



ZAPOROZHIAL STATE MEDICAL UNIVERSITY

THE DEPARTMENT OF PATHOLOGICAL ANATOMY and FORENSIC  
MEDICINE

FORENSIC MEDICAL EXAMINATION MATERIAL EVIDENCE

*lecture of the Ass. Prof. Tumanskaya L.M.*

# **MATERIAL EVIDENCE**

**Objects which are served as crime instruments or are saved on itself tracks of crime or were the objects of criminal acts of accused are material evidences.**

**They are explored by medico-legal experts, forensic chemists and specialist in crime detection.**

# MATERIAL EVIDENCE

Axe, rolling-pin, knives, screw-driver, scissors, iron, revolver





# MATERIAL EVIDENCE

Electrical cable, rope, penknife, billiards ball with blood stains, bullets



# **MATERIAL EVIDENCE**

**Cloth with tear and blood stains , coat with blood stains**

# **MATERIAL EVIDENCE**

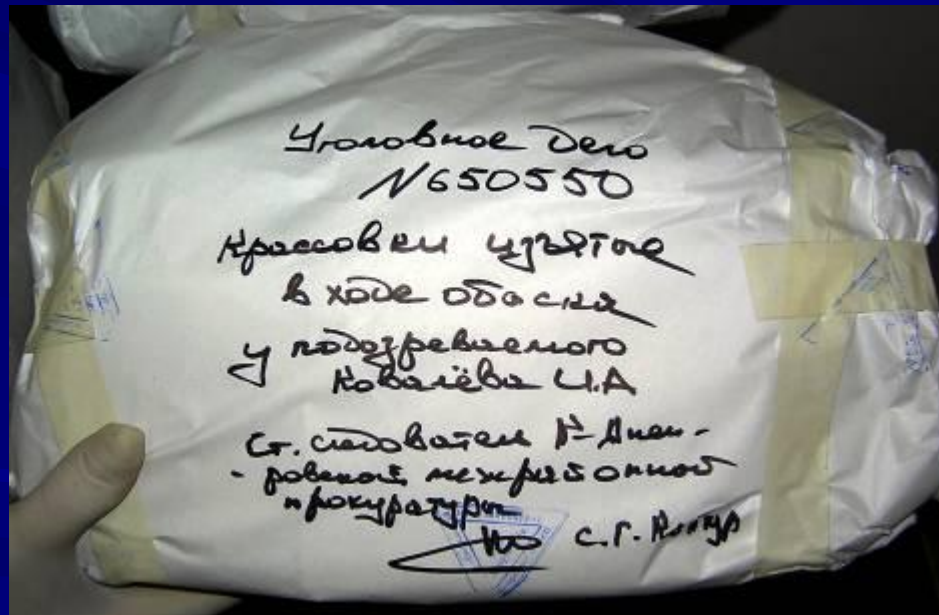
**Sketch of knife, fragment of skin with wounds, skull with the fracture**

# FORENSIC-MEDICAL EXAMINATION OF THE MATERIAL EVIDENCES

There are performed by specialists having general forensic-medical education and the special training in area of research of material evidences.

**There are 3 stages in research of material evidences :**

**1 stage. Discovery, withdrawal, packing and sending.**



**2 stages. Research of material evidences in laboratories.**

**3 stages. Interpretation of the results.**

# **FORENSIC-MEDICAL EXAMINATION OF THE MATERIAL EVIDENCES IN A FORENSIC-MEDICAL IMMUNOLOGICAL LABORATORY**

**Forensic Immunological Examinations are carried out to establish presence, kind and group-belonging of objects of biological origin.**



# **FORENSIC-MEDICAL EXAMINATION OF THE MATERIAL EVIDENCES IN A FORENSIC-MEDICAL CRIMINALISTICS LABORATORY**

**Medico-Criminalistic Examinations are carried out to establish the instruments of the trauma, their differentiation and identification, personal identification, definition of the nature and element structure of microobjects, traces, reconstruction of the situation in which damages were caused.**

# **FORENSIC-MEDICAL EXAMINATION OF BLOOD IN A FORENSIC-MEDICAL TOXICOLOGICAL LABORATORY**

**Forensic Toxicological Examinations are carried out to reveal and determine chemical substances in objects of biological origin and other proofs.**

**The objects are taken by a medico-legal expert at autopsy and at examination of victim can be sent in a laboratory: pull out hairs with bulbs, cut off nails**

**The objects taken by a medico-legal expert at autopsy and at examination of victim can be sent in a laboratory: blood, bile**



# **INVESTIGATION OF THE SCENE OF CRIME (BLOOD STAINS ON THE FLOOR AND WALL)**

# BLOOD AS TRACE EVIDENCE

Sometimes, something contaminated with other materials come to tremendous help in medico-legal and other forensic investigations.

For example, when a weapon is found stained with blood of the victim of assault, then it becomes very much reasonable to suspect that, that particular weapon might have been used to injure the victim.

Blood of the victim on the weapon here acts as trace evidence to link the weapon with the assault on the basis of which further investigation proceeds.

Blood itself is a very important entity in medico-legal practices, which alone or along with other trace evidence play key role to unfold different criminal problems

# MEDICO-LEGAL QUESTIONS

- 1.** Whether the stain is due to blood or some other material?
  
- 2.** If it is due to blood, then whether it is of human origin or it belongs to some other animal?
  
- 3.** What is the source of the bleeding.
  - a)** Is it from arterial or venous source?
  - b)** Does it belong to the victim or the accused?
  - c)** Is it from an injury or due to haemoptysis, menstruation or miscarriage?

# MEDICO-LEGAL QUESTIONS

**4. What is the sex of the person?**

**5. What is the group of blood?**

**6. Is it blood of the adult person or newborn child?**



**All blood stains should be sent to the Forensic-medical immunology laboratory.**

**The stained article is allowed to dry at room temperature.**

**Extra heat should not be used as this will cause deterioration of the stain.**

**If the stained clothes are not dried, putrefaction sets in and it becomes difficult or impossible to know whether the blood is of human or animal origin.**

# **COLLECTION OF BLOOD STAINS**

- 1. A clean piece of white filter paper may be used, allowing blood to soak into it, then drying it at room temperature.**
- 2. If the object is porous, a portion of unstained area should also be taken if this is practical.**
- 3. If the object is non-porous and particularly if it is metallic, stains can be removed by scraping and placed in small glass containers.**
- 4. Stains on clothing may be scraped off or a fragment of the material cut.**

# **COLLECTION OF BLOOD STAINS**

Taking of blood on gauze, example of clean gauze

# EXAMINATION OF BLOOD STAINS

## STAINS OF CLOTHING

In the case of clothing, **type** of garment, its **colour** and **consistence** should be noted and if the garment is torn, the **position of the tears** should be noted.

Both the outer and inner surfaces of the garments should be examined.



# **EXAMINATION OF BLOOD STAINS**

## **STAINS OF CLOTHING**

**The position of all stains should be given correctly by a description of the stain in its relation to the manner in which a garment is usually worn, e.g., a stain on the trousers should be described as being above, behind, or to the outer side of the knee.**

**Stains may also be described in relation to the pockets, the buttons or the seams of a garment.**

# EXAMINATION OF BLOOD STAINS

## STAINS OF CLOTHING

The **size** and the **shape** of the stain should be noted.

If the stain is in the form of a smear, its **general direction** should be noted.

**Blood stains are extremely resistant to washing by water.**

**Dried blood on a dead body or article is very resistant for quite a long time even though the body has been totally submerged.**

# EXAMINATION OF BLOOD STAINS

## I. General examination:

- Scene of the crime.
- Part of the body from which stain is derived.
- Age of Blood Stains.
- Sex and Age of Person.
- Living or Dead Body.
- Source of Blood.

## II. Chemical examination:

- Phenolphthalein Test
- Ortho-tolidine Test.

# **EXAMINATION OF BLOOD STAINS**

## **III. Microscopical and microchemical examination:**

- **Red Corpuscles.**
- **Haemin Crystal Test (Teichmann's Test).**
- **Haemochromogen Crystal Test (Takayama Test).**

## **IV. Spectroscopic examination**

## **V. Serological examination**



# **GENERAL EXAMINATION OF BLOOD STAINS**

## **Scene of the crime:**

- 1. When much blood is present it suggests serious injury during life, but if a large vessel is cut, bleeding can occur after death.**
- 2. The collection of a pool of blood near the body during life indicates that the deceased fell unconscious and remained immobile after the injury.**
- 3. A trail of blood stains will indicate that the victim was wounded at some distance from the place at which the body is found.**

# **GENERAL EXAMINATION OF BLOOD STAINS**

## **Scene of the crime:**

- 4. It can happen when the victim is attacked while running or in case of suicide.**
- 5. Blood coming from the arteries of a living person will be scattered in fine spray over the surface upon which it has fallen.**
- 6. Venous bleeding is a slow steady flow, causing a pool if the victim is at rest, and separate widely spaced drops, if the victim walks about.**

# GENERAL EXAMINATION OF BLOOD STAINS

## Scene of the crime:

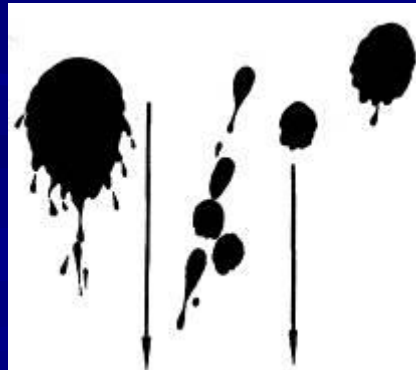
The direction of the fall of blood on to a surface may be recognized:

- if it drops **vertically** on to flat surface, the stains are **circular**.
- If the height does not exceed a few cm, the drop appears as **a round spot**.
- If it has travelled **thirty cm. or more**, it shows prickly edges, the projections growing finer and larger in number with the increase in length.

# GENERAL EXAMINATION OF BLOOD STAINS

## Scene of the crime:

- When the height is still greater ray-like splashes break out from the drop, and may be seen up to a distance of **twenty cm**.
- Splashes of blood striking a surface obliquely may appear like spears or exclamation marks;
- the pointed end indicates the direction of the motion.
- When blood falls upon porous articles or clothing, such as linen or cotton, it is absorbed and spreads.
- Smears caused by fingers or palms are helpful in identification.



# GENERAL EXAMINATION OF BLOOD STAINS

Part of the body from which stain is derived:

**Menstrual blood** is usually found on female garments, diapers or pieces of cloth.

It is dark and fluid, has a disagreeable smell and the reaction is acid.

On microscopic examination it shows endometrial and vaginal epithelial cells and number of microorganisms. It contains fibrinolysins.

If the blood is from the **nose**, mucus and hair from the nose may be found.

# GENERAL EXAMINATION OF BLOOD STAINS

Part of the body from which stain is derived:

- **Vomited blood** is of chocolate colour and acid in reaction due to the action of gastric juice.
- Blood due to **haemoptysis** is bright-red and frothy, with alkaline reaction.
- In blood due to **rape**, semen and pubic hair may be found.
- Blood stains due to the **boils and sores** show a smeared appearance without definite drops of blood, and may contain pus cells and bacteria.



# **MICROSCOPIC AND SPECTROSCOPIC EXAMINATION OF BLOOD**

## **MICROSCOPICAL EXAMINATION**

**Red Corpuscles:** Intact red cells are seen only when the stains are fresh, or when a fragment of clot is available.

The red cells become unrecognizable when dried.

**Red blood cells are circular, biconcave, non-nucleated discs in all mammals except camels.**

In camels they are oval and biconvex but non-nucleated.

In birds, fishes, amphibian and reptiles they are oval, biconvex and nucleated.

# **MICROSCOPIC AND SPECTROSCOPIC EXAMINATION OF BLOOD**

## **SPECTROSCOPIC EXAMINATION**

**It is the most delicate and reliable test for detecting the presence of blood in both recent and old stains.**

**The blood stain is dissolved in water, normal saline, or dilute ammonia, and is placed in a small glass test tube, which is then put between the spectroscope and the source of the light.**

# **MICROSCOPIC AND SPECTROSCOPIC EXAMINATION OF BLOOD**

## **SPECTROSCOPIC EXAMINATION**

**The extract of the blood must be dilute and if turbid it should be filtered.**

**The solution of the blood has the property of absorbing some of the rays from the spectrum, producing characteristic dark absorption bands, which vary with the type of the blood pigment present.**

# **SPECTROSCOPIC EXAMINATION**

Oxyhaemoglobin

Reduced haemoglobin

Carbon monoxide haemoglobin

Methaemoglobin

Alcaline haematin

Haemochromogen

Haematoporphyrin

# **SEROLOGICAL EXAMINATION**

## **1. Precipitin Test:**

**Blood serum contains protein in colloidal suspension, and when human serum is injected into an animal, the animal becomes immunized against these proteins, and antibodies develop in its blood.**

**If human serum is then brought into contact with this animal serum, the antibodies in the animal serum react with the proteins in the human serum, and a visible precipitate forms.**

# SEROLOGICAL EXAMINATION

## 1. Precipitin Test:

The antibodies causing this reaction are known as **precipitins**, and the animal serum is known as an **anti-human precipitin serum**.

A rabbit or a fowl is injected with human blood every third day for 3-5 injections. After this the animal is killed, and the antiserum is collected.

A suitable antiserum should react immediately or within a minute on the 1:1,000 dilution.



# THE BLOOD GROUPS and TYPES SYSTEMS

The blood group systems in use are:

## 1) Red cell antigens:

- The ABO System:

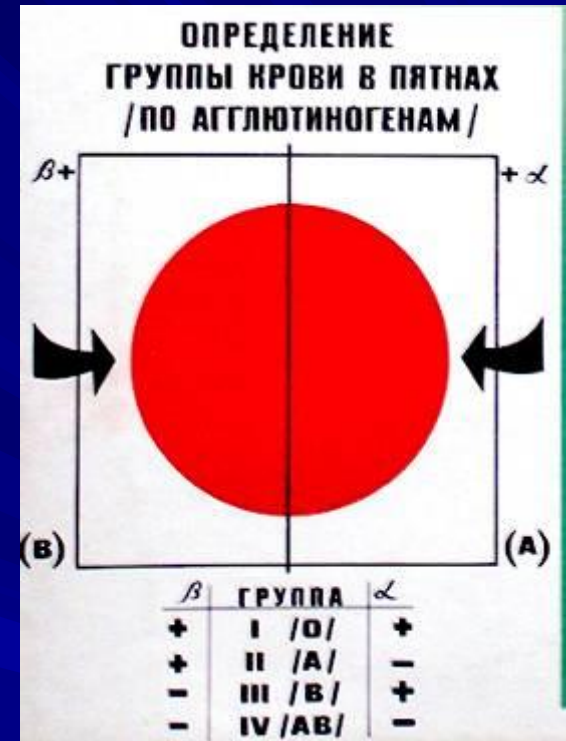
1 group - O ( $\alpha \beta$ )

2 group - A ( $\beta$ )

3 group - B ( $\alpha$ )

4 group - AB (0).

- The Systems: M, N, MN, Ss, P, Rh (C,c,D,d,E,e), Ii, Kell, Kidd, Duffy, Lutheran, Lewis, Xg System



## 2) White cell antigens HLA.

# **THE BLOOD GROUPS and TYPES SYSTEMS**

**The blood group systems in use are:**

## **3) Serum protein polymorphism.**

- Serum Haptoglobins**
- Gc Groups**
- Ag Groups**
- Gm Blood Serum Polymorphism**
- Km System**

## **4) Red cell enzyme polymorphisms:**

- red cell acid phosphatase (EAP),**
- serum cholinesterase (SCE),**
- 6-phospho-gluconate dehydrogenase (G-6PD).**

# RED CELL ANTIGENS

## The ABO System:

Human blood may be divided into four distinct blood groups, A, B, AB and O, depending upon the presence in the red cells of two agglutinogens which are designated by the letters A and B.

The A, B and O, characters are inherited by means of three allelomorphic genes, every individual having two chromosomes each carrying A, B or O, one from each parent.

Thus the possible genotypes are AA, AO, BB, BO, AB, and OO.

Group A type may thus be AA or AO.

# RED CELL ANTIGENS

A and B are both "dominant" to O, and O is "recessive" to A and B, whereas A and B are equally dominant.

AA, the homozygote, cannot be serologically differentiated from AO, the heterozygote, and the same occurs with the genotypes, BB and BO, the serologically demonstrable blood groups (phenotype) in each case being A and B.

*Blood grouping*

Pheno type	Possible genotypes	Antigen on blood cells	Antibody in serum	Compatible Donor groups	Incompatible Donor
A	AA, AO	A	Anti-B	A, O	B, AB
B	BB, BO	B	Anti-A	B, O	A, AB
AB	AB	both A and B	neither anti-body	A, B, AB, O	none
O	O	neither A nor B	Anti-A Anti-B	O	AB, A, B

# RED CELL ANTIGENS

The other phenotypes are **AB** and **O**.

**A** has two subgroups **A1** and **A2**.

These are also found in group **AB** giving rise to subgroups **A1B** and **A2B**.

Subgroups **A3**, **A4** and **A5** are weak and very rare.

**Anti-A** or  $\alpha$  and **Anti-B** or  $\beta$  agglutinins are normally developed in the serum against whichever agglutinogens are absent from the red blood cells.

There is no positive method of identifying the 'silent' gene **O**.

# RED CELL ANTIGENS

## The MNSs System:

Two further agglutinogens **M** and **N**, which are quite distinct and independent of the agglutinogens **A** and **B**, occur in human blood.

The **M** and **N** factors are inherited as Mendelian dominants. They are present at birth. They form three groups, **M**, **N** and **MN**.

**Anti-M** and **Anti-N agglutinins** are not normally developed in human sera but, they may be present rarely.

The agglutinogens, **M** and **N** are feebly antigenic.



# RED CELL ANTIGENS

## The Rh System:

The Rhesus factor was detected originally by the use of serum from a rabbit which has been immunized against the red blood cells of the Rhesus monkey, and hence the term Rh factor.

This factor is present in the red cells of 85 to 90 percent of individuals, who are known as **Rh-positive**. the remainder **Rh-negative**.

# RED CELL ANTIGENS

## The Rh System:

A complex of antigens is involved, six in number, named **Cc**, **Dd**, and **Ee**, each of which is capable of producing antibodies, although they are all not equally powerful in this respect.

The **Rh antigens** can be detected in a foetus after six weeks of pregnancy.

# BLOOD GROUPS AND HEREDITY

The ABO, MN, and Rh factors are inherited according to Mendelian principles.

The rules of inheritance of ABO system are:

- 1) Agglutinogen **A** or **B** cannot appear in the child unless it is present in one or both parents.
- 2) Agglutinationogen **A1** or **A2** cannot appear in the blood of the child unless it is present in one or both parents.

# BLOOD GROUPS AND HEREDITY

- 3) The combination of **A1B** parent with **A2** child and vice versa cannot occur.
- 4) An **O** parent cannot have an **AB** child and an **AB** parent cannot have **O** child.
- 5) Parents of **AO** and **AO** genotype may have a **OO** child.
- 6) Parents of **AA** or **AO** genotype may have **A** child.

# BLOOD GROUPS AND HEREDITY

The rules of inheritance for MN system are:

- 1) Agglutinogens **M** and **N**, cannot appear in the blood of a child unless present in one or both parents.
- 2) A type **M** parent cannot produce a type **N** child, and conversely an **N** parent cannot produce **M** child.

# BLOOD GROUPS AND HEREDITY

- 3) In matings where both parents are homozygous type **M** or **N**, the children are always of the same type as the parents.
- 4) In matings where one parent is type **M** and other type **N**, all children are type **MN**.
- 5) In matings where one parent is homozygous (**M** or **N**) the children are of parental types in fifty to fifty ratio.
- 6) In matings where the parents are both **MN**, children of all three types are possible.



# BLOOD GROUPS AND HEREDITY

Rules of inheritance of Rh groups are:

- 1) **Rh-negative** parents cannot produce an **Rh-positive** child.
- 2) **Rh-positive** and mixed parents can have **Rh-positive** and **Rh-negative** children.

# DNA FINGERPRINTING

Each human nucleus contains about a metre of **DNA**, but only ten percent is used for genetic coding, the rest being redundant or silent segments (stutters; hyper variable regions (HVR); minisatellites).

Of these redundant segment, there may be two hundred to fourteen thousand repeats of each identical sequence on each **DNA** strand.

These segments of nucleotides are called "**repetitive DNA**".

# **DNA FINGERPRINTING**

The length, constitution, and number of the repetitive sequences are different for each person, but are unique for an individual (except uniovular twins), and are stably inherited in a Mendelian fashion. **This method is as unique as fingerprints to an individual.**

Nucleated cells are the source of **DNA** for extraction from **blood, semen, vaginal epithelial cells, tooth pulp, bone marrow, hair roots, muscle, skin, mucous membranes, etc.**

Because every person's **DNA** sequence is different, the fragments in **DNA** specimen from one individual to another are different in number and length, from those in a **DNA** specimen from another individual.

# **MEDICO-LEGAL IMPORTANCE DNA FINGERPRINTING**

- 1) The blood on a weapon can be matched against the blood of the victim.**
- 2) Hair roots found on a weapon can be matched against the blood of the victim and accused.**
- 3) Seminal fluid recovered from the vagina of a victim can be matched against the blood of an accused.**

# **MEDICO-LEGAL IMPORTANCE DNA FINGERPRINTING**

- 4) It can exonerate a falsely implicated person in a crime.**
- 5) Paternity can be established positively.**
- 6) It can be applied for tracing pedigrees and for establishing family relationship.**
- 7) Identification of victims of accident, mass disasters, mutilated bodies can be made by matching prints with prints of parents or close relatives.**

# **EXAMINATION OF SEMINAL FLUID**

**Seminal stains have to be detected in cases of rape or attempted rape, sexual murder of the female, sodomy and bestiality. Fertility of the fluid has to be proved in civil cases, e.g., disputed paternity.**

**Semen is greyish- yellow, thick, jelly-like and sticky when fresh.**

**The quantity of seminal fluid in a single emission is two to five ml. and contains about 60 to 150 million sperms per ml. of which 90 % are motile at the time of ejaculation.**

# **EXAMINATION OF SEMINAL FLUID**

**The fluid is alkaline with a pH of 7.4.**

**The stains are usually found on the clothing but may be found on the person of either the victim or the accused.**

**They may also be found on bed clothes, on floor or on the grass where the offence was committed.**

**Seminal stains have to be differentiated from those due to starch, pus.**



# **MEDICO-LEGAL ASPECTS OF EXAMINATION OF SEMINAL FLUID.**

**Examination of seminal fluid is important on the many accounts:**

## **Civil importance:**

- Compensation on the ground acquired sterility
- Disputed paternity
- Legitimacy
- Artificial insemination and other.

## **Criminal importance: in relation to sex offence cases**

- Concerning commission of sex offence
- Identification of the offender.

# **EXAMINATION OF SEMINAL FLUID**

## **COLLECTION OF MATERIAL:**

- 1. Dried or drying seminal fluid on the perineum or thighs is collected with a wet throat swab.**
- 1. Fluid from the vagina is collected with a pipette or throat swab inserted with or without the aid of a speculum.**
- 3. The pubic hair should be removed and placed in a small container.**
- 4. A portion of cloth containing the stain is cut out, dried and preserved.**
- 5. Stains on smooth, impervious surface should be gently scraped off with the point of a knife into a glass container.**

# **EXAMINATION OF SEMINAL FLUID**

- 1) Physical Examination.**
- 2) Chemical Examination:**
  - a) Florens Test,**
  - b) Barberios Test,**
  - c) The Acid Phosphatase Test,**
  - d) Creatine Phosphokinase.**
- 3) Microscopic Examination**

# EXAMINATION OF SEMINAL FLUID

## 4) Precipitin Test:

The principle is the same as that for blood.

Spermatozoa of rat (1); rabbit (2); horse (3); human (4,5)

## 5) Group of Seminal Fluid:

The specific agglutinable substances **A** and **B** are present in the semen of secretors.

As such, the group of the individual may be determined.

# EXAMINATION OF HAIR

Questions are decided:

1. Are there the hair?

# EXAMINATION OF HAIR

2. Are there the hair – of human or animal?

# EXAMINATION OF HAIR

## 2. Are there the hair – of human or animal?

*The differentiating features of Human and Animal Hair*

No	Characteristics	Human Hair	Animal Hair
1	Texture	Fine and thin	Coarse and thick
2	Cuticle	Scales are small, flattened, serrated and coronal	Scales are large, polyhedral and imbricate
3	Medulla	Narrow, may be absent, fragmented, or discontinuous	Broad, always present, and continuous
4	Cortex:	Thick	Thin
5	Medullary index	Less than 0.3	More than 0.5
6	Pigment	More towards the periphery of cortex	Uniform, peripheral, or central
7	Precipitin test with intact root	Specific for human	Specific for animal



# EXAMINATION OF HAIR

3. What region of body is a hair from? (head, beard, moustache, pubis)

# EXAMINATION OF HAIR

4. Did hair pull out or did it fall out?
5. Had hair additionally physical and chemical influences?

6. Can hair belong to the certain person?

# **EXAMINATION OF SALIVA, FAECES, VAGINAL SECRETION**

## **SALIVA:**

It contains enzymes like ptyalin, glucose 6-phosphate dehydrogenase, various proteins, lipids, chlorides, thiocyanate ions, etc. The stains are identified from the presence of amylase and buccal epithelial cells. ABO grouping and species origin can be carried out.

## **FAECES:**

The stains can be identified from odour, presence of undigested muscle and vegetable fibres and stercobilin.

## **VAGINAL SECRETION:**

It consists of white coagulated material consisting of shed vaginal epithelium and Doderlein's bacilli.