos industry I. Occurrence of pulmonary fibrosis and other pulmonary affections in asbestos workers II. Processes giving rise to dust and methods for its suppression. London: H.M. Stationery Office; Merewether, ERA, 1930. The occurrence of pulmonary fibrosis and other pulmonary affections in asbestos workers. J Indus Hyg, Vol. 12, No. 4, p. 239; Merewether, E.R.A., 1949. Annual Report of the Chief Inspector of Factories for the year 1947. London: HMSO, 1949. p. 78; Doll, R., 1955. Mortality from lung cancer in asbestos workers. Br. J. Ind. Med., Vol. 12, p. 81; Wagner, J.C., Sleggs, C.A., and Marchand, P., 1960. Diffuse pleural mesothelioma and asbestos exposure in the North Western Cape Province. Br. J. Ind. Med., Vol. 17, p. 260; Mancuso, T.F., and Coutler, E.J., 1963. Methodology in industrial health studies. The cohort approach, with special reference to an asbestos company. Arch. Env. Health, Vol. 6, p. 210; & Selikoff, I.J., Churg, J., and Hammond, E.C., 1964. Asbestos exposure and neoplasia. JAMA, Vol. 188, p. 22.

[5] Brodkin CA, Rosenstock L, 2005. Asbestosis and asbestos-related pleural disease, 19.8. In: Rosenstock L, Cullen Mr, Brodkin CA, Redlich CA, Textbook of Clinical Occupational and Environmental Medicine, second edition. Elsevier Saunders; 364-379.

[6] Smoking and Risk of lung cancer increases more than just additive but of a multiplicative nature. Both asbestos and smoking are independently capable of increasing the risk of lung cancer. One of the largest cohorts of asbestos workers to demonstrate this is that of the North American insulators studied by Dr. Selikoff. His co-investigator Dr. E. Cyler Hammond of the American Cancer Society (ACS) reported among 12,051 insulation workers with more than 20 years of work experience when compared to a control population from the ACS of 73,763 men both of whose smoking history was known that the RR went up to 53.24 for smoking asbestos insulation workers compared to non-smoking asbestos workers with 5.17 and non-asbestos insulation workers, as controls, of 10.85 (Hammond et al., 1979). In addition, another summary of smoking and asbestos exposure combined, reported the RR for 3 additional studies to be 8.2; 32.7; and 25.7 (Blennerhassett et al., 1995). Asbestosis patients had an Standard Mortality Ratio (SMR) of 15.47 (95% CI: 11.2-20.8) for lung cancer (Morinaga et al., 1993). An analysis of 23 studies on asbestos exposure and smoking shows that asbestos multiplies the risk of lung cancer in non-smokers and smokers by

Take-home asbestos on workers clothes, shoes, or hair can cause household exposures as can proximate residential exposures to asbestos sources. These types of exposures and their resultant disease manifestations are outline very effectively in the National Institute for Occupational Safety and Health Report to Congress on Workers' Home Contamination Study, which was conducted under The Workers' Family Protection Act (29 U.S.C. 671a).[7] In this report NIOSH concludes that ***". . . families of asbestos-exposed workers have been at increased risk of pleural, pericardial, or peritoneal mesothelioma, lung cancer, cancer of the gastrointestinal tract, and non-malignant pleural and parenchymal abnormalities as well as asbestosis."***

It has been known for many years that the best method to control diseases associated with exposure to asbestos was to control the exposure to the dust containing the asbestos fibers.[8] As early as 1897 Netolitzky, a physician, reporting on lung disease among textile workers also observed illness among their family members.[9] In1913 it was suggested that street clothes should not be worn in the work area and that work clothes should be removed prior to leaving the factory, thus preventing industrial poisons from being carried away from the workplace and exposing non-workers to the industrial hazard.[10] Kober and Hayhurst (1924) advised that street clothes should not be worn at work and that change rooms and washing facilities be furnished, by the employer at the workplace.[11] The International Labour Office, in their Standard Code of Industrial Hygiene, published in 1934 recommended that "In dusty trades, cloakrooms, wishing accommodations, and eventually douche-baths, separate from the workrooms, should be provided for the workers." The Code also stated that "Such smoke,

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a similar factor and that the combined relationship of exposure to asbestos and smoking can be best described by a multiplicative rather than an additive model (Lee, 2001).

[7] NIOSH, 1995. Report to Congress on Workers' Home Contamination Study Conducted Under The Workers' Family Protection Act (29 U.S.C. 671a). U.S. Department of Health and Human Services, Public Health Service, Centers For Disease Control And Prevention, National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH 45226, September. See sections on Asbestos p. 6-11; 45-46; 55; 62-63; 86-87; tables 2-6 (pp. 145-159).

[8] See Chapter X in: Drinker, P. & Hatch, T., 1936. INDUSTRIAL DUST – Hygienic Significance, Measurement and Control. McGraw-Hill Book Company, Inc., New York and London.

[9] Netolitzky, a., 1897. Hygiene der Textilindustrie. Handbuch der Hygiene, Weyl, T,, (ed), Vol. 8, Industrial Hygiene, Jena: G. Fischer Pub., pp. 1102-1103.

[10] See p. 248-249 in: Tolman, W.H. & Kendall, L.B., MCMXIII (1913). SAFETY Methods For Preventing Occupational And Other Accidents And Disease. Harper & Brothers Publishers, New York & London.

[11] Kober, G.M. & Hayhurst, E.R., 1924. Industrial Health, P. Blackiston' Son, Philadelphia, p. 24.

fumes and gas should be rendered harmless prior to being passed into the outside air."[12] In 1940, the German "GUIDELINES FOR THE PREVENTION OF HEALTH HAZARDS FROM DUST IN ASBESTOS MANUFACTURING PLANTS" specifically mentions that street garments must not be left in the working area and that the retained dust on working clothes must be removed at regular intervals.[13]

In 1943, the United States Public Health Service published in their MANUAL OF INDUSTRIAL HYGIENE AND MEDICAL SERVICE IN WAR INDUSTRIES the importance of cleanliness so that the worker did not carry the workplace exposures out of the workplace. The Manual stated that "[I]t is highly necessary that workers have adequate washing facilities. This implies enough wash stands or showers and a sufficient quantity of hot water as well as cold. There should also be adequate time to enable thorough cleansing, change of clothes and dressing between the end of work and the time when transportation facilities are available. Many plants give too little time between the end of work and the bus home." The report further states that "The work clothes should be provided and laundered by the employer." Also, that '[T]he employer should, without expense to the employees, furnish proper boots or shoes for the use of the employees while at work in such places."[14] As can be seen from the above cited references concern for take home exposure and the release of toxic materials from the factory were a major concern.

Specifically, by 1943 documentation of the effects of these take-home and environmental contamination concerns were appearing in the literature. Good & Pensky (1943) reported a few cases in workers' wives of eruptions resembling their husbands' from halowax acne (cable rash). The authors suspected the cases in the wives to have been the result of contact with work clothes and from laundering shirts and underwear.[15]
In 1965, two events documented asbestos take-home exposure and environmental exposure to asbestos with disease. The first was the publication of Newhouse & Thompson reporting mesothelioma among persons with a history of living with asbestos workers and of cases in

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[12] ILO, 1934. STANDARD CODE OF INDUSTRIAL HYGIENE. International Labour Office, Geneva, R. S. King & Son, Ltd., London.
[13] See GUIDELINES FOR THE PREVENTION OF HEALTH HAZARDS FROM DUST IN ASBESTOS MANUFACTURING PLANTS. Effective as of 1 August 1940. (See Bulletin for labor Practices in the Reich No. 29/1940, III 263.).
[14] See Gafafer, W. M. (ed.), 1943. MANUAL OF INDUSTRIAL HYGIENE AND MEDICAL SERVICE IN WAR INDUSTRIES. Division of Industrial Hygiene, national Institute of Health, United States Public Health Service, W. B. Saunders Company, Philadelphia and London, p. 168; 350-351.
[15] Good, C. K. & Pensky, N., 1943. Halowax Acne ("Cable Rash") Cutaneous eruption in marine electricians due to certain chlorinated naphthalenes and diphenys. Arch Derm Syph, September, Vol. 48, No. 3, American Medical Association, 254.

persons living in the neighborhood of asbestos factories.[16] Also, at a meeting of the New York Academy of Sciences, published in December 1965, discussion of the Newhouse & Thompson findings, the Wagner findings of community disease in South Africa, first published in 1960 and re-reported at the NYAS meeting, and the Kiviluoto finding of bilateral pleural calcification in a 50 year old woman whose only known exposure to asbestos was living in the immediate vicinity of an asbestos mill and playing with asbestos, as a child.[17]

Subsequent to the events of 1965 many studies have shown the effects of take-home asbestos exposure and of community environmental exposures. Navratil & Trippe (1972), in Czechoslovakia found 9 out of 155 persons living in the neighborhood of an asbestos factory to have x-ray evidence of pleural calcification, with or without other signs of asbestosis when only 0.53 would have been expected. They also found 4 out of 114 persons older than 20 years who were relatives of factory workers when only 0.39 would have been expected. Finally, they found 28 of 8,127 persons over the age of 40 years that lived in the same district of the factory, but not in the immediate neighborhood of the factory to have pleural calcification or about 0.34%.[18] Lieben & Pistawka (1967) of the Pennsylvania Department of Health reported several cases from both neighborhood and household asbestos exposures that resulted in mesothelioma.[19] Anderson et al., 1976, 1979a, &1979b; & Anderson 1983 reported on familial exposure to asbestos and disease showing both non-malignant and malignant disease occurring in family members not otherwise exposed to asbestos.[20] In 1991, Joubert et al., followed

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[16] Newhouse, M. L. & Thompson, H., 1965. Mesothelioma of pleura and peritoneum following exposure to asbestos in the London area. Brit J industr Med, Vol. 22, pp. 261-269.

[17] See papers by Thompson – Asbestos and the urban dweller, pp. 196-214); Kiviluoto – Pleural plaques and asbestos: Further observations on endemic and other nonoccupational asbestosis, pp.235-245; Mancuso, T. F. – Discussion, p. 589, in: BIOLOGICAL EFFECTS OF ASBESTOS, 1965. Selikoff, I. J. & Churg, J. (eds.). Annals of the New York Academy of Sciences, Vol. 132, Art. 1, pages 1-766. See Wagner, J. C., Sleggs, C.A. & Marchand, P., 1960. Diffuse pleural mesothelioma and asbestos exposure in the North Western Cape Province. Br J Ind Med, Vol. 17, p. 260.

[18] Navratil, M. & Trippe, F., 1972. Prevalence of pleural calcification in persons exposed to asbestos dust, and in the general population in the same district. Environ Research, Vol. 5, pp. 210-216.

[19] Lieben, J. & Pistawka, H., 1967. Mesothelioma and asbestos exposure. Arch Environ Health, Vol. 14, April, pp. 559-568.

[20] Anderson, H.A., Lilis, R., R., Daum, S.M. et al., 1976. Household exposure to asbestos and risk of subsequent disease. In: Saffiotti, U. & Wagoner, J.K. (eds.), Occupational Carcinogenesis. Ann. NY Acad Sci, vol 271, pp. 311-323; Anderson, H.A., Lilis, R., Daum, S. et al., 1979a. Household exposure to asbestos and risk of subsequent disease. In: Lemen, R. & Dement, J. (eds.). Dusts and Disease. Chicago, Pathotox Publishers, Inc., pp. 145-156; Anderson, H.A., Lilis, R., Daum, S.M., & Selikoff, I. J., 1979b. Asbestosis among household contacts of asbestos factory

household contacts from one amosite factory in New Jersey and found 28% died of lung cancer, 23% died of gastrointestinal tract cancer and 9% died from mesothelioma. The authors stated that this represented 2 times expected based on national estimates.[21] Magnani et al. (1993) reported that among family members of Italian cement workers that 4 pleural tumors (1 mesothelioma) were observed when only 0.5 were expected and that 6 lung cancers were observed when only 4 were expected. This represented a significantly elevated SMR of 792.3 for cancer of the pleura among domestically exposed women. The authors reported that the plant had no laundering facilities and therefore the work clothes were laundered at home.[22]

Miller (2005)[23] reported on 32 cases of take-home asbestos resulting in mesothelioma. Miller's unique approach surveyed law firms reporting such claims and from 15 firms received information to evaluate the claims relevance to take-home induced mesothelioma. After excluding those with other potential exposures to asbestos, found 32 cases with sufficient evidence to conclude take-home asbestos as their only source of exposure to asbestos. All cases were diagnosed since 1990, which the author attributes to the ongoing risks of asbestos-related cancers. Roggli and Longo (1991)[24] found that household mesothelioma patients had similar exposures to shipyard workers and other asbestos-related trades and far greater than building occupants.

Many other community studies,[25] case-control studies,[26] and according

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workers. Ann NY Acad, Vol. 330. Pp. 387-399; Anderson, H.A., 1983. Family contact exposure. In: Proceedings of world symposium on asbestos. Montreal, Canada, Canadian Asbestos Information Center. PP. 349-362.

[21] Joubert, L., Seidman, H., & Selikoff, I. J., 1991. Mortality experience of family contacts of asbestos factory workers. Ann NY Acad Sci, vol. 643, pp. 416-418.

[22] Magnani, C., Terracini, B., Ivaldi, C. et al., 1993. A cohort study on mortality among wives of workers in the asbestos cement industry in Casale Monferrato, Italy. Br j Ind Med, Vol. 50, pp. 779-784.

[23] Miller A, 2005. Mesothelioma I household members of asbestos-exposed workers: 32 United States cases since 1990. Am J Ind Med, May; 47(5): 458-62.

[24] Roggli VL, Longo WE, 1991. Mineral fiber content of lung tissue in patients with environmental exposures: Household contacts vs. building occupants. Ann NY Acad Sci 643: 511-518.

[25] Kilburn, K.H., Lilis, r., anderson, H:A. et al., 1985. Asbestos disease in family contacts of shipyard workers. Am J Pub Health, Vol. 75, No. 6, pp. 615-617.

[26] Ashcroft, T. & Heppleston, A.G., 1970. Mesothelioma and asbestos on Tyneside—a pathological and social study. In: Shapiro, H.A., ed. Pneumoconios. Proc Int Conf Johannesburg, South Arrica. Capetown, South Africa, Oxford University Press. Pp. 177-179; McDonald, A.D. & McDonald, J.C., 1980. Malignant mesothelioma in North America. Cancer, Vol. 46, No. 7, pp. 1650-1656; McEwen, J., Finlayson, A., Mair, A., Gibson, A.A.M., 1971. Asbestos and mesothelioma in Scotland. An epidemiological study. Int Arch Arbeitsmed, Vol. 28, pp. 301-311; Rubino, G. F., Scansetti, G., Donna, A., & Palestro, G., 1972. Epidemiology of pleural mesothelioma in north-Western Italy (Piedmont). Brit J Ind Med, Vol. 29, pp. 436-442; Vianna, N.J. & Polan, A.K., 1978.

to NIOSH some 17 case reports[27] and 22 case series reports[28] have also discussed both take-home asbestos exposure and subsequent disease development as well as neighborhood exposure to asbestos and disease. Additionally, one study observed 12 of 16 dogs with mesothelioma had a history of asbestos exposure. Among these, 75% of dogs had a history of exposure to asbestos, 9 were living in a house with a member having an asbestos-related occupation or hobby, 5 lived in households where additional insulation or home remolding had occurred, and 5 others were living in residential proximity to industrial sources of asbestos.[29] It is interesting that, when using a method to equate dog to human age that the mesothelioma were occurring at similar ages in dogs as in humans.

Laundering of Worker Clothing Contaminated with Asbestos

Much of the exposures to asbestos among family members can come from the laundering of worker clothing. Laundresses or those that wash clothing have been known for centuries to be at risk of a variety of diseases ". . . they inhale by the mouth and nose a mixture of harmful vapors of all sorts; . . ." This observation by Bernardio Ramazzini, the father of modern occupational medicine, in 1713.[30]

Family members of asbestos workers who laundry their clothes are also at risk of diseases, as is the worker, from exposures to asbestos. Concentrations of asbestos were recorded in workers homes who brought their work clothes home of 50 to >2000 ng/m^3 when compared to homes of non-asbestos workers of 32 to 65 ng/m^3.[31] Newhouse and Thompson reported 7 females among 76 mesothelioma patients who only had a history of washing the work clothes of their occupationally exposed

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Non-occupational exposure to asbestos and malignant mesothelioma in woemen. Lancet, Vol. 1, pp. 1061-1063; Whitwell, F., Scott, J., & Grinshaw, M., 1977. Relationship between occupations and asbestos fibre content of the lungs in patients with pleural mesothelioma, lung cancer and other diseases. Thoraz, Vol. 32, pp. 377-386.

[27] NIOSH, 1995. Report to Congress on Workers' Home Contamination Study Conducted Under The Workers' Family Protection Act (29 U.S.C. 671a). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, September, Table 5, pp. 151-153.

[28] See Reference 19, NIOSH, 1995, Table 6, pp. 154-159.

[29] Glickman, L.T., Domanski, L.M, Maguire, T.G., Dubielzig, R.R., & Churg, A., 1983. Mesothelioma in pet dogs associated with exposure of their owners to asbestos. Environ Res, vol. 32, pp. 305-313.

[30] Ramazzini B, 1713. **Diseases of Workers (De Morbis Artificum of 1713)**. Translated by Wilmer Cave Wright, Published under the auspices of the Library of the New York Academy of Medicine, Hafner Publishing Company, New York/London, 1964.

[31] Nicholson WJ. Tumour incidence after asbestos exposure in the USA: Cancer risk of the non-occupational population. VDI-Berichte Nr 475, Düsseldorf, 161-177.

husbands or family members.[32] In the Newhouse and Thompson study 9 of the mesotheliomas did not have occupational exposures and a secondary analysis found their OR=16.75 (95% CI: 2.0-136.78).[33]

Vianna and Polan doing a case-control study of mesothelioma found 7 wives and 1 daughter's only exposures were to washing asbestos-contaminated work clothes. In the case-control study only one matched control had such a history.[34] Schneider et al. calculated the OR=8.0 (95% CI: 1.0-64.0).[35] Schneider et al. mentions two other reports where the family members developing mesothelioma had only exposure during washing their other family members work clothes contaminated with asbestos.[36] Roquin et al (1994) report two cases of family members with pleural mesothelioma. The first a 33 year old man whose father worked with asbestos boards for 5 years and the work clothes were laundered at home. The second was a 76 year old woman who had laundered her husbands work clothes as he worked 32 years in and asbestos factory and developed the disease 18 years later.[37]

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[32] Newhouse ML, Thompson H, 1965. Mesothelioma of Pleura and peritoneum following exposure to asbestos in the London area.' Br J Inudst Med, 22: 261-267.

[33] Schneider J, Straif K, Woitowitz H-J, 1996. Pleural mesothelioma and household asbestos exposure. Rev Environ Health, 11(1-2): 65-70.

[34] Vianna NJ, Polan AK, 1978. Non-occupational exposure to asbestos and malignant mesothelioma in females. Lancet, 20: 1061-1063.

[35] Schneider J, Straif K, Woitowitz H-J, 1996. Pleural mesothelioma and household asbestos exposure. Rev Environ Health, 11(1-2): 65-70.

[36] Schneider J, Straif K, Woitowitz H-J, 1996. Pleural mesothelioma and household asbestos exposure. Rev Environ Health, 11(1-2): 65-70.

[37] Roguin A, Ben-Shahar M, Ben-Dror G, Cohen I, Hazani E, 1994. 'Malignant mesothelioma in families of asbestos workers. Harefuah, June 15, 126(12): 702-704, 764.