B89 A Study of the Formation, Collection, and Microscopic Trace Material and Genetic Makeup of Household Dust Specimens

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After attending this presentation, attendees will recognize how typical household dust specimens (i.e., dust bunnies) are formed and how the fibrous components form a cage-like structure that acts as a snare which in turn entraps an array of human and animal hairs, natural and synthetic fibers, as well as an assortment of particulate materials. Attendees will learn various techniques and strategies for the collection and handling of household dust specimens. The quantity and quality of all the materials collected in household dust bunnies will be presented.

This presentation will impact the forensic science community by demonstrating the probative value of an underutilized yet extremely valuable form of probative physical evidence — household dust.

Over the last century, classic forensic science as developed and practiced by early forensic pioneers (e.g., Dr. Edmond Locard, Dr. Harry Söderman, Dr. Paul L. Kirk, and others) has demonstrated that trace evidence in the form of dust is a valuable source of non-biased probative evidence in criminal investigations. As Dr. Locard asserts in his early writings, trace materials found in dust can be used to identify the individuals involved in a crime, as well as reconstruct the event itself. In the past few years, several papers have been presented which demonstrate that household dust specimens may in fact be unique to a given location. To date, these studies have focused on developing a rapid, accurate, microscopic methodology for tabulating the fibrous materials such as animal and human hair and natural and synthetic fibers, as well as the particulates commonly found in household dust specimens. This study combines the developed microscopic methodology used in these prior studies with new methods used to extract and analyze the human DNA present within each household dust specimen. It is believed that the combination of these different approaches will greatly enhance the discriminating power, as well as the probative value, of household dust by enabling one to not only identify a location but to also identify its habitual occupant(s).

In this part of the combined study, the structure of household dust specimens, the mechanics of how these specimens formed, and simple techniques for their collection were researched. Simple traps were prepared and the dust specimens were observed as they formed over a range of time spans. The simplest traps were prepared by labeling a pre-cleaned microscope slide, photographing it, and placing it on the floor in the subject location. Next, strips of Gel-Film® were cut and affixed to pre-cleaned, labeled microscope slides. Additional dust traps were prepared by attaching one- to two-inch lengths of Scotch® Brand 3M® Double-Sided Tape to pre-cleaned, labeled microscope slides. Finally, dust traps were prepared by sticking 12mm-diameter, double-coated carbon tabs to pre-cleaned, labeled microscope slides.

As in the case of the simplest dust traps, the dust traps containing the adhesive media were photographed and placed on the floor in the subject location. All of the dust traps were allowed to freely collect dust as it settled naturally on their surfaces over a range of time spans. After the collection period, each specimen was recovered and packaged separately. A number of the dust specimens were examined microscopically and their contents tabulated on a dust tabulation sheet while others were analyzed for their human DNA content. Select specimens had both their trace material content tabulated and their human DNA analyzed. For example, trace material content tabulation for specimen No. 4a listed the following: red-, blue-, black-, and pink-colored cotton fibers; blue wool fibers; gray/black nylon fibers; colorless polyester fibers; red-colored acrylic fibers; human skin cells; stellate-shaped plant hairs; manila-colored paper fibers; and one tiny piece of green vinyl tape. Finally, the data from both the microscopic method and the DNA analysis were collected, tabulated, and evaluated.

The results of this combined study demonstrate that human DNA of sufficient quantity and quality can be recovered from household dust. The use of DNA profiles in combination with micro-chemical analysis of the non-biological material in dust bunnies should permit an identification of the room from which the dust originated as well as the occupier(s) of the room.

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Household Dust, Human DNA, Microscopic Method