Dragon, Karen E. (CDC/NIOSH/EID)

From: Middendorf, Paul (CDC/NIOSH/OD)
Sent: Tuesday, June 01, 2010 8:46 AM
To: Dragon, Karen E. (CDC/NIOSH/EID)
Cc: Castellan, Robert (CDC/NIOSH/DRDS); Castranova, Vincent (CDC/NIOSH/HELD); Harper, Martin (CDC/NIOSH/HELD); Zumwalde, Ralph D. (CDC/NIOSH/EID) (CTR)
Subject: FW: Comments on NIOSH Asbestos Roadmap
Attachments: Webber 2010 Roadmap Comments.pdf

Paul
-----Original Message-----
From: James Webber [mailto:webber@wadsworth.org]
Sent: Thursday, May 27, 2010 4:17 PM
To: Middendorf, Paul (CDC/NIOSH/OD)
Subject: Comments on NIOSH Asbestos Roadmap

Paul,

Overall, Version 4 of the NIOSH Roadmap is an important and comprehensive document that's incorporated a great deal of good information and ideas. However, two serious problems remain, as detailed in the attached document. Even though I've missed the deadline for public comments, I appreciate your accepting these comments for consideration during your review. If you have any questions, please don't hesitate to contact me.

Best Regards,
Jim
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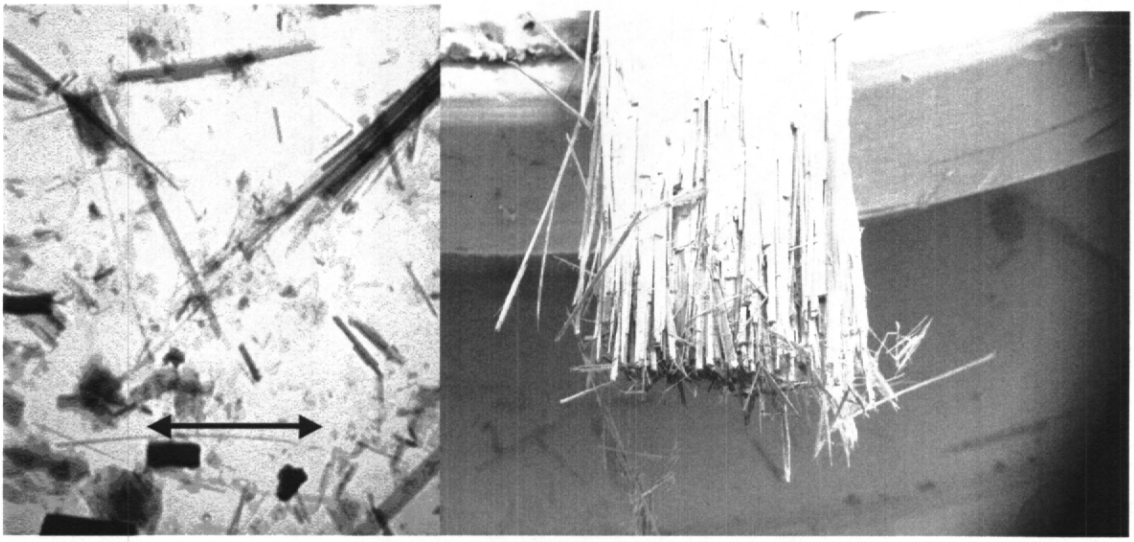
Observations on *Asbestos Fibers and Other Elongate Mineral Particles: State of the Science and Roadmap for Research. Version 4*

James S. Webber, PhD
New York State Department of Health
May 27, 2010

I would like to bring to your attention two problems with the latest NIOSH *Roadmap*.

Habit of talc mined in upstate New York

Throughout the *Roadmap*, talc mined in upstate NY is referred to as nonasbestiform. This is not accurate, in that most of the "talc" produced from this area is indeed asbestiform. My 2004 paper[1] describes the crushed, respirable "talc" fraction: "The fiber assemblage included fewer talc ribbons but contained a larger proportion of asbestiform fibers, typified by aspect ratios exceeding 10 (often in the hundreds), curved fibers, and fibers terminating in frayed ends (Figure 3)." I have included Figure 3, below left, where the scale bar equals 5 μm.



Also, please review slides 17 through 21 of my presentation to the *Roadmap* panel in March 2008[2]. The fiber bundle in that presentation was a sliver I randomly removed from a slab of Arnold "talc" ore with tweezers and placed on an SEM stub. Even without anaglyph (3-D) glasses, the asbestiform morphology of this "talc" is unmistakable. A non-3D figure from that presentation is shown above on the right. Asbestiform morphology is glaring in this ~1-μm-wide bundle and in the adjacent Figure 3.

The *Roadmap* discussion of mass percentages on page 26, lines 18-36, is misleading because a health-related investigation of the ore would ignore the high-mass large particles because they never become airborne, let alone respirable. This talc is commercially valuable because of the extremely thin fibers produced by milling. This produces the enormous surface area to mass ratios that are desired by end users.

Comparison of Microscopical Methods

TEM remains the instrument of choice for definitive analysis of airborne asbestos. Its high resolution allows detection of the thinnest EMP, its EDX capability yields chemical composition of any EMP, and its SAED reveals the crystalline structure (and hence mineralogy) of an EMP. PCM lacks the capability to perform any one of these. The *Roadmap* wrongly downplays TEM's capability in two sections. On page 34, lines 33 and 34, the *Roadmap* states that TEM "frequently cannot differentiate nonasbestiform from asbestiform EMPs". This is misleading in that EMPs in air samples will seldom exhibit asbestiform morphology. Airborne fibers are usually individual fibrils, not the large bundles that exhibit the splayed ends and flexibility seen at the macro level. Such bundles usually settle out and are not of concern from a health perspective because their large aerodynamic diameter prevents them from reaching the lungs. The *Roadmap* neglects to mention that PCM is likewise incapable of differentiating nonasbestiform from asbestiform morphologies. Further down in lines 36-37, the Roadmap continues: "Important limitations of TEM are that partial lengths of long fibers that intersect grid bars can be hidden due to the small field of view…" This is another non-issue in that very few airborne asbestos fibers are long enough to make this a reality. Dement *et al.* analyzed by TEM more than 20,000 asbestos fibers from filters collected as early as 1971.[3] They reported last year, "In most plant exposure zones, only a small proportion of airborne fibres were longer than 15 μm, with a range of 1.6% (95% CI 1.1% to 2.2%) in zone 1 (carding) of plant 4 to 6.7% (95% CI 4.8% to 8.8%) in zone 7 (finishing and shipping) of plant 1." There is low likelihood that fibers even as long as 15 μm will cross TEM grid bars that are spaced 100 μm apart. For the vast majority of shorter fibers that constitute air samples, grid-bar intersection will not be a problem. An important question to ask is what is more critical: missing a percent or two of fibers that might cross TEM grid bars or missing the majority of fibers because PCM cannot detect them?

Finally, starting on page 62, line 18, the *Roadmap* states, "However, asbestos particles of 3:1 aspect ratio and longer than 5 μm are not usually individual fibrils, but fibrillar bundles that are much wider than fibrils [Hwang and Gibbs 1981; further data cited in Walton 1982], so that the number of particles meeting these criteria counted under PCM has not generally been found to differ greatly from the number of particles meeting the same criteria counted under the electron microscope [Lynch et al. 1970; Hwang and Gibbs 1981; Marconi et al. 1984; Dement and Wallingford 1990]." This sentence points to NIOSH's continued PCM bias in the face of increasingly clear evidence that TEM is superior in detecting and identifying EMPs of health concern. The outdated references above are refuted by many studies, most recently by last year's publication[3] of data demonstrating the chasm separating PCM and TEM measurements. The authors state, "TEM results for 77 airborne dust samples found that only a small proportion of airborne fibres were measured by PCM (>0.25 mu m in diameter and >5 mu m in length) and the proportion varied considerably by plant and operation (range 2.9% to 10.0%). The bivariate diameter/length distribution of airborne fibres demonstrated a relatively high degree of variability by plant and operation. PCM adjustment factors also varied substantially across plants and operations." So not only does PCM fail to detect all EMPs of interest, but there is no consistent conversion factor for calculating TEM fiber concentrations from PCM fiber concentrations. The final sentence in that *Roadmap* paragraph stating, "For these reasons,

asbestos particles visible by PCM may contribute more to risk than those that are not visible, lending credibility to PCM counts as an index of risk." is speculation.

Thus it would be remiss of NIOSH to continue PCM as the standard for measuring airborne EMP's. While current risk-assessment models are based on PCM fibers, it's because TEM data were not available decades ago. Ongoing toxicity studies continue to point to narrow fibers as primary culprits. Even the Stanton hypothesis[4] of almost three decades ago pointed to fibers narrower than 0.25 μm as the most carcinogenic. These are the very fibers that cannot be resolved by PCM. The bottom line is that one can tease PCM distributions from TEM analysis, but one can't tease TEM distributions from PCM analysis. Future risk assessment models will almost certainly rely heavily on TEM-generated data, so NIOSH would be remiss to depend on PCM measurements into the future.

References

1. Webber, J.S, Bopp, R., Parekh, P., and K. Jackson. 2004. Reconstruction of a century of airborne asbestos concentrations. *Environmental Science & Technology* 38(3):707-714.

2.http://www.iom.edu/~/media/Files/Activity%20Files/Research/AsbestosNIOSH/WebberPresentation.ashx

3. Dement, J. M., Myers, D., Loomis, D., Richardson, D., Wolf, S. 2009. Estimates of historical exposures by phase contrast and transmission electron microscopy in North Carolina USA asbestos textile plants. *Occupational and Environmental Medicine*, 66: 574-583.

4. Stanton, M.R., Layard, M., Tegeris, A., Miller, E., May, M., Morgan, E., and A. Smith. 1981. Relation of particle dimension to carcinogenicity in amphibole asbestos and other fibrous minerals. *Journal of the National Cancer Institute 67:*965-975.