CHAPTER- I: INTRODUCTION

Blood is a body fluid in humans and other animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products away from those same cells. In vertebrates, it is composed of blood cells suspended in blood plasma. Plasma, which constitutes 55% of blood fluid, is mostly water (92% by volume), and contains proteins, glucose, mineral ions, hormones, carbon dioxide (plasma being the main medium for excretory product transportation), and blood cells themselves Vertebrate blood is bright red when its haemoglobin is oxygenated and dark red when it is deoxygenated. Blood is circulated around the body through blood vessels by the pumping action of the heart. In animals with lungs, arterial blood carries oxygen from inhaled air to the tissues of the body, and venous blood carries carbon dioxide, a waste product of metabolism produced by cells, from the tissues to the lungs to be exhaled. [11]

Blood accounts for 7% of the human body weight, with an average density around 1060 kg/m^3, very close to pure water's density of 1000 kg/m^3. The average adult has a blood volume of roughly 5 litres (11 US pt.) or 1.3 gallons, which is composed of plasma and several kinds of cells. These blood cells (which are also called corpuscles or "formed elements") consist of erythrocytes (red blood cells, RBCs), leukocytes (white blood cells), and thrombocytes (platelets). By volume, the red blood cells constitute about 45% of whole blood, the plasma about 54.3%, and white cells about 0.7%. [12]

Blood Spatter is an important indicator at a crime scene because it usually tells an investigator what type of weapon caused the injury. High-Velocity blood spatter typically results from a gunshot wound. Medium-Velocity spatter comes from a stab wound or blow from a blunt instrument.

Much has been written regarding the shapes, sizes and appearance of bloodstains found at a crime scene. Passively falling drops of blood produce stains of a certain size depending on factors such as volume of the drop, dropping height, angle of impact and the object which the blood strikes (target surface). Substantially smaller stains are produced after enough energy is applied to the blood source to overcome the surface tension of the fluid blood. The greater the energy applied to the blood source, the smaller the blood droplets and the resulting stains. Bloodstains produced by actions such as blows are termed medium velocity impact spatter and bloodstains produced by actions such as gunshots are termed high velocity impact spatter. There is little information in the literature about stains on fabrics other than general statements that examination of ions of bloodstains on clothing can be Important in criminal investigations

Examination of bloodstains on clothing may sometimes determine factors such as whether a person was standing, sitting or lying down at the time the blood was deposited. It is also sometimes possible to determine if the bloodstains were consistent with mechanisms of production such as impact spatter, passively falling drops, cast-off stains arterial gushing, back spatter or smearing. These examinations can confirm or refute theories or witness statements. Sometimes very few stains are present on articles of clothing. An opinion of how the stains were produced may not be possible because no published information is available on how various cotton materials affect the size, shape and appearance of bloodstains. [4]

The purpose of this research was to produce bloodstains on different cotton materials commonly used in clothing and other items found at crime scenes and to observe the effect of varying the drop volumes, dropping heights and impact angles. The stains on cotton were compared with those produced on a smooth cardboard surface as a control. The size, of the smallest and largest bloodstains produced on each cotton materials using two drop volumes were determined. Any stain falling within this range would be consistent with being produced by a passively falling drop. Any smaller stain would be consistent with impact spatter and any larger stain would be consistent with being produced by some other mechanism. Attention was paid to satellite spatter which can resemble the stains produced by impact spatter as well as affecting the size of the stain produced by the parent drop. The calculated impact angle (from stain size measurements) and the actual impact angle were compared. [3]

Bloodstains are classified into three basic types: passive stains, transfer stains and projected or impact stains. Passive stains include drops, flows and pools, and typically result from gravity acting on an injured body. Transfer stains result from objects coming into contact with existing bloodstains and leaving wipes, swipes or pattern transfers behind such as a bloody shoe print or a smear from a body being dragged. Impact stains result from blood projecting through the air and are usually seen as spatter, but may also include gushes, splashes and arterial spurts. [3]

Blood spatter is categorized as impact spatter (created when a force is applied to a liquid blood source) or projection spatter (caused by arterial spurting, expiated spray or spatter cast off an object). The characteristics of blood spatter depend on the speed at which the blood leaves the body and the type of force applied to the blood source.

One of the factors influencing blood stain size is the initial blood drop volume. Passively falling blood drops do not always have the same volume but may differ depending on the object from which they fall. This is related to the surface area of the object. Once the weight of the blood drop overcomes the forces of adhesion to the object, the drop is released. A hammer head has a larger surface area than a knife tip, therefore a greater area for the blood to adhere to before the weight of the drop allows it to fall. Blood drops from a hammer resulted in larger stains than blood drops falling from a knife tip. For each fabric examined a minimum and maximum stain size has been determined which was dependent on blood drop volume, impact angle and in some cases on the dropping height. [12]

Impact angles were calculated from the average width and length measurements using the formula:

Angle of impact = Width of bloodstain / Length of bloodstain

CHAPTER- II: LITERATURE REVIEW

Prof Samir Kumar Bandyopadhyay (1990), Bloodstain Pattern Analysis on Fabric, Dr. Samir Kumar delivered one of the first comprehensive studies in the field of bloodstain pattern analysis in 1990 at the University of Vienna entitled “Concerning Origin, Shape, Direction and Distribution of Bloodstains following Blow Injuries to the Head” which stated that blood flung from a weapon would create a specific parabolic arc that would help in determining the direction in which the weapon was being moved. This research was followed by a number of other researchers world-wide, leading up to Dr. Ernest Zemke’s book chapter “The Examination of Blood Tracks” which stated the importance of bloodstained clothing.

Stephen Michaelson et.al (2017), Effect of yarn structure on wicking and its impact on bloodstain pattern analysis (BPA) on woven cotton fabrics, in this article, custom weaves were made from yarns produced by each of the three most common staple yarn production techniques to control this variable. It was found that porcine blood wicked into the fabrics made with ring spun yarn, but not into those made with open end or vortex spun yarns. The uneven wicking of blood into the different yarns resulted in elliptical-shaped stains on commercial bed sheeting that can be misleading when performing bloodstain pattern interpretation based on the stain morphology. This surprising result demonstrates that it is not sufficient to analyse the structure of the fabric, but one must also characterize the yarns from which the fabric is made. This study highlights the importance of a deeper characterization of the textile structure, even down to the yarn level, for BPA on textiles

Dicken Knock et.al (2019), Investigating bloodstain dynamics at impact on the technical rear of fabric, it was seen that there were two stages in the creation of a bloodstain on fabric; the impact dynamics, followed by wicking along the intra-yarn spaces. The increase in technical rear bloodstain area was caused by continued movement of the blood through to the rear of the fabric as the blood drop spread on the technical face. Once the impact dynamics were concluded within 8 ms of impact, there was no further change in the bloodstain for the remaining 67 ms of high speed video. Following this the blood wicked into and along the yarns, resulting in a dry technical rear bloodstain on all fabrics at all velocities.

Prashant Agrawal et.al (2017), Bloodstains on woven fabric: Simulations and experiments for quantifying the uncertainty on the impact and directional angles, The present work studies experimentally and numerically the formation of drip stains on a woven fabric. The proposed methodology first relies on Darcy's law to measure the imbibition characteristics of the fabric through a set of simple imbibition experiments. Next, the fabric properties are fed into a numerical model to predict the growth of the bloodstain after impact of a droplet. Experiments at different drop release heights and impact angles are compared with the numerical simulations. The uncertainties induced by the fabric on the determination of the impact and directional angles are explained and quantified.

Frank Crispin et.al (2016), Alternative method for determining the original drop volume of bloodstains on knit fabrics, in this topic, a drop of known volume of an appropriate artificial blood substitute is applied to a region similar to the stained region but in an area away from any stains/areas of interest. The areas of the original stain and the artificial blood substitute stain are determined, from which the original drop diameter can be calculated. Errors in the drop diameters, the Reynolds numbers and the Weber numbers resulting from this procedure are less than approximately 6%. This procedure has only been verified on cotton single jersey knit fabrics with 30 μL ≤ drop volume ≤ 80 μL.

Kenneth F. Martin et.al (2015), The use of micro computed tomography to ascertain the morphology of bloodstains on fabric, this paper explores the possibility of using a micro computed tomography (CT) scanner to study bloodstain size and shape throughout fabrics. Two different fabrics were used: 100% cotton rib knit and 100% cotton bull drill. Bloodstains were created by dropping blood droplets from three heights; 500 mm, 1000 mm and 1500 mm. Results from the CT scanner clearly showed the bloodstain shape throughout the fabric. The blood was found to form a diamond shaped stain, with the maximum cross-sectional area 0.3–0.5 mm below the surface. The bloodstain morphology depended on both the impact velocity and fabric structure.

William D. Ristenpart (2015), Quantitative bloodstain analysis: Differentiation of contact transfer patterns versus spatter patterns on fabric via microscopic inspection, in this work, they demonstrate that microscopic inspection of the stain orientations provides a quantitative differentiation of bloodstains resulting from spatter versus contact transfer. Their microscopic examination of more than 65,000 individual stained loop legs shows that spatter stains are approximately evenly distributed between left and right loop legs, but contact transfer stains are unevenly distributed. They further show that in these fabrics the left loop legs protrude further out than the right loop legs by approximately 50 μm, indicating that the observation of left loop legs preferentially stained over right loop legs is associated with the topography of the fabric. These findings suggest that microscopic quantification of the relative loop leg stain distributions could provide an objective means of differentiating contact transfer versus spatter patterns in crime scene reconstruction.

CHAPTER- III: AIM AND OBJECTIVES

AIM:

To study The Effect of Drop Volume, Dropping Height and Impact Angle of Bloodstain Patterns on different cotton materials.

OBJECTIVES:

i. To observe the size and shape of bloodstain falling from various heights and angles.
ii. To determine the dropping height and impact angle from bloodstain pattern.

CHAPTER – IV: MATERIALS AND METHODOLOGIES:

MATERIALS:

i. Blood from three donors
ii. Glass tubes
iii. Measuring magnifier (0 to 20 mm)
iv. Syringe
v. Vials

Fig 1: Measuring Magnifier

Fig 2: Glass Tube

Fig 3: Blood Vials

Fig 4: Syringe

METHODOLOGY:

Blood from three donors were drawn by venepuncture in sterile 5 mL syringe and was used within 48 hrs.

Blood was dropped vertically from glass tubes having inner diameters of 1.3 mm and 4.0 mm. The volumes of the drops were 0.034 mL and 0.091 mL respectively.

The blood was dropped onto cardboard and 6 different cotton materials clamped in Plexiglas frames inserted in an angle board.

The blood was dropped onto each target surface at impact angles of 90° ,70°,50°, 30°, and 10° from dropping heights of 5 cm, I5 cm, 30 cm, 60 cm, 120 cm and 180 cm. Between 3 and 7 drops of blood were used and measured for each experiment.

The orientation of each cotton materials was kept constant for each series of experiments. Each cotton material was pre-washed in laundry detergent and dried in a residential dryer.

The diameters and lengths of the stains were measured using a Bausch and Lomb measuring magnifier (0 to 20 mm) to the nearest 0.1 mm and the ranges and averages calculated.

A ruler was used to measure stain widths or lengths greater than 20 mm to the nearest 0.5 mm and the ranges and averages calculated.

TABLE:

Characteristics of different Clothes

END PRODUCT	THREAD ORIENTATION	THREADS/ COURSES PER 10MM	THREADS/ RIBS PER 10MM	WEAVE TYPE	YARN TYPE	FABRIC COMPOSITION
T-shirts, dresses		13	15	Weft	Spun	50% cotton/ 50 % polyester Knit
Shirts, Bedding	90°	42	52	Plain	Spun	100% Coton Light weight
Coveralls, Trousers	90°	22	46	Twill	Spun	100% Cotton (heavy)
Shirt		16	11	Weft Double Knit	Spun	100% Coton
Shirts, Bedding, Blouses	90°	37	26	Plain	Spun	50% cotton/ 50% polyester

CHAPTER- V: OBSERVATIONS

a) Cotton:

The stains produced were characterized by an irregular shape. There were stain size range overlaps among the various dropping heights at all angles. As the dropping heights increased there was often a decrease in bloodstain widths and lengths as compared with the next one or two higher heights. Using the larger blood volume at 90° from 180 cm produced relatively large circular satellite spatters up to 7.5 cm from the parent drop stain. The lengths of some stains at 30° were not measurable because the blood had "run" down the surface. The calculated angles were all within 14° of the actual angles of impact except using the 0.034 mL blood drop at 10°, where differences as great as 19° were noted. The larger blood drop striking the target fabric at 70° from 60 cm resulted in stains which had widths greater than their lengths making it appear as if the blood had struck the cotton materials at right angles to the actual direction of travel.

b) Heavy cotton:

In many instances as the dropping heights increased the stain sizes decreased. Overlap in the stain size ranges was also noted among the various dropping heights at all angles. Stains produced at 5 cm and 15 cm by the larger drop at 90° resulted in oval shaped stains leading to calculated angles of as little as 43°. At impact angles of 70° and 50° there was up to a 27° difference with the calculated angles. The calculated angles were within 9° of the actual impact angles at 30° and 10°.

c) Cotton knit - double layer:

The bloodstains produced at 90°, many of the stains produced at 70° and one stain produced at 50° showed stain widths greater than their lengths. There was a decrease in stain size at higher dropping heights as some of the blood penetrated and passed through the cotton material. Stains produced using the 0.091 mL blood volume at 50° from 5 cm were larger than the stains produced from the 180 cm dropping height. The bloodstain lengths produced using the smaller blood drop volume at 30° from a dropping height of 15 cm were not measurable because of the long "tails" which were formed. At 10° and 30° the calculated angles were within 9° of the actual impact angles using the 0.034 mL blood drop volume, and within 5° using the 0.091 mL blood drop volume.

d) Cotton polyester:

Large, irregular shaped stains were produced on this fabric as a result of a high degree of diffusion along the fibres. Great stain size overlap was noted with some of the stains produced from the 5 cm dropping height being almost as large as the stains produced from 180 cm. Some of the stain lengths were not measurable because of the formation of large satellite spatter stains. The stains produced at the 70° impact angle had stain widths greater than their lengths except for stains produced using the larger blood drop volume from dropping heights of 15 cm and 120 cm. The calculated angles of stains produced at the 50°, 30° and 10° impact angles using the larger volume were all within 13° of the actual impact angles, except for one stain produced at 50° from a dropping height of 60 cm which had a calculated angle of 71°.

e) Cotton polyester knit:

Great stain size overlap occurred at each angle because the stain sizes decreased as the dropping height increased. Some stains at the lower dropping heights were not measurable as satellite spatter stains almost as large as the parent drop stain were produced. The calculated angles were within 7° of the actual impact angles at 10° and 30°. The differences were within 16° at the 50° impact angle and showed up to a 27° difference at the 70° impact angle. The stains produced using the larger blood drop volume at 90° from dropping heights of 120 cm and 180 cm produced stains with calculated angles of 58° and 48° respectively.

TABLE 2(a)

SIZE OF BLOODSTAINS AS A FUNCTION OF ANGLE, DROPPING HEIGHT AND DROP VOLUME ON COTTON.

ANGLE	DROPPING HEIGHT (CM)	DROPPING VOLUME			
		0.034ml		0.091ml	
		Average Width (mm)	Average Length (mm)	Average Width (mm)	Average Length (MM)
90°	5	15.0	15.3	20.9	26.2
	15	14.9	15.8	18.8	28.3
	30	14.1	15.8	20.2	25.5
	60	14.4	15.9	20.0	23.2
	120	14.2	13.9	19.2	23.0
	180	14.3	14.5	20.6	21.5
70°	5	14.4	15.3	23.7	24.8
	15	13.7	15.8	23.5	23.7
	30	13.9	15.8	23.5	24.2
	60	14.1	15.9	23.0	22.7
	120	13.6	13.9	17.9	18.9
	180	14.2	14.5	18.1	18.8
50°	5	11.9	16.7	20.2	26.2
	15	10.9	17.3	18.4	28.3
	30	12.9	14.8	19.7	25.5
	60	12.3	14.2	20.5	23.2
	120	12.9	14.8	17.5	23.0
	180	13.5	15.0	19.4	21.5
30°	5	9.0	17.8	12.6	45.6
	15	9.0	18.6	15.7	40.6
	30	9.4	14.5	14.9	33.4
	60	10.2	16.8	16.9	30.7
	120	11.5	17.6	15.8	24.8
	180	10.6	15.4	15.8	27.0
10°	5	6.5	17.9	10.5	39.2
	15	7.7	25.1	11.3	48.5
	30	8.3	17.1	12.6	53.3
	60	8.4	17.9	14.1	59.5
	120	8.6	22.8	11.3	53.5
	180	8.2	24.8	12.5	50.0

TABLE 2(b)

SIZE OF BLOODSTAINS AS A FUNCTION OF ANGLE, DROPPING HEIGHT AND DROP VOLUME ON HEAVY COTTON.

ANGLE	DROPPING HEIGHT (cm)	DROPPING VOLUMES			
		0.034ml		0.091ml	
		Average Width(mm)	Average Length (mm)	Average Width (mm)	Average Length (mm)
90°	5	10.3	10.0	14.3	17.8
	15	10.4	10.9	16.2	17.6
	30	10.9	11.5	18.2	17.5
	60	11.3	11.2	16.8	16.4
	120	11.6	10.6	18.3	16.7
	180	11.7	11.6	17.6	16.3
70°	5	10.0	14.6	17.8	22.8
	15	10.9	14.5	17.6	22.7
	30	11.5	13.7	17.5	21.6
	60	11.2	12.5	16.4	20.5
	120	10.6	11.3	16.7	18.7
	180	11.6	12.0	16.3	18.8
50°	5	10.3	12.7	17.0	22.0
	15	9.9	13.3	17.9	21.8
	30	10.6	11.2	17.9	21.2
	60	10.1	12.0	15.9	19.6
	120	10.1	12.3	17.1	20.3
	180	10.3	12.4	16.2	20.8
30°	5	6.0	12.8	9.1	21.5
	15	7.4	17.3	12.1	26.5
	30	8.5	16.7	13.4	24.5
	60	9.4	16.1	14.9	23.8
	120	10.2	17.5	16.0	27.8
	180	10.4	16.9	15.5	27.8
10°	5	4.6	18.8	7.2	35.8
	15	5.4	23.9	8.3	38.8
	30	6.2	30.8	10.1	43.3
	60	7.0	25.4	11.6	49.6
	120	7.6	31.8	12.1	53.0
	180	8.3	28.6	13.0	47.0

TABLE 2(c)

SIZE OF BLOODSTAINS AS A FUNCTION OF ANGLE, DROPPING HEIGHT AND DROP VOLUME ON COTTON KNIT

ANGLE	DROPPING HEIGHT (cm)	DROPPING VOLUMES			
		0.034 ml		0.091 ml	
		Average Width (mm)	Average Length (mm)	Average Width(mm)	Average Length (mm)
90°	5	16.7	13.9	28.8	25.0
	15	16.3	13.8	27.5	26.0
	30	15.7	12.9	28.8	24.3
	60	15.3	12.9	23.3	21.3
	120	14.5	12.8	23.8	21.5
	180	15.2	11.8	24.2	22.3
70°	5	15.4	12.6	20.4	25.8
	15	15.3	12.4	19.5	23.0
	30	15.4	13.0	20.9	23.3
	60	15.0	13.7	19.4	22.0
	120	14.4	14.2	19.4	17.9
	180	14.2	14.2	20.5	19.5
50°	5	13.6	13.3	21.8	24.7
	15	14.5	15.1	22.2	24.7
	30	13.8	14.1	21.3	25.3
	60	11.4	13.5	19.8	24.3
	120	14.1	17.1	17.3	24.5
	180	12.7	14.7	16.0	23.3
30°	5	7.8	12.6	12.8	24.3
	15	8.6	13.6	16.2	31.4
	30	10.0	21.6	17.0	32.7
	60	10.1	21.6	15.5	27.0
	120	13.6	23.6	15.0	30.5
	180	12.9	22.0	14.4	28.3
10°	5	6.5	1937	11.8	54.5
	15	7.2	25.9	12.3	56.5
	30	7.9	33.5	11.4	58.0
	60	8.5	35.8	13.9	60.0
	120	8.6	40.8	11.2	54.8
	180	11.0	39.4	13.2	63.3

TABLE 2(d)

SIZE OF BLOODSTAINS AS A FUNCTION OF ANGLE, DROPPING HEIGHT AND DROP VOLUME ON COTTON POLYESTER.

ANGLE	DROPPING HEIGHT (CM)	DROPPING VOLUMES			
		0.034ml		0.091ml	
		Average Width (mm)	Average Length (mm)	Average Width(mm)	Average Length (mm)
90°	5	17.9	17.5	20.6	21.8
	15	18.0	17.9	22.3	24.7
	30	20.2	19.7	23.5	26.5
	60	21.7	21.0	26.8	31.0
	120	24.2	20.1	22.8	22.3
	180	23.3	20.3	25.7	22.2
70°	5	20.7	17.5	21.8	20.5
	15	20.9	17.9	24.7	25.3
	30	22.0	19.7	26.5	25.7
	60	24.8	21.0	31.0	23.7
	120	21.2	20.1	22.3	24.8
	180	23.2	20.3	22.2	20.7
50°	5	21.0	21.4	22.5	22.6
	15	22.3	20.3	23.0	31.4
	30	22.2	23.4	24.3	23.0
	60	22.8	23.0	28.4	27.3
	120	20.9	22.8	23.2	27.3
	180	22.8	23.1	22.8	27.3
30°	5	15.4	20.5	17.4	23.9
	15	16.7	22.6	20.7	25.6
	30	18.4	25.8	20.2	38.8
	60	20.4	29.5	23.7	41.8
	120	19.0	27.0	21.5	33.8
	180	20.4	25.8	23.8	31.8
10°	5	12.3	23.8	19.9	54.8
	15	15.2	29.2	20.5	61.5
	30	14.8	23.4	20.4	62.5
	60	14.9	37.1	21.5	67.6
	120	15.7	36.9	18.7	56.8
	180	15.9	40.5	17.5	65.2

TABLE 2(e)

SIZE OF BLOODSTAINS AS A FUNCTION OF ANGLE, DROPPING HEIGHT AND DROP VOLUME ON COTTON POLYESTER KNIT.

ANGLE	DROPPING HEIGHT (CM)	DROPPING VOLUMES			
		0.034ml		0.091ml	
		Average Width(mm)	Average Length(mm)	Average Width(mm)	Average Length(mm)
90°	5	9.5	10.1	15.4	8.4
	15	10.0	10.2	15.7	8.3
	30	8.6	10.2	16.1	7.3
	60	9.6	10.4	15.5	7.7
	120	7.4	12.4	13.7	8.1
	180	8.0	11.8	12.5	7.6
70°	5	8.0	10.2	13.8	16.9
	15	8.1	10.1	14.7	16.5
	30	8.3	10.6	13.8	17.6
	60	7.9	10.2	12.6	18.1
	120	7.6	11.1	13.5	15.1
	180	8.3	11.2	14.0	16.5
50°	5	8.4	10.1	5.6	12.5
	15	8.3	10.2	10.5	14.5
	30	7.3	10.2	14.1	19.7
	60	7.7	10.4	13.9	20.0
	120	8.1	12.4	10.4	18.0
	180	7.6	11.8	10.9	19.4
30°	5	2.1	4.5	6.5	11.5
	15	4.1	6.8	9.1	15.5
	30	5.0	11.1	10.4	18.3
	60	6.6	12.3	11.2	21.1
	120	6.4	12.7	8.8	21.0
	180	6.6	12.9	9.3	20.8
10°	5	3.9	16.5	7.4	47.5
	15	4.0	19.3	9.4	47.5
	30	4.1	14.7	7.4	33.0
	60	4.7	17.1	8.4	32.3
	120	6.1	20.8	10.5	44.8
	180	6.4	23.3	10.3	40.8

Fig 4: A 23 mm diameter bloodstain produced on cotton knit from a dropping height of 5 cm (0.091 mL

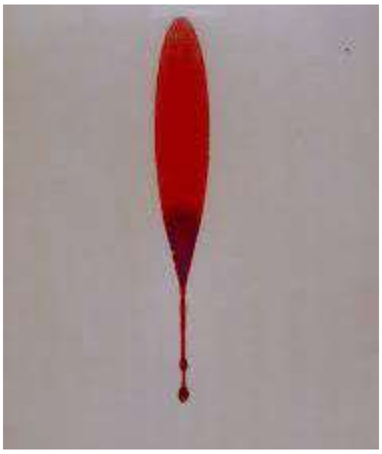

Fig 5: Long, wide "tails" were produced on cotton polyester (0.091 mL - 10° - 5 cm)

Fig 6: Satellite spatter stains produced on cotton of nearly circular in appearance (0.091 mL - 90° - 180 cm).

Fig 7: A 15.7 mm diameter bloodstain produced on heavy cotton from a dropping height of 180 cm (0.091 mL at 50°)

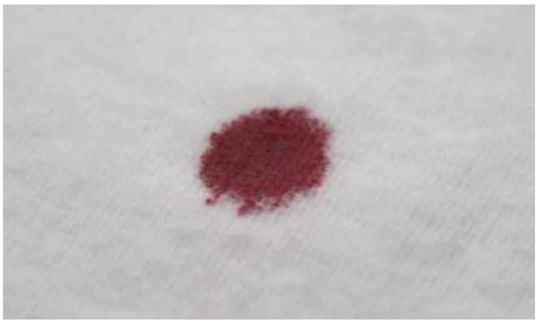

Fig 8: Irregular shape of a bloodstain produced on cotton (0.034 mL - 50° 60 cm)

CHAPTER- VI: RESULT AND CONCLUSION

RESULT:

Glass tubes of inner diameters of 1.3 mm and 4.0 mm were chosen to deliver blood drops which produced stains of a size similar to those produced by various items which can be found at crime scenes such as knives, hammers or wrenches. Table given shows the stain diameters resulting from blood dropping from various items onto cardboard from a height of 1 m. Blood from 3 donors were drawn and dropped from a pipette onto a plexi-glass surface from a height of 1m. The average bloodstain diameter produced was 16.0 mm. The largest stain produced was 6.3 mm in diameter and the smallest was 49.5 mm in diameter. There were no measurable differences between male and female donors. The three blood donors chosen for these experiments produced bloodstains of between 15.8 and 16.0 mm in diameter in average. Blood drops were allowed to passively fall from the glass tubes onto the cardboard (control surface) or the various cotton materials. The stain dimensions were measured. An indication of the dropping height can sometimes be determined if "runs" or "trails" of blood are present. These are usually only formed at very low dropping heights (and low angles). There was also an increasing amount of satellite spatter from higher dropping heights. Impact angles were calculated from the average width and length measurements using the formula sine width of bloodstain.

CONCLUSION:

From the present study it has been concluded that determination of the average length and width of bloodstain at different angle and different lengths on different cotton materials. This study will be useful in finding the effect of drop volume, dropping height and impact angle of bloodstain on different cotton materials. These experiments should be conducted using a number of appropriate blood drop volumes, which would be dependent on the history of the case. The information gained from the experiments may determine whether an opinion on such aspects as the mechanism of production of the bloodstains, the position of the fabric when the blood was deposited and the dropping height can be expressed. Further studies are needed in the area of the interpretation of bloodstain patterns on cotton materials.

CHAPTER- VII: REFERENCES

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