FM 19-20

WAR DEPARTMENT FIELD MANUAL

CRIMINAL INVESTIGATION

WAR DEPARTMENT • APRIL 1945

CHAPTER 12

RECONSTRUCTING CRIME

105. GENERAL. a. A determination of what occurred at the scene of a crime may lead to disclosure of the *modus operandi* (method of operation) of the criminal and the truth or accuracy of certain statements of witnesses. The process of evaluating a crime scene search is known as reconstructing the crime.

b. Reconstruction may include physical reproduction of the positions of articles and persons, and of the actions and words of the latter during the circumstances of the crime. It should also include a mental reconstruction—an analysis of the evidence and the facts to form a coherent picture of the crime. The inference or conclusion drawn from this reconstruction of the crime is called "theory." To the investigator all theories are merely tentative until proved true or false. The tentative theory merely suggests the line of investigation most likely to produce proof of the crime.

106. PHYSICAL RECONSTRUCTION. a. Whenever possible, the investigator should attempt an actual physical reconstruction of the crime as it is reported to him by the witnesses and indicated by the evidence. For example, in homicides all articles at the scene may be placed in the positions occupied prior to the homicide. The witnesses may be required to resume their exact positions and to reenact their actions during the events which led to the killing. These reenactments by the witnesses should be photographed in each pose. A reconstruction of the position of participants and of the witnesses at the scene of a homicide may furnish valuable leads for further interrogation and investigation.

b. The physical reconstruction of the scene of the crime, if practicable, should be done at the same time of day and under the same conditions of light and weather as prevailed when the crime occurred.

107. MENTAL RECONSTRUCTION. a. The facts disclosed by a reconstruction of the crime should be compared with the statements of witnesses. Certain physical evidence or statements may be so related to and confirmed by other facts as to be proof of the circumstances of the crime. If a statement or act of an individual is unusual or inconsistent with the proof, the investigator should ask himself what caused the individual to make the statement or commit the act, and what must his conduct necessarily have been to conform with the circumstances shown by the proof.

b. In tracing the probable actions of a suspect, the investigator may encounter evidence that the criminal followed a course which does not seem logical. This should not cause the investigator to reject the evidence or to ignore inferences or conclusions which follow from the evidence. The criminal may possess poor judgment or little intelligence or may have acted deliberately, to mislead the investigator.

c. The investigator will often reach an erroneous conclusion if he tries to place himself in the position of the criminal and assumes that the perpetrator acted as he himself would act. In reconstructing the crime the question is not "How would the investigator have acted if he were the criminal?," but "How would the perpetrator act?"

d. In reconstructing a crime, the investigator should not assume anything as fact which is not supported by the evidence or which cannot be substantiated. On the other hand, it should not be assumed that a fact does not exist unless there is proof of its absence. The goal in crime reconstruction is not to ascertain what probably happened but to ascertain what actually did happen.

CHAPTER 18

BLOOD AND OTHER BODY FLUIDS

168. GENERAL. The examination of stains produced by blood and other body fluids such as saliva, urine, and semen, frequently furnishes valuable evidence in criminal investigations. The investigator should know the various types of scientific examinations which may be conducted and should be thoroughly familiar with the methods of preserving evidence so that these examinations may be conducted successfully.

169. TYPES OF EXAMINATIONS. From an examination of stained evidence the chemist may be able to answer any of the following questions:

a. Is the stain blood?

b. If not blood, what is it?

c. If blood, is it human blood or animal blood?

d. If animal blood, from what animal?

e. If human blood, what blood group?

f. If stain was produced by body fluids other than blood, of which group is it?

170. EXAMINATION OF SUSPECTED BLOODSTAINS. a. A murder suspect may claim that a dark stain on his clothing was caused by ink, ketchup, animal blood, or some other substance. The chemist can determine not only whether a suspected stain is a bloodstain or a stain of some other substance, but he can also determine, if the stain proves to be blood, whether it was made by human blood or animal blood. The examination of a suspected bloodstain may be divided into three phases:

(1) A preliminary test is conducted to determine whether the stain may be blood.

(2) If the preliminary test indicates that the stain may be blood, a confirmatory test is conducted to establish definitely the fact that the stain is blood.

(3) After it has been established that the stain is blood, determination is made of the origin of the blood.

b. These tests are discussed in the following paragraphs.

171. PRELIMINARY TEST FOR BLOOD. There are various preliminary tests for blood, such as the guaiac test, phenolphthalin test, leucomalachite green test, and the benzidine test. One of the most satisfactory of the preliminary tests is the benzidine test. This test is based upon the production of a greenish-blue color when a drop of an alcoholic solution of benzidine and a drop of hydrogen peroxide are added to an extract of a portion of a suspected stain. The directions for this test are as follows:

a. To a test tube add a 1-inch layer of ethyl alcohol (grain alcohol). Then add two to three drops of glacial acetic acid. To this solution add a knife edge full of benzidine and mix until the benzidine has been dissolved.

b. Prepare a physiological saline solution. This is a 0.85 percent solution of ordinary table salt and water and can be prepared by adding one teaspoonful of salt to a quart of water.

c. Using a medical applicator or a small piece of wood, prepare a cotton swab.

d. Moisten the swab in the saline solution and rub the swab over a small portion of the suspected stain, thus transferring a small quantity of the suspected stain to the cotton swab. With an eyedropper, add one drop of the benzidine solution to the material on the swab and then add one drop of a 3 percent solution of hydrogen peroxide.

e. If the stain contains blood, the material on the swab

will change to a greenish-blue color within 5 seconds after the peroxide is added. This test is sensitive to one part of blood in 300,000 parts of solution.

f. A positive reaction in this test—the production of the greenish-blue color change—does not mean that the stain is blood since there are a few other substances which will produce a similar color change. However, if the test is properly conducted and no color is produced within 5 seconds it may be stated definitely that the stain is not blood. Other substances which will produce similar results with the benzidine reagent are saliva, pus, manganese salts, and certain forms of iron rust.

g. The above test is preferably conducted by a trained scientist in a chemistry laboratory. However, if the proper chemicals are used and they are properly applied, the test may be performed by the investigator. When this test is conducted by the investigator the following cautions should be observed:

(1) The test is *never* conducted on the bloodstain itself. This would destroy the whole bloodstain and prevent a later confirmatory test. The investigator should follow the procedure outlined in d above so that only a small portion of the stain is used.

(2) A *control* test should be conducted before the bloodstain is tested. The cotton swab is dipped into the saline solution and, without rubbing the swab on the bloodstain, a drop of the benzidine solution and then a drop of the peroxide are added. No color change should take place. If there is a color change, the chemicals may contain impurities and fresh solutions should be made and another control test conducted. Control tests may also be run on known bloodstains before the questioned material is tested.

(3) The benzidine solution should not be prepared until the investigator is ready to conduct the test. The solution should not be made up ahead and stored as the test requires that a fresh solution be used.

(4) The reaction is very sensitive and, accordingly, the articles used—knife, applicator, cotton, test tube, eyedropper—must be absolutely clean.

172. CONFIRMATORY TESTS FOR BLOOD. a. When a positive reaction has been obtained with the benzidine test, it is then necessary to determine whether the reaction was caused by blood or by one of the other substances which might give a positive reaction. This analysis is strictly a chemical problem and can be conducted only by a chemist trained in such work. One or both of two tests may be conducted:

(1) Micro-spectroscopic test.

(2) Teichmann test (Hemin test).

b. The micro-spectroscopic test consists of a spectroscopic examination of the saline extract of the stain and is based on the fact that hemoglobin, which is the red coloring matter contained in the red cells of the blood, and its derivatives produce characteristic absorption bands or darkened areas in the visible spectrum. The Teichmann test is based upon the production of characteristic brown, rhombic, hemin crystals when hemoglobin is treated with glacial acetic acid containing a trace of sodium chloride. Each of these tests is specific for blood.

173. ORIGIN OF BLOOD. After it has been ascertained that the questioned stain is blood, a test must be conducted to determine the origin of the bloodstain; that is, to determine whether the stain is human blood or animal blood. The most common method of determining the origin of blood is by the *precipitin* reaction. This test is based upon the reaction between the questioned blood and a serum prepared by injecting rabbits (or other animals) with the

blood of the same species for which the test is conducted. For example, a serum for use in testing human blood may be prepared by injecting a rabbit with several small doses of known human blood obtained from donors. The rabbit will produce precipitins in its blood serum, forming what may be called antihuman serum. A small quantity of blood from the questioned stain is scraped off and dissolved in a saline solution for a few hours and then filtered to obtain a clear liquid. This solution is then carefully mixed with the antihuman serum extracted from the rabbit which was previously injected with human blood. If the bloodstain is due to human blood, a white ring will appear at the junction of the two layers within 20 minutes. If this reaction is not obtained, the stain is not due to human blood. Control tests must be conducted with known blood to insure that the proper reaction will take place. If the stain is not due to human blood, it is then tested to determine the animal from which it came. The animal tests are conducted in the same manner, with an antiserum prepared by injecting a rabbit with another animal's blood. For example, antidog, anticat, antihorse, antichicken, and other animal antisera are prepared by injecting a rabbit with dog, cat, horse, chicken, or other known animal blood.

174. **BLOOD GROUPING TESTS.** When a bloodstain is sufficiently large, it is possible to group the blood to determine to which of the four major groups it belongs. These major groups are, according to the International System of nomenclature, "O," "A," "B," and "AB." There are additional subgroups and types which can be determined with fresh liquid blood but cannot be determined by the examination of dried bloodstains. Grouping of blood does not establish the identity of the blood. It is only possible to solve in a negative way the question as to whether the blood came from a certain individual; that is, it is possible

to determine that the blood did *not* come from a certain individual. If a murder suspect belonging to group "O" has bloodstains on his clothing and claims that the bloodstains were caused by his own blood, and it is shown that the bloodstains are in group "A," such evidence is conclusive proof of the falsity of the suspect's statement. The grouping tests are based on the ability of the blood serum of one person to clump or to agglutinate, or to bring together the red blood cells of certain other individuals. An absorption method of grouping dried bloodstains has been found to be quite satisfactory. This method is dependent upon the observation of the strength of the reaction of "A" and "B" sera (with "B" and "A" cells respectively) after they have been allowed to remain in contact with the dried bloodstain for a period of 12 hours. These reactions are compared with the reactions of the same "A" and "B" sera which have been absorbed with known group "O," "A," "B" and "AB" bloods and from this comparison the group of the questioned blood is determined.

175. **DETERMINATION OF QUESTIONED PATERNITY.** In determining fatherhood from blood group tests, a *positive* proof that a man is the father of a certain child cannot be obtained; however, a *negative* proof may be obtained in that it is possible to show that a man is *not* the father of a certain child. For such proof of nonpaternity, it is necessary to have samples of blood from the child, the mother, and the alleged father.

176. **SEMINAL STAINS.** Semen is the viscid whitish fluid produced in the male reproductive organ. Stains of semen may be found in the investigation of rape, sex murders, and sex offenses of various kinds. The location of the semen stains on clothing, bed linen, and other fabrics may be accomplished under an ultraviolet ray. Seminal stains have a strong bright luminescence under ultraviolet rays.

The chemist examines the suspected material under the ultraviolet rays, marks the stained area, and tests it to determine if sperm cells (male reproductive cells) are present and if possible, the group. The grouping is possible only when the individual is a *"secretor,"* that is, a person whose body fluids, other than blood, contain the same group specific substance as found in his blood. Approximately 50 percent of all human beings fall into the "secretor" class. Semen may not only be detected in dried stains on clothing, but also may be found in smaller quantities in the genital organs of the victim. Vaginal smears should be obtained within 12 hours of the alleged offense and should be secured by a physician with the consent of the victim. The demonstration of semen in a vaginal smear strengthens the investigative evidence since it proves that penetration had occurred, although it does not necessarily prove rape.

177. **SALIVA STAINS.** Saliva on cigarette butts, cigar stubs, envelope flaps, postage stamps and similar articles may be grouped if the person involved is a "secretor" as explained in paragraph 176. As in blood grouping, the determination of the group is not an identification of the person but may serve to eliminate him if his group differs from that of the questioned evidence specimen.

178. **EXAMINATION OF BLOODSTAINS BY INVESTIGATOR. a. General.** Although the chemical analysis and grouping of blood and other body fluid stains must be conducted by a chemist, there are several examinations which the investigator may make himself and these may furnish him investigative leads of value.

b. Determining direction of fall. The direction from which a drop of blood fell may be deduced by the application of the following principles:

(1) A drop of blood which falls vertically from a considerable height flattens to a circular disk, around which there are evenly distributed splashes. (See fig. 26.)

(2) A drop of blood which falls from a moving object or person is elongated and the splashes are found to be con-

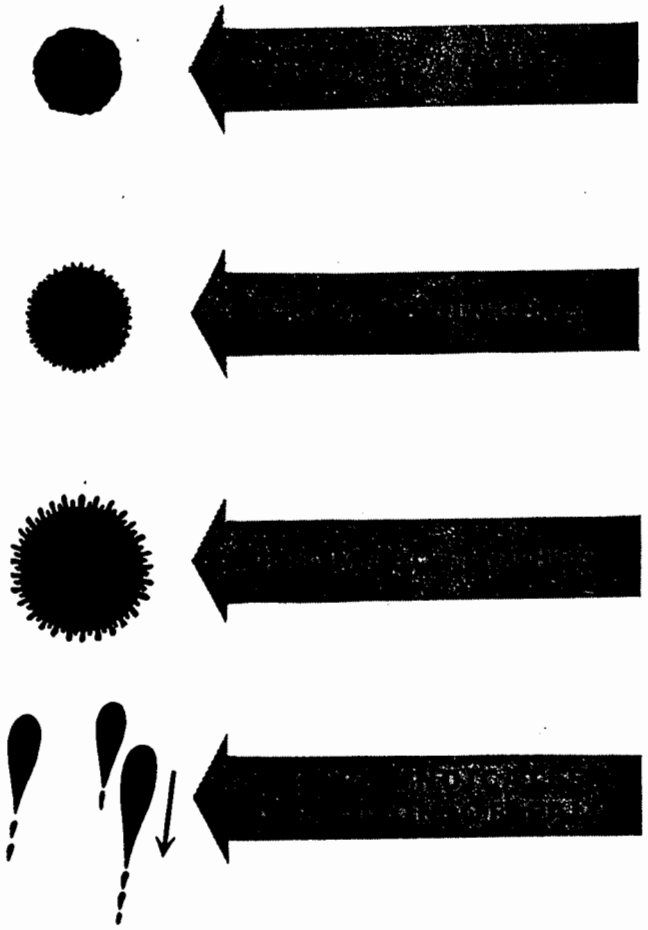

Figure 26. Shape of blood drops falling from different heights.

centrated around one end of the stain. As a rule, the splashes and the extension of the drop lie in the direction of movement. (See fig. 26.) The faster the movement of the object or person from which the blood drops, the more elongated the bloodstain will be.

(3) Investigators should not base their conclusion on the examination of a single drop, lest they arrive at an erroneous conclusion. For example, a murderer, with a wound on his hand, may swing his hand while walking rapidly, and a drop of blood left by a backward swing will indicate a direction opposite to the direction he was walking.

c. Clotting of bloodstains. By an examination of the clotting of bloodstains, the investigator may be able to estimate the elapsed time since the stain occurred. Bloodstains clot in from 10 to 20 minutes. When blood has clotted, the blood cells form a jellylike mass, and surrounding the jellylike mass is a liquid serum which is still wet.

d. Drying of bloodstains. The time required for the drying of a bloodstain is affected by temperature and humidity, the type of material on which the stain is found, and the size of the stain. A stain of approximately 2 to 2½ inches diameter will, under average conditions, require ¾ to 1 hour to dry. Bloodstains dry on the outside edges first. Continued exposure to wind and sunlight will hasten the drying of a bloodstain. Blood dries more slowly on a nonabsorbent surface such as glass, finished wood, or metal than it does on absorbent surfaces such as cotton or cloth.

e. Color of bloodstains. Bloodstains are not uniform in color. The color varies, depending upon the material on which the stains are found and the age of the stains. Fresh, wet bloodstains are bright red in color. After drying, the stain acquires a dark scarlet color. Upon exposure to daylight, this color will change gradually to a dull brown. It usually requires from 1 to 10 days for this change to take place, after which the color will not change materially. It

should be remembered, however, that under some conditions bloodstains may be green, black, gray, yellow, or some other color.

f. Experiments. The investigator should confirm any conclusions arising from these examinations by conducting tests with animal blood or other liquids to prove his theories.

179. EVIDENCE FOR ANALYSIS. a. Stains may be found on clothing, bedding, soil, floors, hair, weapons, and the numerous other articles which may be related to a crime. Although stains caused by such substances as rust, paint, mud, food, sealing wax, grease, and vegetable matter frequently have the appearance of blood, their actual constituents can be determined by chemical analysis. All stained evidence pertinent to the crime should be gathered by the investigator and submitted to the chemist for analysis.

b. Samples of the victim's blood and samples of the suspect's blood should be obtained by the appropriate medical officer and submitted to the chemist for comparison with the evidence stains.

c. In some cases, scrapings from beneath the fingernails of a suspect may also be desirable. Chemical examination of these scrapings may reveal traces of blood of the same group as that of the victim.

180. COLLECTING BLOODSTAINED EVIDENCE. a. Where bloodstains are found on floors, pianos, walls, and other articles which cannot be recovered as a unit, it will be necessary to remove the stains. The method of removing the stains will depend on the nature of the material on which they are found. Stains on wood may best be removed by cutting beneath the stain, taking some of the wood with the cutting. Stains on a wooden floor may be removed with a carpenter's plane or with a wood finisher's scraper. If stains are found on loose earth, suffi-

cient earth should be removed to insure getting the entire stain without mixing in an unnecessary amount of unstained material. If the bloodstains appear on fabrics such as furniture or automobile upholstery, or on heavy rugs or carpets and it is not possible to preserve the whole article as evidence or to transmit the whole to a laboratory, part of the stained material may be removed for analysis. This is accomplished by placing a chemically clean white blotting paper beneath the material and saturating the stained area with a physiological saline solution (par. 171) which may be obtained from the Medical Corps. The salt solution is applied to the fabric with a clean glass rod or eyedropper and the stained fabric manipulated with the glass rod until the blotting paper has absorbed a good portion of it. The blotter is then allowed to dry and may be transmitted to the laboratory with a description of the procedure used to extract the stain and of the material upon which the stain was originally found. Investigators will obtain the assistance of Medical Corps or laboratory personnel, whenever possible, before attempting to remove stains.

b. After removal, the stained residue should be placed in a clean, well-stoppered test tube. The test tube should be marked for identification with a gummed label. The use of envelopes and paper to transmit scrapings to the laboratory is undesirable due to the risk of losing the specimen through the corners of the envelope and from the folds of the paper. Furthermore, if the specimen is very small and slightly moist it may stick to the paper, making it extremely difficult to remove after it is received in the laboratory. For all ordinary purposes, suitable glass vials may be obtained from the Medical Corps or may be purchased in drug stores. In the absence of such glass vials, round cardboard pill boxes may be used.

c. Axes, knives, hammers, clothing, and other stained evidence including scrapings and washings must be properly tagged, labeled, or otherwise marked by the investigator so that he can identify the evidence positively at a later date. (See ch. 16.)

181. HANDLING BLOODSTAINED EVIDENCE. When bloodstained evidence is collected by the investigator, it is of utmost importance that care be taken to see that the stains are not transferred from one piece of evidence to another. Each piece of evidence must be handled and wrapped separately. When it is necessary to send bloodstained evidence to a laboratory or preserve it for future reference, the specimen should be thoroughly and naturally dried in the air. No artificial heat should be used, nor should fans be employed. The application of artificial heat is undesirable due to the fact that it has a tendency to fix bloodstains in the fabric, and if the temperature is sufficiently high subsequent laboratory analysis may be impossible. It is undesirable to dry material such as this in a current of air due to the possibility that valuable evidence particles such as dust, burned or unburned gunpowder residues, and hairs or textile fibers may be blown away. There is also the possibility that foreign dust and debris may be blown onto the material.