CHRISTOPHER BOMMARTIO

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Stephen L. Braga
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Report of Analyses
State v. Baldwin, Echols & Misskelley

Dear Mr. Braga:

The following is a summary of my work on the aforementioned case:

Evidence Received:
Received via Federal Express on 06/20/11 (Tracking #873520325005) from the Arkansas State Crime Laboratory, Little Rock, AR. The evidence was maintained in unopened condition until 2/29/12:

1-white cardboard FedEx box containing:
1-taped manila envelope containing
1-cardboard slide holder labeled "1993-05716; 1993-05717; 1193-5718; 15 Jun 11; MEA Arkansas Crime Laboratory" containing:

Item E3:	1-silde labeled "93-05716 E3 QF Red Cotton Match w/ E92 Permount 6/1/2011" containing three small red fibers
Item E1:	1-slide labeled "93-05716 E1 QF Red Cotton Match w/ E92 Permount 6/1/2011" containing one red fiber
Item E9:	1-slide labeled "93-05716 E9 QF Blue Green Cotton Match w/ E79 Permount 6/1/2011"containing one blue-green fiber
Item E5:	1-slide labeled "93-05716 E5 QF Green Polyester Match w/ E79 Permount 6/1/2011" containing one partially flattened green tinted fiber
Item E134 Blue:	1-slide labeled "93-05716 E134 QF Blue Polyester (flattened piece) Match w/ E109a Permount 6/1/2011" containing one flattened fiber
Item E134 Blk:	1-slide labeled "93-05716 E134 QF Black Polyester Match w/ E78 Permount 6/1/2011" containing two black fibers, one flattened and one with intact shaft and flattened end

Item E109a:	1-slide labeled "93-05716 E109a KF Blue Polyester" containing a quantity of blue trilobal fibers
Item E92:	1-tape sealed envelope labeled "93-05716 E92 Std LC" containing: 1-folded tissue paper packet containing red fabric
Item E79:	1-tape sealed envelope labeled "93-05716 E79 Std LC" containing: 1-folded tissue paper packet containing blue-green fabric
Item E78:	1-tape sealed envelope labeled "93-05716 E78 Std LC" containing: 1-folded tissue paper packet containing black fabric
Item E99:	1-tape sealed envelope labeled "93-05716 E99 Std LC" containing: 1-folded tissue paper packet containing red fabric
Item MM1a:	1-tape sealed envelope labeled "93-05716 MM1a (Red)Std" containing: 1-folded tissue paper packet containing red fabric

Background on Fiber Analysis:

Fibers can be classified into two broad categories - natural and man-made. Natural fibers are derived from animal, vegetable or mineral sources. Animal fibers include furs, wool, silk, horsehair, and animal hairbrushes. Vegetable fibers include cotton, linen, jute, hemp, and sisal. Many ropes, clothes, paper, and packing materials are made from vegetable fibers. Mineral fibers include asbestos, glass wool, and fiberglass. Products such as insulation, auto body repairs, clothing, drapery, safe insulation, and fire proofing are produced from mineral fibers. By far, the most commonly encountered natural fiber is cotton. However, due to the commonality of white and blue denim fibers produced from cotton, cotton fibers of these colors have little evidentiary value.

Regenerated fibers are a type of man-made fiber manufactured from natural raw materials in which pure cellulose is extracted and chemically treated. This type of fiber includes rayon, acetate, and triacetate fibers. Synthetic fibers are produced solely from synthetic polymers. These include nylon, polyester, and acrylic fibers. These fibers can be found in clothes, carpets, drapery, bindings, fishing lines, and hosiery.

Laboratory examination of fibers is principally performed using a polarizing light microscope. Using this instrument and oils of known refractive indices, a scientist can examine and compare a fiber's color, thickness, cross sectional shape, amount of pigment, delusterant and composition. Other instrumental techniques, such as infrared spectroscopy, are commonly used to determine the chemical composition of synthetic fibers. UV-VIS microspectrophotometry can be used to objectively discriminate color in the ultraviolet and visible regions that cannot be discerned visibly in colored fibers. Analysis of dyes present in fibers can also be performed.

As is the case with glass and paint, a positive association in forensic fiber analyses is usually not a conclusive identification. A positive association will typically result in a conclusion that a questioned fiber is consistent with a known textile. The importance of this finding may be directly related to how rare or how common the specimens may be, in terms of availability. No statistical data is typically applied to this type of conclusion.

I understand the current standards in forensic fiber analysis and in fact serve on a NIJ sponsored working group (SWGMAT) that sets these standards. For the fiber analysis in this case, I

utilized the commonly accepted methods of stereomicroscopy, polarized light microscopy and UV-VIS microspectrophotometry.

Results of Examinations:

The requested analysis was to reexamine fiber comparisons where an association had been previously reported by the Arkansas State Crime Laboratory (ASCL). The samples had been split and repackaged by the ASCL prior to being shipped to our laboratory (Report 6/1/2011 Chantelle Taylor).

Most of the fibers mounted on slides were noted as mounted in Permount, a commercial histological mounting media. The unmounted samples received in manila envelopes were also mounted in Permount for examination.

The questioned red cotton fibers from Items E1 and E3 were compared to the known red cotton fibers from E92. The questioned fibers from both items had similar microscopic characteristics but showed significant color differences from the known fibers via UV-VIS Microspectrophotometry (MSP); therefore, the questioned fibers from Items E1 and E3 were both eliminated as having originated from the same source as Item E92 (elimination).

The questioned blue-green cotton fiber from Item E9 was compared to the known blue-green cotton fibers from E79. The questioned fiber had similar microscopic characteristics but showed significant color differences from the known fibers via UV-VIS Microspectrophotometry (MSP); therefore, the questioned fiber from Item E9 was eliminated as having originated from the same source as Item E79 (elimination).

The questioned green synthetic fiber from Item E5 was compared to the known green synthetic fibers from E79. The microscopic features of this fiber could not be fully compared to the known fiber due to partial flattening. The questioned fiber showed significant color differences via UV-VIS Microspectrophotometry (MSP); therefore, the questioned fiber from Item E5 was eliminated as having originated from the same source as Item E79 (elimination).

The unflattened portion of the questioned black synthetic fiber from Item E134 was compared to the known green black synthetic fibers from E78. The microscopic features of this fiber differed from those in the known fiber sample. Specifically, the fibers differed in dichroic characteristics; the differences being most apparent when viewed perpendicular to the polarizer on the polarized light microscope. The questioned intact fiber from Item E134 was eliminated as having originated from the same source as Item E78 (elimination). These fibers were not examined via UV-VIS Microspectrophotometry (MSP) as they were eliminated prior to this examination via microscopic examination.

The questioned fiber from Item E134 was severely flattened. No meaningful comparison could be made to the fibers from Item E109a (inconclusive). These fibers were not examined via UV-VIS Microspectrophotometry (MSP) due to the flattened state of the questioned fiber.

No corresponding questioned fibers were submitted for comparison to the known samples from Items E99 and MM1a.

Infrared spectroscopy was not performed on any of the samples as all the questioned samples for which a meaningful examination could be performed were eliminated as having originating from the corresponding known source by other methods.

UV-VIS Microspectrophotometry & Multi-Variate Statistical Analysis:

Initial UV-VIS Microspecrophotometry was performed at our laboratory utilizing a Zeiss MPM800 Microspectrophotometer. Variations between questioned and known samples were noted from this analysis. The samples were transported to the Forensic Chemistry Laboratory at Indiana University-Purdue University at Indianapolis (IUPUI) and rerun on a CRAIC QDI2010 UV-VIS Microspectrophotometer on 4/9/12 by the undersigned. The purpose of the reanalysis was two-fold, to take advantage of the superior signal to noise and energy levels of this instrument and to allow multivariate statistical analysis (Chemometrics) on the data by Dr. John Goodpaster, IUPUI, to determine if differences observed were statistically significant.

The following sample comparisons via MSP were performed at the IUPUI laboratory: E92 to E1 and E3, E79 synthetic to E5 synthetic, and E79 cotton to E9 cotton. Unbeknownst to Dr. Goodpaster, two blind control samples, F1 (from sample E92) and F2 (from sample E79) were created by the undersigned and also examined via MSP at the IUPUI laboratory. In all the samples from this case, the data from the CRAIC instrument correlated with the data from the Zeiss instrument and in fact the graphical differences observed between the known and questioned samples in the Zeiss instrument were more apparent on the CRAIC instrument due to the increased energy in the lower wavelength ranges and improved signal to noise.

Dr. Goodpaster's results of multi-variate statistical analysis correlated with my visual examination of the spectra in this case. His statistical analysis demonstrated the discrimination of the MSP data of E1/E3 cotton from E92 cotton, E5 synthetic from E79 synthetic, and E9 cotton from E79 cotton. His statistical analysis also demonstrated that the blind control samples (F1 and F2) could not be discriminated from the corresponding source fabric (E92 and E79).

Terminology Key for Associative Evidence:

The following descriptions are meant to provide context to the levels of opinions reached in this report. Every level of conclusion may not be applicable in every case nor for every material type.

> Level I Association: A physical match; items physically fit back to one another, indicating that the items were once from the same source.
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> Level II Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and share atypical characteristic(s) that would not be expected to be readily available in the population of this evidence type.
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> Level III Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. Because other items have been manufactured that would also be indistinguishable from the submitted evidence, an individual source cannot be determined.

Level IV Association: An association in which items are consistent in observed and measured physical properties and/or chemical composition and, therefore, could have originated from the same source. As compared to a Level III association, items categorized within a Level IV share characteristics that are more common amongst these kinds of manufactured products. Alternatively, an association between items would be categorized as a Level IV if a limited analysis was performed due to characteristics or size of the specimen(s).

Level V Association: An association in which items are consistent in some, but not all, physical properties and/or chemical composition. Some minor variation(s) exists between the known and questioned items and could be due to factors such as sample heterogeneity, contamination of the sample(s), or having a sample of insufficient size to adequately assess homogeneity of the entity from which it was derived.

Inconclusive: No conclusion could be reached regarding an association/elimination between the items.

Elimination: The items were dissimilar in physical properties and/or chemical composition, indicating that they did not originate from the same source.

Disposition of Evidence:

The evidence will be held at our secure laboratory facilities, pending direction from your office regarding disposition.

Christopher R. Bommarito
Forensic Scientist
Forensic Science Consultants, Inc.