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TRACE EVIDENCE

JOHN F. WILLIAMS

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The application of modern scientific methods to the examination of physical evidence in criminal investigations often provides important information to the investigator which he could not otherwise obtain. This applies particularly to the examination of small objects and materials present in minute quantities or trace evidence. The quantities of these materials are such that they may be overlooked without methodical searching, and often special means of detection are needed. Microscopic examination is most frequently involved; while the use of special photographic methods, ultra-violet light, and similar devices may be used on appropriate types of evidence.

Whenever two objects come in contact with one another, there is a transfer of material, however slight. Usually, the softer object will transfer to the harder, but the transfer may be mutual. The quantity of material transferred differs with the type of material involved and the violence of the contact. It may be almost undetectable, such as fingerprints, particles of dust, fibers, etc., or may be as large as a part of a car fender in a hit-and-run case. The abrasions or markings left when one object strikes another have been discussed elsewhere, but they are also a part of this transfer process. When these minute quantities of evidence can be located, identified, and matched with the materials from a known source, they provide valuable information for the investigator.

The basic concept of handling trace evidence is the same as in the handling of other types of physical evidence. This involves the identification of material left at the scene (or carried from the scene by the suspect) with material found on or in the possession of a suspect (or as coming from the scene). Absolute identification of evidential materials is often not as important as establishing the fact that the two materials are identical in all observable characteristics and came from the same

source. When the materials in question can be traced to or identified with a suspect in the case, he may have some explaining to do. On the other hand, they may eliminate the individual as a suspect and serve an equally important role. This is the ultimate objective of most scientific examination of physical evidence: to furnish facts to the investigator.

A listing of all things or materials which might at one time or another become important as evidence would be impossible. Almost anything could be included. Information obtainable will vary with the type of material involved. Identifications may be positive, negative, or inconclusive depending upon the characteristics which can be observed and measured. Simple, commonly occurring materials are much more difficult to identify with a particular source than are more complex, rarely occurring materials.

In identifying an individual, designation of sex can eliminate a large percentage of our suspects, but it does not let us arrive at a positive identification of a particular individual. If we add height, weight, age, color of eyes and hair, prominent gold teeth, scars or deformities, tattoos, etc., the identification becomes more positive. The same principle applies to the examination and identification of physical evidence. If we can add to the facts observable by the investigator's unaided senses, through scientific methods of determining physical properties and chemical composition, the chances of identification (or elimination) are increased. An important factor in reaching conclusions from examinations of physical evidence is the quantity of material available. While minute quantities of evidence reveal surprising amounts of information on occasions, there are limits beyond which the chemist, physicist, or microscopist cannot go. This fact is often misunderstood by inexperienced investigators and the general public who sometimes

expect much more from the scientist than he can reasonably deliver. As in the example of the male and female, we can frequently arrive at a negative finding or elimination rather quickly while additional data must be recorded to establish a positive identification. Even possible or probably identifications may furnish valuable information in a case, and when several independent factors are considered, may help in arriving at a positive conclusion.

DUST AND DIRT

Dust, an ever-present material in one form or another, often furnishes information to an investigator. If it is undisturbed at a crime scene, we can conclude that the areas involved or particular objects bearing undisturbed dust had not been handled, at least since the dust settled. The sequence of acts may be indicated through such observation. Fingerprints, footprints, tire marks, and so on may be legible enough to permit identification by use of photographic methods. Undisturbed dust in a gun barrel would indicate that the gun had not been fired recently. Thus, obvious information may be available through more thorough examinations. Dust is representative of the area in which it is found, and when there are unique or rare components present, the significance of the specimens is increased. We must occasionally be cautious in this respect since dust may travel long distances, and there have been times when the red dust of New Mexico and Oklahoma has been dropped by rain storms in Missouri and in such cases is not characteristic of the local area. Dust found in the clothing of an individual might indicate something of the geographical area through which he had passed or information about his occupation. The laborer from the zinc smelter will carry different dust in his clothing, cuffs, pocket, hair, and even ear wax than the worker from a granite quarry, clay mine, or farm. Pocket accumulations may differentiate a smoker from a non-smoker or indicate the person who habitually carries drugs in his pockets. In many cases, specimens from clothing, pockets, etc., will be of a general nature and offer little specific information; however, it is always worth the effort to examine these sources on the chance that they may produce information important to the case under investigation.

This type of evidence is important when the identification of an unknown subject is involved

and may also be a factor in tying in a suspect with a crime scene. The safe burglar, for instance, frequently disturbs the insulating material in the safe walls and carries it with him on his clothes. This may be disturbed through blowing the safe or by other means of breaking open the safe. Dust may be accumulated from other sources around the scene of the crime. In one case, a burglar crawled through a transom and picked up dust, paint chips (distinctive red) and grease from the hinges of the transom. Identifications of the materials on his trousers with the dust, grease, and paint from the transom helped to convict him. In another case, the suspect was found with steel chips in his pocket after a safe had been opened by drilling. These chips matched, chemically, steel from the safe door and confronted with this information, the suspect admitted his act. Clothing of hit-and-run victims may contain dust from the suspect's car as well as dust and grime from the roadway. This type of thing is important when the body is removed from the actual scene of the accident or where the crime was committed. In another case, the locale where a woman was killed was traced from cinder-like material imbedded in the skin over her knees. In this case, the body had been left in a wooded, grassy area which was not compatible with the cinders found in the knees. The search led to a railroad right-of-way and a hobo jungle where the attack had actually taken place. Without a thorough methodical examination, evidence such as this might have been overlooked and the crime gone unsolved.

Similar in many respects to the examination of dust is the analysis of dirt or soil. Here the possibility of identification depends on the presence of components peculiar to a specific locality. Chemical composition would be an important factor as well as such things as distribution of particle size, and specific gravity distribution of the various particles from the suspected locality and from the suspect or his car. These specimens may be carried from the scene or left at the scene. The presence of some good black prairie soil on a suspect's car may disprove his statement that he has not left the hill region where the predominant soil is a red clay. A knowledge of the geology and soil distribution of an area would help interpret the information of this type. It should become obvious here that in addition to those specimens from the crime scene, we must have specimens of known origin in order to make the identification. While a single specimen

may give us some general information, specific information as to exact source must depend on a comparison with material known to have come from that particular source.

GLASS FRAGMENTS

Glass is a common material in our everyday life and frequently features in crimes of one sort or another. Glass being an under-cooled liquid as distinguished from crystallized substances has no orderly fracture lines and does not break along any exact pattern. Thus, broken glass when matched jig-saw fashion will establish proof of common source. In addition, chemical composition is quite variable and may differ substantially from batch to batch during manufacture. Physical properties will vary in addition depending on the method of annealing. In addition to color and dimensions, specific gravity and refractive index are appropriate criteria for identification purposes when dealing with glass. Headlight lenses are often broken in collisions and parts left at the scene while other parts remain with the vehicle. Glass fragments frequently remain in the clothing of persons who break out windows or crawl through broken windows in burglaries. Broken eye glasses of victims of assault may provide valuable information including the prescriptions to which the glass was ground—hence, the possible identification of an individual.

PAINT

Paint scrapings and chips become evidence when they are removed from or left at the scene of a crime. Chemical composition and physical properties are factors of identification as well as the sequence of layers. Impressions of polish marks on the surface underneath the paint may indicate the type of surface from which the paint came and on occasions have led to positive identifications of the source of paint.

HAIRS AND FIBERS

Hair is another class of material frequently obtained as evidence. Since hair is common to all humans and most warm blooded animals, we encounter it often. It is also most prevalent in the human on the head (some of you more than some of us) and in other areas where criminal assaults may be focused. Microscopic examination is usually required and permits differentiation of human hair from that of other animals. Many a hit-and-run

suspect has been exonerated when the hair and blood on the undercarriage of his car proved to be that of a dog or rabbit as he had claimed. Some idea of racial origin may be indicated when pure racial strains are involved, and hair from the head may be distinguished from hair from the body and hair from the pubic regions. By measuring such factors as scale count, refractive index, and specific gravity, some idea may be gained as to the sex of the individual from which the hair came if the racial strain is pure and if enough data have been assembled on these various factors. There is generally some overlap of these values between the male and female so that the classification is not always clear and concise. Positive identification of an individual from a single or just a few hairs is impossible due to the wide variations in hair characteristics appearing in hair from a single head. The characteristics usually observed include the shape and size of the hair in general and the shape and size of the scale or cuticle, color and distribution of pigment in the cortex, and the character of the medulla or core. Length and characteristics of tips and roots are also observed. Unnatural features appearing in the hair, such as the presence of hair dye or malformations due to disease, would add considerable to the effectiveness of the identification.

Fibers other than hair are also encountered in many cases particularly during acts of violence and at points of entrance and exits during burglaries. Classifications of fibers as animal (hair, fur, silk), vegetable (cotton, linen), and mineral (glass, asbestos), and synthetic is fairly easy through microscopic examination. In addition to the natural characteristics of these fibers, man-made variations in color due to dyeing, set due to weaving, and changes due to chemical treatment may be apparent. The classification of synthetic fibers is becoming more difficult as new products are placed on the market. A recent study by the Minnesota Bureau of Criminal Investigation classified some nineteen synthetics by their chemical and physical properties. The basis of fiber identification is similar to that of hair identification and is more or less positive depending on the uncommonness and number of observable characteristics. When mixtures of fibers are encountered, the proportion of colors and types present may help in establishing facts in the case.

When fibers are woven, the material becomes fabric. Large pieces of fabrics may be matched

jig-saw fashion and smaller pieces revert to an examination of the individual strands or fibers. Foreign material in the fabrics such as stains, dust, grease, etc., may be in itself important as evidence. The type of weave of fabric should be considered and often this pattern or weave is impressed on another surface. Prints of fabrics on fenders or in the mud and grease under a car have been used to solve hit-and-run cases. Bullets may pick up a fabric pattern on the nose of the bullet as it passes through the fabric into the body underneath.

FINGERNAIL SCRAPINGS

In crimes of personal violence, the fingernails may be used as a weapon of defense. Debris from under the nails may include hair, fibers, or skin and blood from the assailant. Care must be used in removing this material so as not to include any tissue from the person whose nails are being checked. Methods of examination will vary according to the material obtained but generally, will start with the use of the microscope. Identification of tissue as human may be possible if present in large enough quantities and representative of the proper types of tissues or cells. Serological tests on this type of material may be inconclusive since the evidence comes from a human being, and it would be natural to expect to find some human debris under the nails. However, if blood group determinations indicate the material from under the nails is not the same as that of the individual from whom the specimen was taken, the investigator has a little more to work on. Evidence of geographical origin or occupation can often be derived from the fingernail scrapings.

CONCLUSIONS

This has been a hasty listing of some of the materials commonly examined in connection with trace evidence or evidence transfer cases. The list is by no means complete nor are complete details given for the various types of examinations which might be employed. Reference to one or more of the books listed in the bibliography will fill in these missing details. We would like to emphasize the importance of considering a wide variety of objects or materials as potential evidence during any

investigation and the importance of considering any or all types of scientific examinations which might be applied in the fact-finding process. No one of us can be expert in all fields of evidence examination, but we can be aware of the assistance workers in these other scientific fields can give to us. This team work of investigator, scientist, and finally the members of the legal profession should greatly improve the finding of factual evidence and its presentation in court.

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