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PHYSICAL EVIDENCE IN THE INVESTIGATION OF TRAFFIC ACCIDENTS

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For this discussion we might define physical evidence as any material which might indirectly serve to identify the people involved in an occurrence or which might reveal the sequence of events. An example of the former might be identification of the car by means of its paint. The driver of the car at the time in question must be identified by other means. An example of the latter might be a trail of debris along the roadway.

Most officers fail to use physical evidence to fullest advantage, but the fault is not entirely theirs, since it is part of the function of a laboratory to acquaint investigating officers with the importance, limitations, collection, transmission, and practical interpretation of physical evidence. A list of materials which are common as physical evidence in traffic cases will include glass from headlight or windshield, metal parts, paint, hairs, fibres, blood, debris from the undercarriage of the cars, grease, and brush marks. This list is not complete but represents the commonest types of physical evidence in these cases. Actually, more unusual materials, for example an unusual stain or marking may have even greater significance in some cases. These materials are not only of interest in themselves but are of interest because of their location, therefore, it is essential that they be carefully described, measured, and photographed before being collected.

It was thought best to present first some details of the handling of various types of physical evidence even though this may not be the most logical order of presentation of the subject matter. The subsequent sections will present, under various headings, some of the details of collection, identification, and packaging of these various types of physical evidence. Where ever possible the probable range of conclusions from these examinations will be presented. These conclusions will vary from sample to sample and from laboratory to laboratory, depending on the factors discussed in the section dealing with factors in establishing an identification.

GLASS AND GLASS FRAGMENTS

Perhaps the most useful pieces of physical evidence found at the scene of an accident are pieces of glass. These pieces of glass can later be matched with the pieces of

glass remaining in the headlight, parking lights, or windshield of a suspect's vehicle. This is a physical matching and is similar to fitting together the pieces of a jigsaw puzzle.

The success of this matching, in part, depends on matching the general form and contour of the pieces of glass, but the most useful feature of the matching is found in the fracture patterns on the edges of the pieces. One can see these fracture patterns himself if a piece of glass is broken, and the broken edges compared with each other in an area where the shape of the glass indicates that the two pieces of glass should correspond. Sometimes this fracture pattern consists of a series of fine parallel lines, sometimes there are a series of markings which appear as waves, other times these markings appear as sort of a whirlpool which may or may not be circular in cross section. Microscopic examination of these fracture patterns can reveal sufficient detail to indicate that the two pieces of glass were originally joined together. If one of these pieces was picked up at the scene and the other was removed from the broken headlight of the suspect car, this examination would indicate that the car broke its headlight at the scene.

From this discussion you will see how necessary it is that the edges of the pieces of glass be preserved from further wear or breakage. When collected, it is necessary to wrap each piece of glass individually in some soft material, for example, kleenex or other soft tissues. Since we are dealing with a jigsaw puzzle, our chances of succeeding with the puzzle are, of course, better if we have most of the pieces. The pieces of glass should be wrapped individually, and all of the pieces, picked up at the scene, enclosed in a separate envelope or parcel. Similarly, all of the pieces of glass remaining in the headlight or parking light should be individually wrapped and all of these enclosed in a separate envelope or parcel. Fitting together the pieces from a windshield would, of course, present a major problem, and if required, that portion of the windshield and frame containing the remaining portions of the glass should be removed for complete examination.

This comparison of glass fragments could be done by the investigating officer. If this preliminary examination is attempted, he must mark all the pieces of glass in a distinctive way using adhesive tape, scratch markings, or nail polish. In cases where physical matching is not obvious, careful examination by trained observers in this laboratory, may still reveal a physical matching. Failing this, the laboratory examination of the chemical and physical characteristics of the glass may reveal an identity. Except under very unusual circumstances, an identification of glass obtained by the chemical and physical methods will yield evidence that this is the same type of glass or at best the same batch of glass, there being many sources of this type of glass and possibly several sources in that area of this batch of glass. In these latter circumstances, it becomes necessary to provide the laboratory with samples from the other possible sources suggested by the evidence.

Often small fragments of glass may be found embedded in the clothing of a deceased after a hit and run accident. It is quite possible that these small fragments of glass could become dislodged if the clothing were handled carelessly. Fragments of glass as small as one-quarter inch square and a sixteenth of an inch thick may be adequate for a determination of chemical and physical characteristics by some

methods of examination. As you will appreciate, it takes very careful detailed examination of the clothing of a deceased to find such small pieces of glass, yet such small pieces have yielded extremely useful evidence in these cases and, indeed, in cases of assaults and thefts. Small pieces of glass should first be wrapped in paper and then placed in an envelope distinctively marked. The sealed package of glass, picked up at the scene, or found in the victim's clothing should be packed by cushioning it in a cardboard or other solid container and surrounding it with a sufficient cushioning material that it will not be damaged in transit. Instructions for transmitting these packages to the laboratory are contained in an *F.B.I. Bulletin*, December 1955.

FRAGMENTS OF PAINT AND PAINT SMEARS

Fragments of paint and paint smears have been very useful as evidence in cases of motor vehicle accidents. Especially, in cold weather the collision between two autos or between an auto and a pedestrian will tend to crack the paint at the point of impact, and chips of paint may be found at the scene, on the other vehicle, or embedded in a victim's clothing.

In cases where chips of paint of a minimum size of one-eighth inch square, composed of two or more layers, are obtained, it is probable that these will yield conclusive evidence of interaction of that car with the pedestrian or other auto. The laboratory examination, in a case of this kind, consists of a detailed microscopic examination under various types of lighting conditions. This examination shows the wear and erosion of both surfaces of the paint, various errors and deficiencies in the application of the paint, something of the type of surface to which it had been applied, various inclusions such as dust and sand and the type of scratching on its surface; in addition, the thickness of the layers of paint can be determined. Following this, an examination using spectrographic and X-ray diffraction methods may be made of the layers of the paint separately. These examinations yield evidence about the chemical identity of the various layers of the paints. In cases where both chemical and physical examinations are possible of a fragment of paint, the evidence is often conclusive. In practical terms, this may mean that the paint found at the scene, i.e. on the other car or on the victim's clothing, came from the car in question.

Small fragments of paint should first be wrapped in a piece of paper which is marked with identifying marks. The piece of paper can then be placed in a pill box or vial which is properly sealed, preferably with a numbered or distinctive seal. The container should be thoroughly identified, giving details about its source, the date, the name of the officer, etc. For comparison purposes, large fragments of paint should be obtained from the suspect car as close as possible to the points of damage on the car—this is quite necessary since it is possible that the type of scratching and wear on one fender of a car may be quite different from that appearing on the other fender of the car, moreover, it is possible that only one fender has been repainted. These flakes should be removed down to the base metal, including the primer coat.

In cases where a smudge or smear of paint is observed on another car, a fixed object, or on the clothing of the victim, the examination is mainly chemical in nature. This examination is rarely as conclusive as it would be in the case of a fragment of paint. Ordinarily, such examination will yield evidence that this is the same type of paint or,

perhaps, that it is the same batch of paint as the paint in question. In the case of clothing, the clothing should be carefully wrapped, labelled, and identified. In the case of a smudge of paint on a car or a fixed object the smudge or smear should be submitted intact if possible. If this is on a large object, it may be necessary to scrape the paint and submit the scrapings. For this a special technique is necessary.

To remove a smudge of paint from a car, the car should be placed in some area out of the wind. A piece of paper should be attached to the area of the car just under the smear to be removed. This paper can be fixed in position by means of a strip of Scotch tape or other adhesive. A fold is made in the paper to form a trough to collect the scrapings. The smear can then be removed by scraping with a razor blade, a pen-knife or other sharp instrument. Care should be taken to remove only the paint in the smear, not the paint of the car itself. The paper trough is removed and carefully folded to preserve its contents. It can be sealed and initialled in a distinctive way and placed in pill box or vial which can then carry the full label and appropriate seals. At least two comparison samples are required in this case, (1) scrapings from the paint of the car from which the smudge has been removed and (2) paint removed from the suspected source. If possible, a chip of paint should be removed from both of these objects from an area as close as possible to the area believed to be the area of contact. If, for some reason, it is not possible to remove a chip of paint from the suspected car, then scrapings should be made in two ways, first, scrapings from the superficial layer of paint and second a deeper scraping which will include the base layers of paint. These should be packaged separately in the same manner as previously described.

PIECES OF METAL

Pieces of metal may be found at the scene which can provide a physical matching with their counterparts remaining on the suspect car, in the same way as was outlined under "Pieces of Glass". In many cases, these pieces of metal may be so small that physical matching is not possible. Spectrographic examination of small pieces of metal may yield conclusive evidence as to their source, especially when there is a possibility of matching some features of the surfaces of the pieces of metal as described for fragments of paint. The minimum size for worthwhile laboratory examination is much smaller than in the case of paint. Under extremely good conditions, pieces of metal which just glisten on clothing can be removed using a vacuum sweeper technique and can provide an identity. Again, the possibilities of using these small fragments of physical evidence necessitates the careful handling of clothing so that this type of evidence is not lost. Comparison samples are required of the metal parts of the car in question. Usually, the parts of the car in question, which are the most likely sources of comparison metal, will be those which show evidence of having been rubbed or which are bent. A most frequent example are little pieces of chrome plating which have begun to peel through age or which have peeled through impact. Spectrographic examination of these bits of metal can be quite as conclusive as has been indicated for the examination of paint in many cases.

BRUSH MARKS AND IMPRESSIONS OF CLOTHING

Sometimes in the investigation of a hit and run case, the only appearance of contact between a clothed body and a car is a brush mark or imprint of the clothing. Some-

times these imprints are very difficult to see. The lighting conditions must be just right and strong lights should be used. Sometimes a marking will show under oblique light which does not show up when the light shines perpendicular to the surface. These brush marks may appear as a series of parallel lines—sometimes just on the surface of the paint—sometimes the contact has been forceful enough to remove some of the paint and these lines appear embedded in the paint itself. These parallel lines have been made by a rubbing action of the ridges formed by the weave of cloth over the surface of the car. When present, they indicate violent contact between the object and clothing having that type of weave, and, of course, there are many possible sources of clothing of that weave. Sometimes when the two surfaces have come into direct rather than glancing contact, a full imprint of the weave may be left on the surface. When this occurs, there is a stronger possibility of matching the fabric with the imprint. Sometimes one will see several imprints, one which could have been made for example, by the weave of the cloth of a coat, another which could have been made by the cloth of the pants. This type of marking gives evidence which is consistent with a given set of circumstances. It would be almost useless, except under very unusual conditions, to proceed with a case, if this were the only evidence. On the other hand, for purposes of investigation, these findings serve the purpose of narrowing the field of possibilities. Usually, it is not worthwhile to remove a part of the car bearing a brush mark for laboratory examination, unless there are some very unusual features about the imprint.

FIBERS

Often when a car comes in contact with a person, fibers or threads of his clothing may become attached to various rough edges on the surface of the car, especially the edges of chrome trimming. It is not sufficient in the examination of a car to merely look at the edges of the chrome trimming. If the chrome trimming is pried slightly away from the body of the car, this may reveal whole threads rather than a few fibers.

The laboratory examination of fibers consists of microscopic examination as to the type of fibers and the distribution of various dyes on the fibers, as well as a search for various accidental characteristics. Depending upon the nature, arrangement, colour, and types of fibers represented in the sample, the evidence may be anything from consistent to conclusive of having come from a given source. The suggestions given for the collection of smudges of paint should be used in the case of collection of fibers and threads. The clothing, for comparison purposes, should be submitted in a separate parcel.

HAIRS

The discussion of hairs will indicate possibilities similar to those mentioned for fibers. Hairs can be classified as to whether they are human or animal, whether the hair has been recently cut, whether it has been pulled by the roots, whether it has been dyed or damaged, or whether it is from a young person or an old person. Rarely human hairs show peculiarities which lead to an identification as having come from a certain individual.

In the case of hairs, as much as possible of the questioned sample should be collected. These hairs should not be kinked but should be placed in a pill box, or better

in a plastic vial, since the grease, etc. on the hair is not altered as it would be in a paper folder. At least fifty comparison hairs should be obtained from the suspected source, which, in the case of a hit and run accident, is usually the victim. This hair can be obtained by combing the hair or pulling out the hair near the injured area and should be packaged in the same manner as described for the questioned sample in a separate envelope and suitably identified. Hairs for examination should not be washed or otherwise treated before being submitted for examination. Sometimes the oil and dirt on the hair provides a useful point in the identification.

Examination of a suspected hit and run car may often reveal a stray hair or two not connected with the case. It is very difficult for the officer to tell whether hair removed from a car is, in fact, a hair or a fiber. A hand lens will assist the officer to decide which materials to collect. Only very careful examination of a suspect car, using very strong lights, and preferably using a large hand lens, will reveal these fragments of physical evidence.

BLOOD STAINS

Examination of a vehicle may reveal stains which have the appearance of blood or saliva. Sometimes when a pedestrian has been struck in the chest, the air, violently forced from the chest, will carry some saliva or mucus with it, much in the same way as in coughing. This material, if found on a car, can be identified, and in many cases it can be grouped in the same manner as blood stains. Stains of blood or saliva may be scraped from the surface of the vehicle in the manner described for the removal of smudges of paint and packaged as described under that heading. Laboratory examination can indicate whether or not this is human blood, and if there is sufficient sample, it can indicate to which of the main groups of human blood this blood belongs. Since one of these groups includes some 43 per cent of humans, the grouping itself is only directional evidence. However, when you consider that the blood is human and how few people could be wounded in this manner, the evidence carries more weight than would be expected on the basis of the blood grouping alone. In cases where the blood has not yet dried, and if it can be kept fluid, then various blood sub-groupings can be assigned with a corresponding increase in its evidentiary value. Blood may be kept fluid by the addition of anti-coagulants which may be obtained by consulting the laboratory.

In the case of blood stains and in the case of other types of physical evidence discussed, the location of the blood stains is extremely important. In the case of blood stains, the droplets of blood may show the direction of the flow of the blood over the surface. Often there is a little tail to the droplet of blood, and the tail occurs in the direction of flow of the blood—the tail being longer if the angle of impact with the surface is smaller and the force of impact is greater.

EARTHS, DEBRIS, AND GREASE

These three materials are discussed together since debris and grease are mainly of interest for the earth that they contain. Under some circumstances grease may contain additives which may make it interesting for itself. However, in the field of traffic accidents, the constituents sought for in these materials are usually of an earthy

nature. In some circumstances, where a motor vehicle has gone over a body, grease and debris may be found on the clothing. This material may be compared with corresponding material obtained from portions of the undercarriage of the car. In these circumstances it is very likely that one will also obtain blood, hair, and clothing fibers from the undercarriage of the car. The examination of these materials is partly microscopic in character and partly a chemical analysis of these constituents. In many cases this examination is supplemented by a separation of the various constituents of the sample by means of some of their physical characteristics. The examination of this material does not often lead to the conclusion that the material on the clothing came from that car. More often the conclusion is that the material on the clothing could have come from that car, but there are a number of other cars with that type of material adhering to their undercarriages. In cases of this kind, samples should be obtained from the other cars which the evidence might indicate as possible sources of the material in question. This will assist in defining the problem of identity for the cars in that particular area.

The preceding list of materials is by no means intended to be complete but will serve as examples of the most common materials encountered in the investigation of traffic accidents. Other materials, less often encountered, might well be as useful as evidence.

EXAMINATION FOR PHYSICAL EVIDENCE IN MOTOR VEHICLE ACCIDENTS

Usually, evidence of contact between a car and a person or between two cars is quite obvious. Sometimes this evidence is very difficult to find—this is especially true where the impact has been between a motor vehicle and a person, especially when the person has been well padded with clothing and the motor vehicle is of a substantial build. In checking automobiles in hit and run cases, the exterior surface of the automobile should be examined for clothing fibers, hair, blood, tissue, abrasion marks and paint, dust, grease, impressions of fabric, etc. The examination of the car should begin at the front and move progressively around the car. To be complete, this examination should be made under strong lights, preferably using a hand lens. Much will be missed if one tends to skip about the car from point to point. No examination of vehicles suspected of being involved in a hit and run case is complete without a thorough examination of the undercarriage of the car. The traffic officer should bear in mind that the driver of such a car may have as much reason as any criminal to hide his activity.

In many cases, there has been an opportunity and a definite possibility that the car has been cleaned or repaired after the impact and before the examination. The investigation of the car available in a two-car collision, or the pedestrian in an auto-pedestrian accident, will indicate something of the position of contact with the wanted car. These positions on a suspect car should be especially checked for evidence of recent damage or repair. When evidence of cleaning or repair has been found, the investigating officer should carefully plan his interview with the driver. In addition to the search described for the various items of physical evidence such things as recently replaced nuts, securing bolts on license plates, bumpers, radiators, etc. should be checked. Protruding parts of the car, such as door handles, bumpers, and bumper

guards, should be thoroughly searched for foreign material such as fabric, blood, and hairs. All exterior surfaces, especially motor hood, fenders, radiator, and radiator grill, should be thoroughly examined for fibers and brush marks. Underneath the car, the grease fittings, crank case pan, axle, axle housing, differential, spring shackles, and bolts should be checked for fibers, for abrasion marks, for hair and blood. Notes should be made of the colour of paint, whether or not the vehicle was two-tone and, in taking comparison samples for comparison, both shades of paint should be obtained. Recent servicing, such as lubrication, oil change, and the date and mileage recorded on servicing stickers are also items of interest.

In the ordinary type of traffic accident, the officer would be well advised to take a careful systematic look around each car before interviewing the occupants. Such things as the location and extent of damage will indicate the areas of the cars which came in contact. Stories subsequently received from the occupants can then be interpreted on the basis of the existing evidence of the contact. These stories may also be interpreted in relation to the evidence of skid marks, debris, and scattering of broken parts at the scene.

When various materials, useful as physical evidence, have been found on a car, their locations should be marked on a rough sketch, and measurements should be taken of their position, using reference marks such as the ground, windshield, door posts, front bumper, etc. It is advisable in all cases, especially so in a major case, that the physical evidence be photographed in its position before being collected. Often the position of the material is of as much importance as the type of material itself. A combination of the practical identity as determined in the laboratory and its peculiar location on the vehicle, may present a picture consistent with a given theory and with no other. For example, smudges of paint on car No. 1, which could have come from car No. 2, and smudges of paint on car No. 2 which could have come from car No. 1, may then be interpreted, with the added significance that the positions of these markings were at the points where each of these two cars came in contact with something.

Similarly, with brush marks the position of the brush mark is probably as significant as the type of brush mark found. If, for example, the brush mark is found on the side of the vehicle and no other evidence of contact is found, then the contact, if any, between the car and the clothed object was at the side of the car. Another example of the importance of the location of markings on a vehicle is the relationship between the damage on the vehicle and the injuries sustained by a pedestrian. For example, in one case measurements were taken of the height of the bumper from the ground, the height of both edges of the damaged headlight from the ground and by laying the tape over the fender we obtained the position from the ground of a bump in the upper surface of the motor hood. These positions correspond to measurements of the injuries sustained on the body, i.e. at the height of the bumper there was fracture of both legs, at the height of the headlight, lower edge, there was another fracture, at the level of the top of the headlight there was a deep gouge in the flesh, there was a dent at the position where the head would hit if the body were wrapped over the motorhood, which coincide with a fracture of the skull. This evidence coupled with the findings of hair, blood, fibers, and smudge of paint indicated with certainty that this body had been wrapped over the front end of this car.

The examination of a deceased person, in a motor vehicle accident, is usually done by the coroner or pathologist. The investigating officer should make a note of the location of the injuries sustained and should receive the clothing, a sample of blood for grouping and for alcohol determination, and a sample of hair of the deceased at autopsy, in accordance with the practice in that locality. The clothing should be dried thoroughly, since blood deteriorates when it is in a moist condition. After drying, the exterior garments should be wrapped separately. Depending on the outcome of the investigation, the garments can be sent to the laboratory for examination along with the appropriate comparison samples collected from the suspect car.

MATERIALS NEEDED FOR COLLECTION OF SAMPLES

The materials needed for the collection of physical evidence in accident cases are quite simple. A medical student's dissecting kit, which contains several forceps, scissors, scalpel, and probes, is very useful. The officer should also have a supply of various sizes of envelopes, pill boxes and plastic vials, some numbered seals, heavy wrapping paper, and stout twine. An ordinary magnifying glass and a stick of soft sealing wax are useful; wax seals may be applied in the usual manner, and an initial or identifying mark made on the seal when still soft.

FACTORS IN ESTABLISHING IDENTITY

In most problems brought to laboratory, the questions usually asked by the investigator is, whether two samples are identical paints, glass, dusts, fibers, hairs, etc. An identification is based on: (1) The agreement between the characteristics of the material in question and those of its suspected source. This agreement must include both class characteristics (i.e. the characteristics that make the material that type of paint, metal, hair, etc.) and accidental characteristics (i.e. characteristics due to minor contamination during manufacture, or due to the effects of weathering, wear, repair, abnormal growth, etc.); (2) The characteristics of the material in question which are different from the other materials of the same type; (3) The experience of the laboratory scientist in that particular type of examination. The term experience here is intended to include the overall effect of previous examinations of many such materials. During these repeated examinations, many characteristics may have been observed quite commonly, other features may have been observed very rarely. The number, the nature, and the position of the accidental characteristics may lead to a conclusion that there was only one source of the material.

With many markings or traces left by one person or object on another, one or more of these elements necessary for an identification may be lacking. Each case is different, and in many cases *an identity* between the material in question and the suspect material cannot be established in a conclusive way. In such cases we have to be content with a description of similarities. In other cases it is surprising how many unusual identifying characteristics can be found during careful search, using the tools and techniques which are being developed in Forensic Science. These considerations should guide the investigator when he is considering which laboratory is capable of obtaining the most information from the evidence he submits. This is not just a matter of the equipment that the laboratory scientist has, but is a combination of equipment, general training, and specific experience in cases of the particular kind under

consideration. Small laboratories may well have this combination for some types of cases but probably not for all types.

THE LIMITATIONS OF PHYSICAL EVIDENCE

The limitations of physical evidence and a method of reducing these limitations is illustrated by the following case. In a recent case the investigating officers brought the shoes of a suspect into the laboratory. One shoe had a paint stain on the sole. The story was that the accused was suspected of sliding down a drain pipe to gain access to a building. The officers brought some comparison samples of paint from the drain pipe and from the window sills. The laboratory was able to establish that the stain on the shoe was paint from the same batch of paint as that used on the drain pipe and was different from the paint used on the window sills. All of the paints submitted were the same type and colour, but the paint for the building had been purchased at three different times from the same manufacturer. In the hearing of the case it was agreed that there might be 1,000 gallons in the particular batch of paint found on the suspect's shoe since the paint came from a large company. There was very little other evidence, and the case was not proven.

A short drive around the town after the case was dismissed indicated that this was the only building in town painted with this type of paint. Had the investigators appreciated the nature of the evidence they could have established that very little, if any, of this particular paint had been used elsewhere in that town, or within the distance that could have been covered in the space of time in which the movements of the suspect were unknown. Also the sales record in this area of this particular company for that type of paint would have been valuable in this case.

This case illustrates that it is important for the investigator to know exactly what the laboratory evidence will show. Many of the loopholes left after laboratory investigation can be closed by further investigation. For example, in this case samples of paint from other red buildings in this town might have indicated that the drain pipe was the only source of this paint in that town. The samples necessary in a case of this kind are referred to as control samples. The evidence is strengthened when it is possible in a particular case to rule out a number of other sources as possibilities.

The investigating officer must find out what degree of certainty the laboratory investigator can indicate in a particular examination. In many cases, the laboratory report must be used as a guide so that the other possibilities suggested by the entire evidence can be excluded. Thus, the investigation of the physical evidence in a case is not necessarily finished when you get a laboratory report.

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