SEQUENCING OF BLOODY SHOE IMPRESSIONS BY BLOOD SPATTER AND BLOOD DROPLET DRYING TIMES

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INTRODUCTION: Although there are several facets to bloodstain pattern interpretation, very little attention has been devoted to the rate of drying of blood droplets and how this information might identify the period of time that an individual was at the crime scene (Laber & Epstein 1983; MacDonell & Bialousz 1973).

This work examined the rate of outer ring formation as a blood droplet dries. The degree of ring formation can be related to specific periods of time.

MATERIALS AND METHODS: Freshly drawn human blood or anticoagulated whole blood at a temperature of 37° C was released from a pipette or syringe tip onto a floor tile with a smooth non-absorbent surface. The height from which the blood was dropped was 3' or greater. The blood droplets were blotted with a paper towel at various time intervals and the degree of ring formation was noted. Other droplets were tested by stepping on them with an athletic shoe at specific time intervals.

These studies were conducted within a temperature range of 60-80°F and a relative humidity between 40-89% over a 12 month period. Environmental factors were measured by an NBS calibrated thermometer and a hygrometer.

RESULTS: Drying of a blood droplet is first observed along the thin outer edge and forms a ring. It can be seen that the ring formation increases in thickness with time if the droplet is blotted or stepped on. If a person steps in blood within the first 50 seconds after the blood is shed, no ring will be formed. After the first minute to approximately 30 minutes, ring formation increases in thickness until the entire droplet has dried (Figure 1). In the first 15 minutes, temperature and humidity did not have any identifiable effect.

Studies performed in stagnant air were compared to those with sequential increases in air flow. Air flow will speed the drying rate after the first 10

minutes. This element had more influence on the drying rate than any other environmental factor observed within the limits of this study.

Comparison of drying rate (ring formation) with freshly drawn blood and ACD anticoagulated blood was identical. Therefore, coagulation or the existence of coagulopathies was irrelevant.

For smaller droplets, such as commonly observed in medium or high velocity blood spatter, the drying rate is much faster (Pex & Vaughan 1987).

DISCUSSION: Experimentation has shown the difficulties which exist in the interpretation of blood spatter that has dried prior to being stepped on. This sequence cannot always be differentiated from a dried blood print with blood spatter over the top (Figures 2 & 3). Caution should be exercised whenever evaluating blood spatter "on top" of shoeprints especially if this is attempted from photographs (Eckert & James 1989).

An alternative approach that should be considered is the drying rate of blood droplets and evaluation of shoe prints present in these droplets.

In a recent homicide investigation, the assailant's shoe prints were readily visible in the blood of the victim. Several low velocity blood droplets had been stepped on at the scene. An assessment of these droplets was necessary to determine whether the suspect was at the scene during the attack or a postmortem time interval existed previous to his arrival and discovery of the body.

In artificial environments created by modern climate control systems, very little fluctuation occurs in temperature, humidity or air flow, irrespective of changes in outdoor weather conditions. Therefore, it is possible to perform drying time/rate experiments and relate your findings to case evidence. If evidence is found at the scene as in Figure 4, an individual may be placed at the scene during the attack. The shoe prints were made immediately after the blood hit the floor. Reasonable environmental factors would have no effect upon this conclusion (MacDonell 1971).

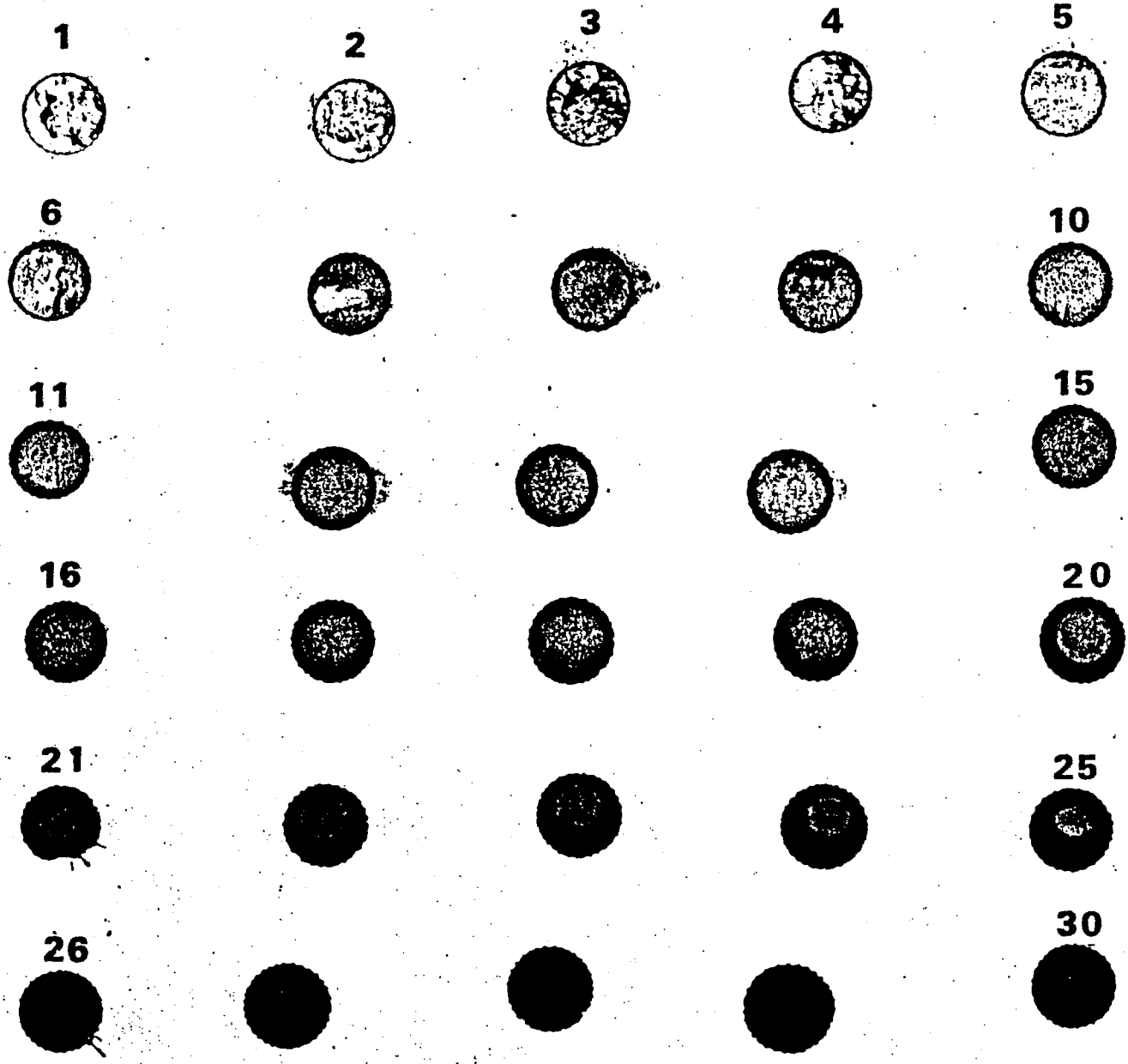

FIGURE 1

The rate of drying and ring formation for low velocity blood droplets over a period of 1 to 30 minutes. (Temp 70°F , Humidity 58% , stagnant air flow).

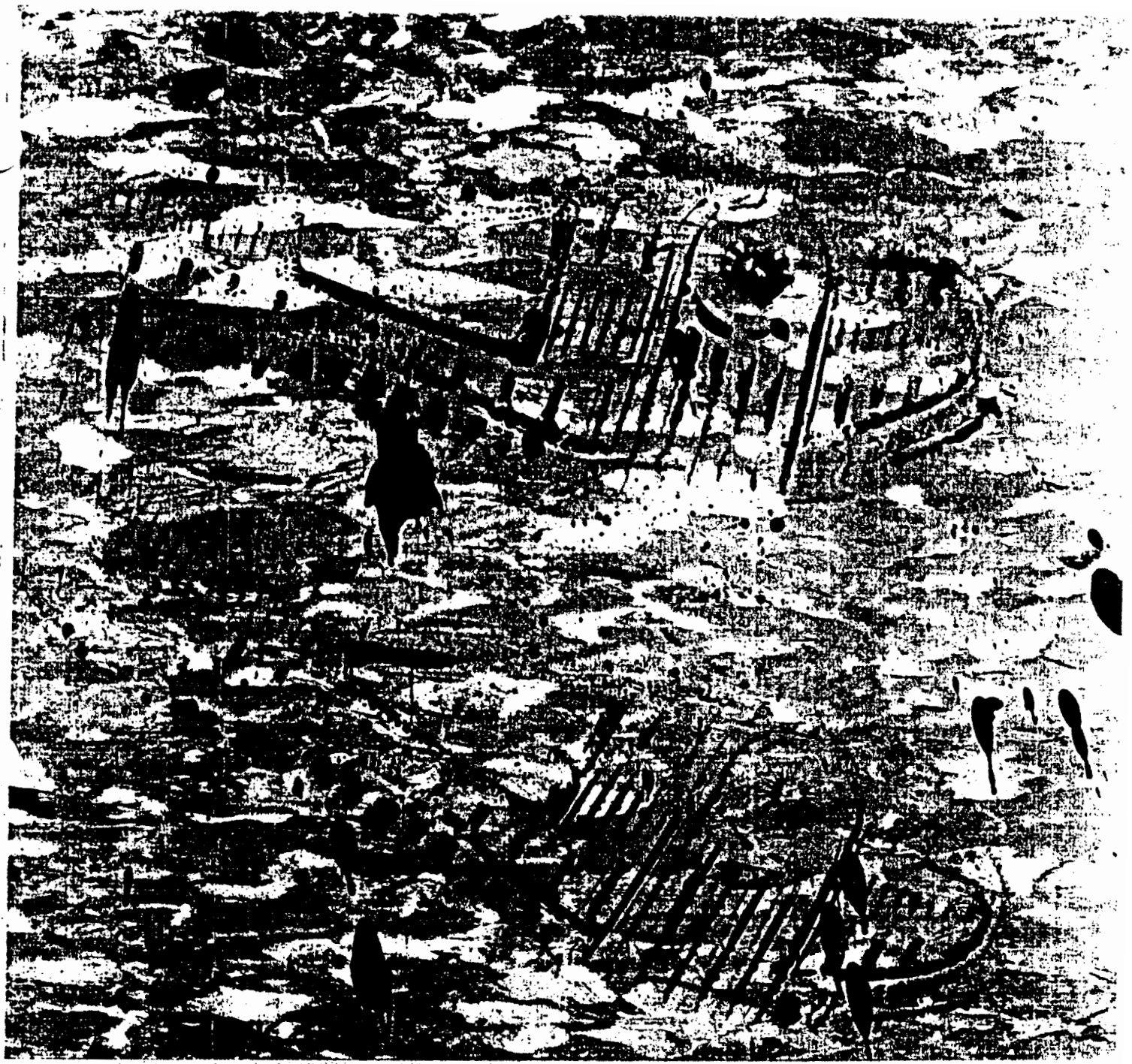

FIGURE 2

Bloody shoe prints over the top of dried blood spatter.

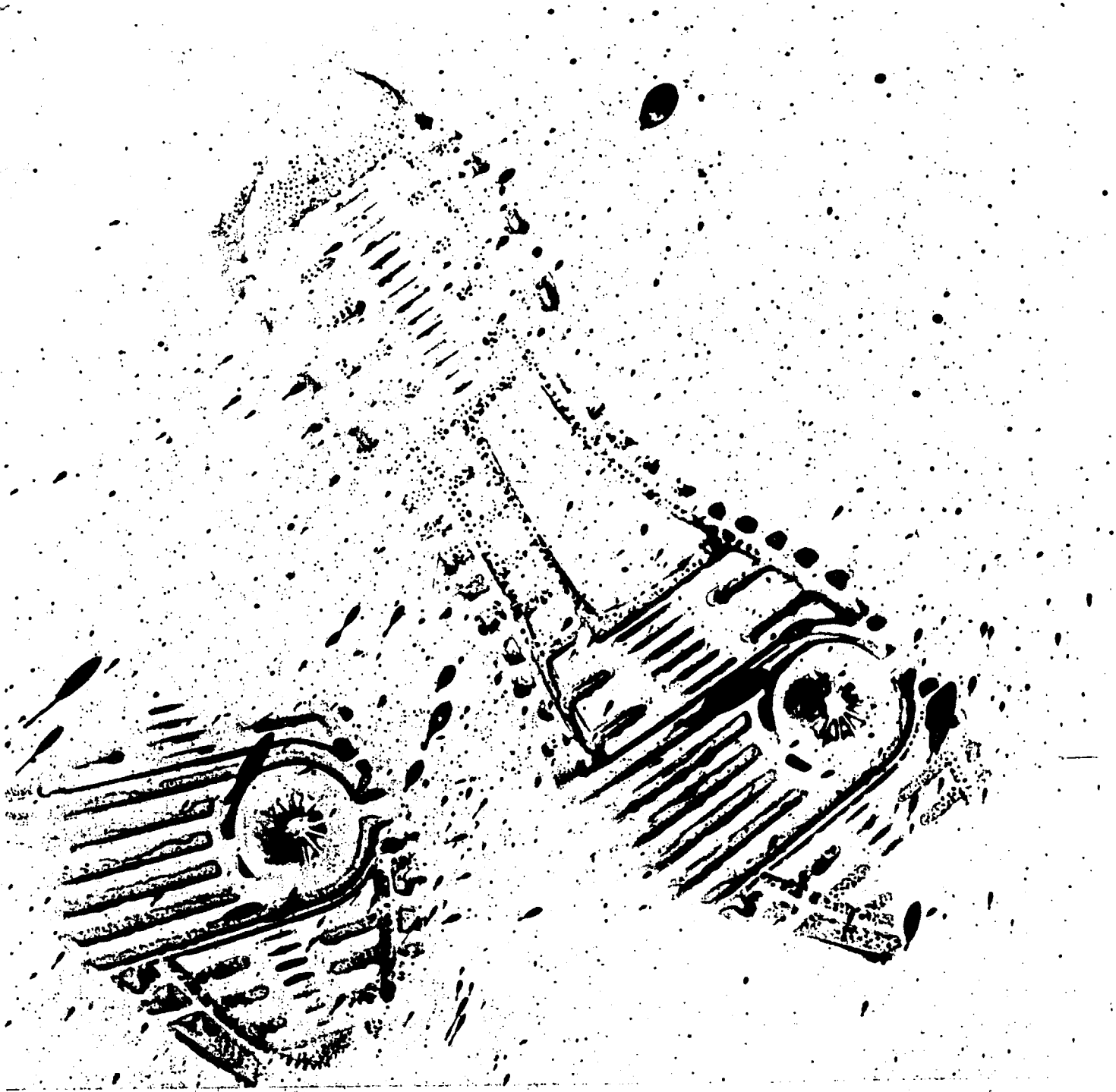

FIGURE 3

Blood spatter over the top of dried bloody shoe prints.

FIGURE 4

Photographs from crime scene showing blood droplets which have been stepped on prior to or just after start of ring formation.

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