Forensic Analysis on the Cutting Edge

New Methods for Trace Evidence Analysis

Edited by
Robert D. Blackledge
Forensic Analysis on the Cutting Edge
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Forensic Analysis on the Cutting Edge
New Methods for Trace Evidence Analysis

Edited by
Robert D. Blackledge
To Sally, my beloved wife and constant source of support.
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Preface

The idea for this book had its genesis as a result of my organization of a symposium, “Forensic Analysis on the Cutting Edge,” at the 2004 Pittcon held in Chicago. Three of my presenters, John Allison, Brian Eckenrode, and Wolfgang Keil, are also contributors. The symposium featured either types of trace evidence that were increasing in importance but had not previously received much attention, or new and better methods for trace-evidence characterization. In its various chapters this book follows that same theme.

Forensic Analysis on the Cutting Edge: New Methods for Trace Evidence Analysis is not intended to be a “coffee table book”! To be sure, mystery writers, attorneys, forensic science students, criminal investigators, or anyone wishing to go beyond being “CSI dilettantes” may find the various chapters both useful and fascinating. However, it is hoped that in forensic laboratories worldwide the book will become a well-thumbed reference on the shelves of both novice and experienced criminalists.

Each of the book’s chapters is stand-alone. That is, no chapter assumes the reader has acquired information provided in a previous chapter. Since no chapter is intended to serve as a basic introduction to the principles, tools, and methods of trace evidence analysis, it is incumbent that some admonition be made regarding precautions against cross-contamination. The entire value of trace evidence lies in its ability to show an association between a suspect/victim/crime scene. Therefore, every effort must be made to prevent even the possibility of cross-contamination. This must begin with the crime scene and the collection and packaging of evidence. Suspects and victims must be transported in different vehicles and interviewed in different rooms. Search/examination areas in forensic laboratories must be scrupulously clean and should
be located in areas with minimal foot traffic and not in areas where the opening and closing of doors or windows can create sudden breezes. Evidence items associated with suspects should if possible be examined in an area separate from those used for examination of evidence items from the victim. Lab-coats and gloves worn by examiners must be changed when going between these areas. For a more detailed discussion readers are referred to Scientific Working Group on Materials Analysis (SWIGMAT) Trace Evidence Recovery Guidelines, http://www.fbi.gov/hq/lab/fsc/backissue/oct1999/trace.htm.

San Diego, California

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ROBERT D. BLACKLEDGE
I am very pleased to have been invited by Robert Blackledge to write the Foreword for this book. I have long admired Bob's contributions to the field of forensic science, specifically criminalistics and trace evidence. We share much of the same philosophy about criminalistics. This might be termed a "classical philosophy of criminalistics." I will return to some of the concepts this term connotes further along in this Foreword. For the time being, I will point out that for many years I have been concerned that this philosophy is in danger of extinction.

This is an important book dealing with important topics. Experts in the field have contributed the chapters on a variety of trace-evidence topics and techniques. The book will be most useful to practicing forensic scientists (criminalists) engaged in trace-evidence analysis. A second group of users will be made up of students in university forensic science programs. It is to be hoped that a third group, already employed in forensic science laboratories, will be inspired to develop expertise with trace evidence and contribute to the field. Although these three groups will make up the bulk of the market for the book, others including attorneys, judges, and even mystery writers will be able to extract from it useful information and ideas. It should be understood that this is a book dealing with a variety of carefully selected trace-evidence techniques and problems. It is not a textbook on trace evidence. No such book exists. There are books that deal with case examples where trace evidence was critical to the case solution. Although case examples are used here, this is primarily a book about the recognition, analysis, and interpretation of types of trace evidence that may occur in nonroutine cases. The broad range of evidence types covered is only a very small portion of the possible trace-evidence types that can be expected to be encountered as trace evidence.
Trace evidence is at the core of criminalistics. Surprisingly, this is not widely appreciated. If one accepts this fact, it is difficult to understand why there are so few trace-evidence analysts compared to the number of narrowly educated specialists employed in forensic science laboratories. To appreciate the potentials of trace evidence, it is important to consider the general question of the creation of physical evidence and the resulting record produced. Individual items of physical evidence can be viewed as the fundamental components of a natural record made of an event. Actions taking place during a human-initiated event create a record of varying degrees of detail through the interactions of energy and matter with the environment in which the event takes place. These actions cannot help but produce a record. This is a trace-evidence record. If the event of concern is a possible crime, decoding and interpreting this record becomes a problem for the criminalist.

There are two different conceptual views of trace evidence. In many quarters trace evidence is thought of as the small amounts of material that are transferred from one surface to another as a result of contact. This has been codified as the Locard Exchange Principle. One expression of this principle is that “every contact leaves a trace.” Here the term “trace” seems to imply the exchange of a small amount of material. It also implies that a contact is necessary for the transfer to occur. However, this interpretation is by no means universal. The transfer may involve that of a pattern rather than that of material. Thus, an example would be indentation or striation-type toolmarks, where a pattern is created by the impression into, or the motion against, a softer material by a harder one, but where no material transfer is detected. The second view is broader. Thus, the word “trace” itself has a broader meaning and does not necessarily connote a small size and direct contact is not necessary. In its broadest concept a “trace” can be thought of as something left behind, a remnant, a vestige, or, more to the point, physical evidence of a prior interaction.

In this sense trace evidence is more than a collection of evidence types or techniques. More generally, it is an approach to problem solving in criminalistics. It is this approach that is most appropriate in all but the simplest of cases. Real cases demand more than unthinkingly applying “tests” on “items” of evidence. “Items” at the crime scene have to be recognized as having potential significance to the investigation before the most appropriate analytical approaches can be designed and decisions made as to what testing is warranted. This leads to better case solutions while simultaneously making the best use of laboratory resources.

It is unfortunate that the attention devoted to trace evidence has been diluted by a combination of factors, including rapid growth in the field, an increasing focus on technology at the expense of science, the desire for high throughput in forensic science laboratories, and the large scale hiring of new laboratory personnel educated in narrowly defined specialty areas. In addition, it is unfortunate that many of the recent, and unquestionably important positive, developments in the field such as methods standardization and laboratory
accreditation have had unforeseen or often unrecognized negative consequences with respect to trace-evidence analysis. One truly regrettable result is that there is a dearth of generalist scientists capable of recognizing trace evidence and formulation testable scientific questions to maximize the information extracted from the available trace evidence in many cases. Evidence that goes unrecognized cannot be analyzed and might as well have been nonexistent. Opportunities for the exculpation of the wrongly accused or inculpation of the guilty and solving a crime are lost.

In addition to providing valuable information for trace-evidence examiners, it is to be hoped that this book will serve to illustrate the power and potential of trace evidence and to stimulate interest in garnering more support for trace evidence in the form of increased hiring of personnel educated with respect to trace-evidence analysis problem solving approaches, and result in increased support in the form of research funding. The work in trace evidence is challenging and difficult, but it also provides an unmatched measure of personal satisfaction. This book should serve to make the reader aware of the possibilities.

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LA ICPMS and IRMS Isotopic and Other Investigations in Relation to a Safe Burglary

Cover photo caption: (right) material in plastic bag with money at suspect’s house and (left) safe wall filling as found at crime scene (sawdust & alum)

Isotopic ratio mass spectrometry (IRMS) results:

Alum 34S variation (a) safe, (b) suspect, (c) Dutch Alum samples, (d) alunite data from minerals – worldwide, (e) alunite Spain – Riaza and (f) alunite Spain – Rodalquilar
We’ve all heard the saying, “all that glitters is not gold.” Although not made of gold, tiny particles of commercial glitter may be “as good as gold” in terms of their potential value as associative evidence in criminal cases.

1.1 WHAT IS GLITTER?

Glitter is entirely man-made. It may be tiny pieces of aluminum foil or plastic with a vapor-deposited aluminum layer, or it may consist of multiple layers of plastic with no metal layer at all. In the manufacturing process, before it is cut into individual tiny particles, it is in the form of rolled sheets of foil or plastic. Most often the sheets are cut to make particles that are hexagonal, square, or rectangular since these shapes can fully fill a two-dimensional surface with no waste material produced. Although glitter can be obtained in specialized shapes such as circles, stars, and crescent moons, these particles are usually much larger since it is intended that a viewer can see and recognize these shapes.
Some cosmetics products are advertised as containing “shimmer.” “Shimmer” is not glitter. Shimmer starts off as tiny pieces of mica. Although shimmer particles may fall into a certain size range, their shape is totally irregular and random. In order to increase their sparkle the mica pieces may be coated with titanium dioxide, and iron oxides or other pigments may be added to produce color. Although like glitter, shimmer has potential value as associative evidence, it will not be considered in this chapter.

Glitter has been around for many years, but until fairly recently its cosmetic use was primarily for special costume party events such as Halloween and Mardi Gras. But today glitter can be found in every possible variety of women’s cosmetic products, and most are intended for everyday wear rather than just for special occasions. Glitter is even found in a number of different brands of sunscreen lotion. There are also many varieties of removable glitter tattoo transfers, and several brands of glitter gel pens in different colors. Glitter is also used extensively in arts and crafts projects. For this purpose it may be sold loose (no vehicle), in pencil sticks (also used in cosmetics), in glues, and in paints. As we shall see later in the chapter, there have been several cases where glitter that had its origination in children’s arts and crafts projects became very important transfer evidence. Glitter is used commercially to add decoration to greeting cards, Christmas balls, and other ornaments, and it is used year round to make decorations on women’s items of apparel such as T-shirts and sweatshirts. Glitter is also used to add eye appeal to many solid plastic items. In these cases the glitter is within the transparent plastic rather than just on the surface. Glitter is often used in fishing lures, and companies sell glitter-containing dough as well as gels into which lures may be dipped. One company offers a glitter-containing gel that has a fish-attracting maggot aroma! Yeech! We hope we never have a case involving that as trace evidence!

1.2 THE IDEAL CONTACT TRACE

In many ways, glitter may be the ideal contact trace. In her master’s thesis, *Evidential Value of Glitter Particle Trace Evidence*, Klaya Aardahl [1] lists the properties of the ideal trace evidence: “(1) nearly invisible, (2) has a high probability of transfer and retention, (3) is highly individualistic, (4) can quickly be collected, separated, and concentrated, (5) the merest traces are easily characterized, and (6) is able to have computerized database capability.” Let’s see how well glitter meets these ideal properties. Like some other polymer evidence types such as paint and some fibers, they will survive most environmental insults like a hot car, a putrefying body, exposure to sunlight, and exposure to cleaning products.

1.2.1 Nearly Invisible

One glitter manufacturer (Meadowbrook Inventions, Bernardsville, New Jersey, USA) offers glitter in 13 different sizes ranging from 0.002 in. (50 μm)