DIAMETER OF A BLOODSTAIN AS A FUNCTION OF ORIGIN, DISTANCE FALLEN, AND VOLUME OF DROP.

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Introduction:

Many people in the field of bloodstain pattern analysis have been taught that a drop of blood is of a constant volume of 0.05 ml and that the height from which a drop of blood originiates can be calculated from its stain diameter. Research conducted in our laboratory shows that there is no standard volume that can be assigned to a free falling drop of blood. This has been confirmed by many other analysts who have attended workshops and have done experiements 1 and 2 as outlined in "Bloodstain Pattern Analysis" (1). Since blood drop volume varies considerably depending upon the object from which it falls, the height from which a blood drop originates cannot be determined from stain diameter unless you also know the drop volume, which is rarely known in actual crime scene investigations.

The realization that constant volume cannot be assigned to a drop of free falling blood is not new. In 1939, Balthazard et al. published the results of their research, "Etude des Gouttes de Sang Projete" (Study of Projected Drops of Blood) (2). Their studies indicate that any correlation between diameter of stain and height of fall must be done with drops of a constant volume. In 1971, Kinnell (3) used various tube sizes to produce drops of different volumes. In 1984, Pizzola (4) wrote a thesis "Blood Droplet Dynamics and Their Implication at Crime Scenes" which supports the variable volume of a drop of free falling blood.

Blood found at a crime scene is often the result of blood dripping from objects. These drops can occur in a variety of ways. Blood can drip from a wound, a weapon, clothing, hair, or from any other surface where sufficient blood has accumulated to form drops.

The diameter of a bloodstain will depend upon the volume of the individual blood drop, the distance the drop falls, and the surface the drop strikes on impact. The volume of a blood drop will depend upon the object from which the drop originiates. The stain diameter will increase with increases in drop volume providing other parameters are held constant.

The range in diameter of several bloodstains as a function of their source of origin is illustrated in Figure 1. All blood drops were allowed to fall from objects which were supported on a ring stand 100 cm above smooth white cardboard targets. The range in stain diameters seen in Figure 1 is due to blood drop volume variation between objects. Since all drops fell from a height of 100 cm it is clearly illustrated that the height from which a drop originates cannot be determined from its stain diameter unless the volume of the drop itself is known. This volume certainly will not be known in most crime scene investigations.

DIAMETER OF STAIN AS A FUNCTION OF ORIGIN

ALL DROPS FELL 100cm.

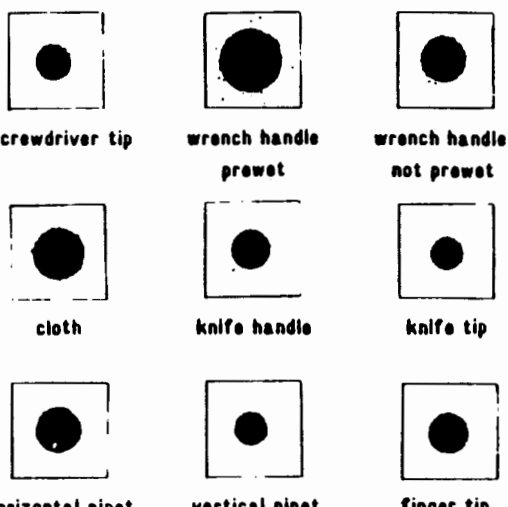

Figure 1

The volume of blood drops falling from eight different objects was determined by volumetric means. The stain diameters that resulted from blood drops falling 100 cm from each of the eight objects were also measured (Table 1). Drops of blood from a single human hair, object #1, gave drop volumes of 0.013 ml/drop and resulted in an average bloodstain diameter of 9.47 mm after falling 100 cm. Drops that resulted from blood soaking through a terry cloth sock, object #8, resulted in drops whose average volume was 0.16 ml/drop and had an average stain diameter of 24 mm.

DIAMETER OF STAIN AS A FUNCTION OF DROP VOLUME

Tests	Volume of Drop (ml)	Diameter of Stain (mm)
1	0.013	9.47
2	0.022	11.39
3	0.040	14.51
4	0.047	15.19
5	0.061	16.83
6	0.073	18.79
7	0.097	19.86
8	0.16	24.00

Table 1

The data in Table 1 clearly illustrates two things. First, there is no standard volume for a blood drop. The drop volume varies considerably depending upon the object from which the blood falls. Second, the diameter of a bloodstain will increase with increases in blood drop volume providing other parameters are held constant.

The diameter of a bloodstain as a function of distance fallen and the diameter of a bloodstain as a function of its drop volume is shown in Figure 2. This side by side comparison further illustrates the dependency of the diameter of a bloodstain on the distance the drop falls and the drop's volume.

DIAMETER OF BLOODSTAINS

AS A FUNCTION OF DISTANCE FALLEN AND DROP VOLUME

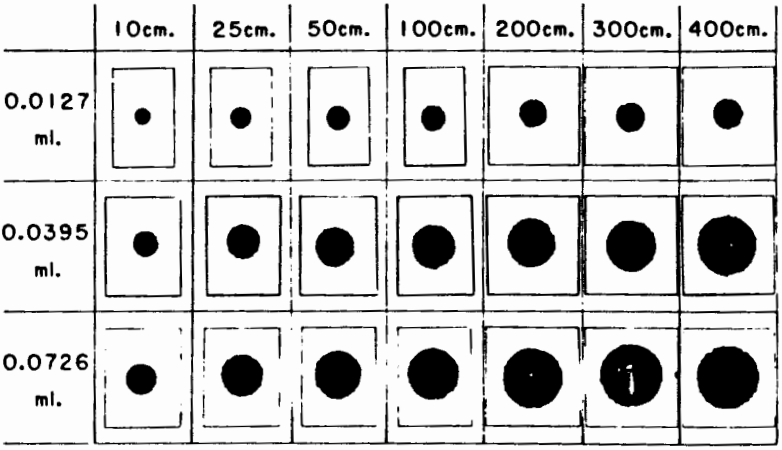

Figure 2

Conclusion: Blood drops cannot be assigned a standard or constant volume. Drop volume is a function of its source of origin and can vary from less than 0.02 ml/drop to greater than 0.1 ml/drop. At any given distance of fall, stain diameter will increase with increased drop volume, assuming defined surface characteristics. The height from which a blood drop originated cannot be determined from stain diameter unless the volume of the drop is known. Since the volume of a drop that caused a particular stain under investigation will for all practical purposes not be known, the height a blood drop originated from cannot be determined.

References

1. Laber, T. L. and Epstein, B. P. , "Bloodstain Pattern Analysis", Callen Publishing, Inc., Minneapolis, 1983.

2. Balthazard, V., Piedelievre, R., Desoille, H., and Derobert, L., "Stude des Gouttes de Sang Projete", Ann. med. legale criminol, et police sci. med. sociale et toxicol., Vol. 19, 1939, pp. 265-323.

3. Kinnell, P. I. A., "The Acoustic Measurement of Water Drop Impacts", Journal of Applied Meteorology, Vol. 11, No. 4, June 1972, pp. 691-694.

4. Pizzola, P. A., "Blood Droplet Dynamics and Their Implication for Bloodstain Pattern Interpretation at Crime Scenes", A Thesis, John Jay College of Criminal Justice of the City University of New York, 1984.