OUT on a TANGENT
with
BLOODSTAIN PATTERN INTERPRETATION

by
TOM J. GRIFFIN
Colorado Bureau of Investigation
and
JOHN W. ANDERSON
Colorado Springs Police Department

International Association of Bloodstain Pattern Analysts News, Vol 9, #1, March, 1993, pp 3-5.
Tangent

February 21, 1993

By definition, the **tangent** (tan) of an angle, in a right triangle, is the ratio of the length of the side opposite the angle to the length of the side adjacent to the angle. (See Figure 1.) The application of the tangent relationship may eliminate one of the most frustrating techniques in bloodstain pattern interpretation: the determination of the area of origin for a series of bloodstains with an apparent common source through the "stringing technique."

Although frequently effective to visually illustrate the area of convergence on a three-dimensional plane, stringing the various angles of impact for a particular pattern requires considerable time, specialized materials, talent, and patience to obtain optimum results. Through the application of this basic trigonometric method, known as the tangent, the need to string a bloodstain pattern may be eliminated.

The application of this method is similar to the function utilized to determine the angle of impact for a bloodstain, where the width is divided by the length, followed by the mathematical equation of inverse sine. This is easily accomplished through the utilization of a scientific calculator, with an inverse sine (arc sin or ASIN) function key, as seen in this example:

1. Width = 1.7 mm
2. Length = 6.5 mm
3. Width divided by length = 0.2615
4. Inv Sin (ASIN) = 15.1614 or 15° Angle of Impact

Once two or more well-developed bloodstains representative of impact spatter are identified, which display a common site of convergence, the tangent function may be employed by further utilization of the scientific

calculator. This relationship will provide the distance from the area of convergence (i.e., height from the floor, distance out from a wall, or down from a ceiling) on a three-dimensional plane. For example, if two or more drops are located on a floor, one with a width to length ratio as illustrated above, and the bloodstains intersect on the surface, at a distance of 60 cm from the site of convergence in this example, the following function can be incorporated:

1. Distance = 60 cm or ≈ approximately 23.6"
2. Tangent of 15.1614 = 0.2710
3. 0.2710 x 23.6" = 6.3949" or ≈ 6.4" away/out from the site of the convergence on the target surface.

(See Figure 2.)

Conclusion

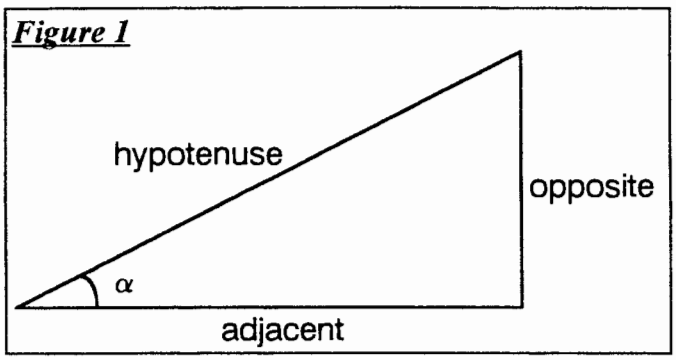
The tangent of an impact angle can be utilized by the bloodstain pattern analysts in the determination of the distance out from the convergence site to the approximate area of origin for a bloodstain. When examining a series of bloodstains with a common convergence site, an analyst can determine the distance for each bloodstain bearing in mind a linear path is presumed for the droplet instead of a parabolic arc. These distances can then be averaged for a value or be used in establishing the extremes to provide a "three-dimensional window" representing the area for the source of origin for a bloodstain pattern.

(Note: This same method has been used by one of the authors {TJG} for years to approximate straight line bullet trajectories.)

*Footnote - The authors do not intend to imply that these angles can be determined to a tenth of a degree. Rather, when carrying this value through a series of calculations and by rounding off, the final result should be more accurate.

Acknowledgement - The authors wish to express their sincere appreciation to Captain Tom Bevel, of the Oklahoma City Police Department, for his gracious review and suggestions regarding this article.

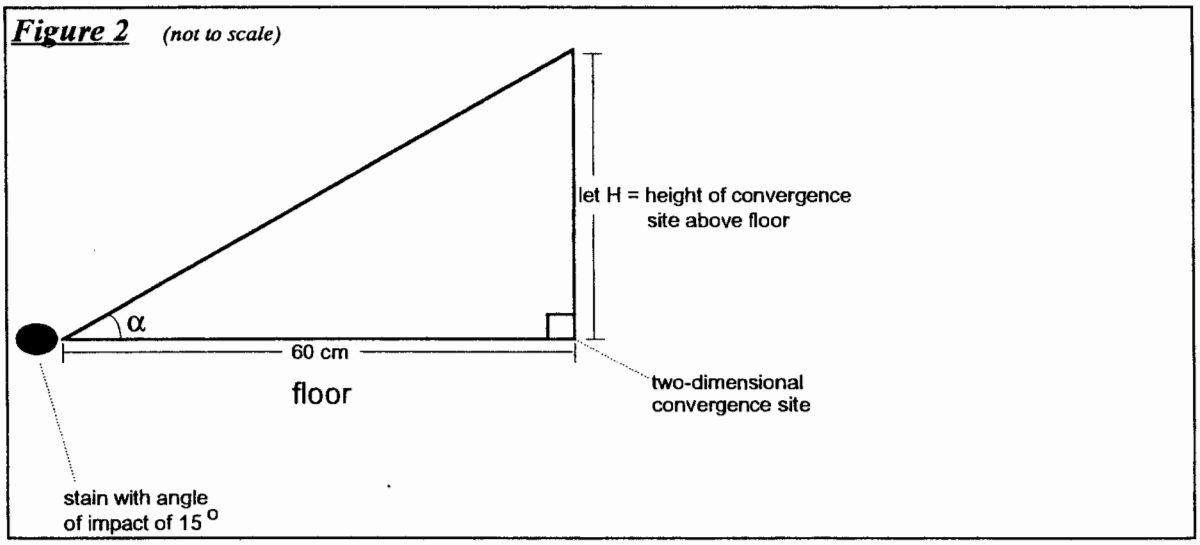
JWA/ja 03/93



By definition, the tangent (tan) of an angle in a right triangle is the ratio of the length of the side opposite the angle and the length of the side adjacent to the angle. For the angle alpha (α), in Figure 1:

$$\tan \alpha = \frac{\text{length side opposite}}{\text{length side adjacent}}$$

Figure 2 illustrates how this relationship can be useful to a bloodstain pattern analyst.



Substituting known values into the equation:

$$\tan 15.1614^{o} = \frac{H}{60 \text{ cm}}$$

Referring to either a scientific calculator or a table of trigonometric functions, the tangent of 15.1614^{o} is 0.2710. The equation now becomes:

$$0.2710 = \frac{H}{60 \text{ cm}}$$

Rearranging the equation:

$H = 0.2710 \times 60$ cm

$H = 16.2$ cm, or approximately 6" above the floor