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BASICS OF FORENSIC PHOTOGRAPHY

FOR LAW ENFORCEMENT AGENCIES OF FOREIGN COUNTRIES

Tutorial

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This course covers the basics of general photography and electronic photography. There are the most necessary practical advices on the use of photographic techniques in investigative activities and the use of research methods in the process of photographs examinations and investigations, as well as features in relation to digital photographic means. The tutorial is intended for foreign professionals to increase qualification at the Moscow University of MIA of Russia named after V.J. Kikot on expert disciplines, may also be useful for specialists and experts using photographic methods for fixing investigative actions and examination of forensic expertise.

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PLAN OF THE COURSE

INTRODUCTION

In the 7th of January 1839 at the Paris Academy of Sciences, physicist and astronomer Arago informed general information about the process of obtaining a stable image in the obscure-camera, which was invented by the artist Daguerre. The year 1839 is considered the official date of the discovery of photography[1].

For mankind, the value of photography is compared with the discovery of printing. Almost immediately after the invention, photography is used in the fight against crime. From the moment of the invention, photographic process is constantly being improved. Photography accompanies the process of investigation of crimes and administrative offenses: from the detection of signs of violation of criminal, administrative or civil law till the trial. There is wide range of individuals using photographic means and methods in their work: investigator, operative officer, specialist, forensic expert etc. Scientific and technological progress allowed creating a digital photograph, which replaced quickly the silver halide (traditional) photography that has a number of significant advantages. The implementation of digital technologies in law enforcement practice led to a change in requirements for specialist and forensic expert, in particular, new means and methods determined the necessary knowledge of computer technology and forensic photography during the process and the production of forensic expetises.

[1] Chibisov K. V. General photography. M. : Iskustvo, 1984. P. 11.

1. KEY TERMS AND DEFINITIONS

Photography – complex of various methods of optical information recording and reproduction based on the action of light rays or other emanation on photosensitive surface.

Electronic photography – a method of recording and reproduction of optical information based on converting the optical signal into an electric and vice versa.

Digital photography – one of the methods of recording and reproduction of electronic optical information converted into a binary format.

Photography picture (photograph) – visual image in digital or analog formats.

Video recording – complex of methods of optical and audio information recording.

Video phonogram (video recording materials) – photographic images of movement phases and audio information about objects recorded in digital or analog formats.

Photographic method – forensic examination method using different techniques of optical information obtaining and processing.

Forensic photography (n) – branch of forensic technique, which is a complex of scientific principles and developed on its basis photographic means, processes (methods) and photography techniques used in evidence obtaining, examination and demonstration.

Forensic photography (v) – the process of information obtaining about the attributes of the object and its properties using photo recording devices (photo – movie – video equipment) and special rules in relation to each object.

2. DEFINITION, SYSTEM AND VALUE OF FORENSIC PHOTOGRAPHY

The basics of forensic photography and video recording include two systems of regularities:

a) the provisions of general, scientific photography and electronic recording and reproduction of image and sound;

b) the provisions of criminal tactics and techniques (for example, specifying tactics of crime scene examination and features of fixing this investigative action during investigation of concrete types and groups of crimes), as well as forensic expertise.

Application of photographic methods of fixing during investigative proceedings and forensic expertises is provided by criminal procedure legislation.

Modern technologies for obtaining digital images in highly integrated devices that combine the capabilities of photographing, audio and video recording allow studying photo and video recording in one single academic discipline, as it is based on the method of producing photographic image.

Photographic method of fixing the evidentiary information has several advantages over other methods of fixation, used both in investigative and in expert practice:

– photograph is produced by the lens according to the basics of perspective and geometric optic and accurately transfer the shape, size and objects position in space;

– speed, objectivity, completeness and clarity of fixing the results of investigation proceedings (investigation protocols, sketches, plans, schemes, drawings are characterized by selective nature);

– large spectral sensitivity and high resolution allows to see the objects details that are beyond the sensitivity of human vision.

Information fixed on the obtained images is an addition to the protocol, to the act of procedural action or to the expert conclusion and also is a source of evidence. The evidentiary value of the obtained images depends on abidance of the recommendations of forensic photography and procedural requirements for the registration of the process of forensic photography and its results.

Forensic photography is one of the types of photography, such as medical photography, aerial photography, astrophotography, space photography, artistic photography, amateur photography, etc. This kind of pho-

tography consists of special methods that are additional tools in solving crimes. They represent objective materials that are considered as valuable evidence[1].

The objectives of the forensic photography include the development and further improvement of methods and means of fixing the evidence, its examination, as well as the effective use of evidence in investigation and solving crimes. With the help of the forensic photography, it is possible to capture the crime scene quickly and accurately, detected traces, objects, tools of crime, the progress and results of the investigative actions, use photographic survey methods in the production of examinations or expertises, to illustrate the conclusion of an expert or specialist. This significantly enrich and complement the traditional methods of fixation such as record-keeping, making schemes, diagrams, and sketches. Forensic photography is also used during operative-search actions and for keeping criminal record. According to the obtained images the identification and search of criminals are produced. The survey methods of photography help expert to obtain the invisible traces, restore faded texts, to detect traces of erasures, conduct comparative expertises, etc.

In forensic photography and video recording there used various instruments, equipment, supplies and materials, applied as in general photography and video recording, and those that produced specifically for forensic purposes. Under current conditions in forensic photography there used methods of digital photography that do not require the application of light-sensitive photographic materials and laboratory processing.

System of forensic photography and video recording consists of the following parts:

– basics of general photography (light and color in photography, basic definitions, photographic tools and methods, etc.);

– capturing photography;

– researching photography.

[1]Chibisov K. V. General photography. M. : Iskustvo, 1984, P. 385.

3. BASICS OF GENERAL PHOTOGRAPHY

Light and color in the photography. Light is a type of electromagnetic waves. Light in a narrow meaning is electromagnetic waves sensed by the human eye. Different wavelengths are perceived as different colors from red 760 nm, to violet 380 nm (fig. 1).

According to modern concepts, light has a dual nature and its properties appear as waves (interference, diffraction) and particles (different rays refractibility and other laws of geometric optics).

Ray of light passing through a glass prism is decomposed into a continuous spectrum of colored stripes – from red to violet (fig. 2).

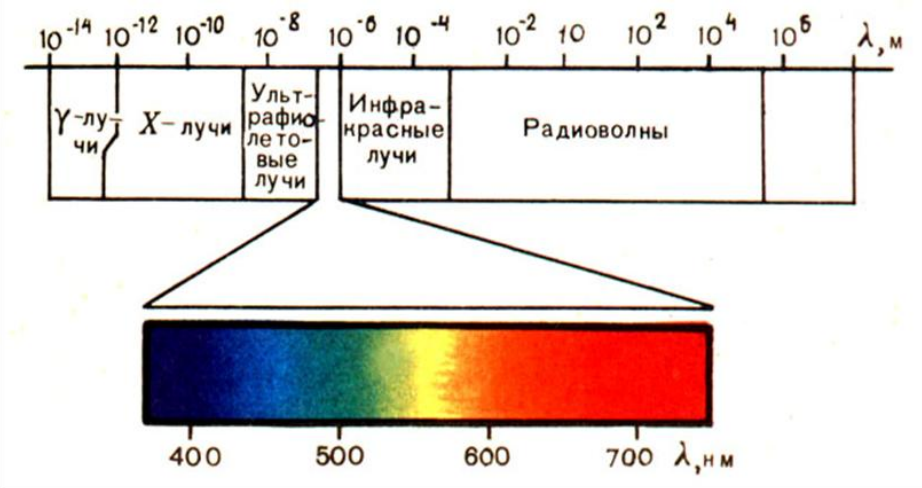
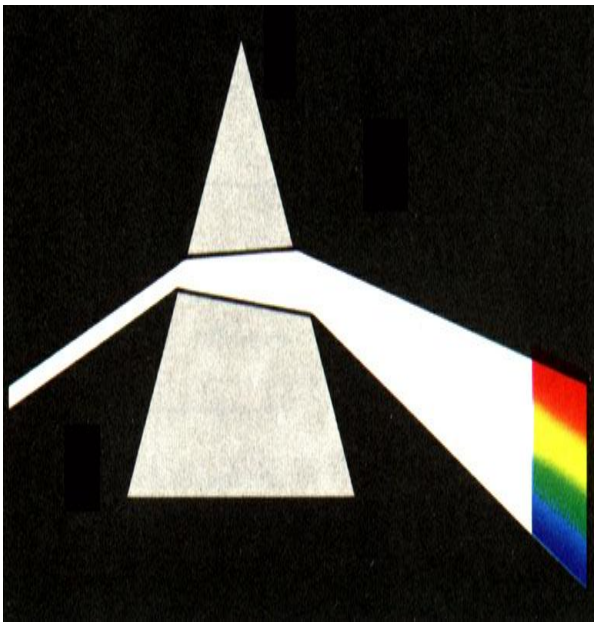


Fig.1. The spectrum of electromagnetic waves



Red: 620–720 nm;
Orange: 580-620 nm;
Yellow: 560-580 nm;
Green: 500-560 nm;
Light blue: 470-500 nm;
Blue: 430-470 nm;
Violet: 380-430 nm

Fig. 2. Expansion of the light in a glass prism on a continuous spectrum of colored stripes

The human eye perceives the three primary colors. The retina has three types of cells called cones, each one is sensitive to a certain range of wavelengths – red, green, blue. Under optical mixing of the three primary colors – red, green, blue in a certain proportion will give the specified color (fig. 3).

Fig. 3. Mixing two primary colors gives one of three additional colors:
red and green gives a yellow color,
red and blue gives purple,
green and blue gives blue

Spectral properties of the object. Objects around us seemed to be colored by the fact that the substances contained selectively absorb and reflect certain rays (fig. 4).

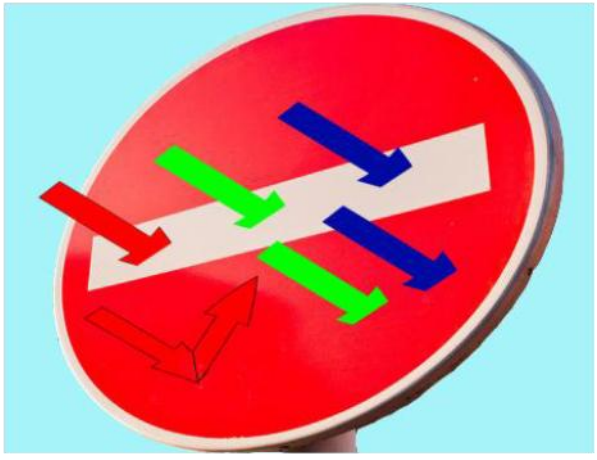


Fig. 4. Red book is perceived in red color because
it reflects only the red rays of the spectrum

In photography there used different light sources – natural light (the sun), sources of artificial lighting – incandescent lamps, fluorescent lamps,

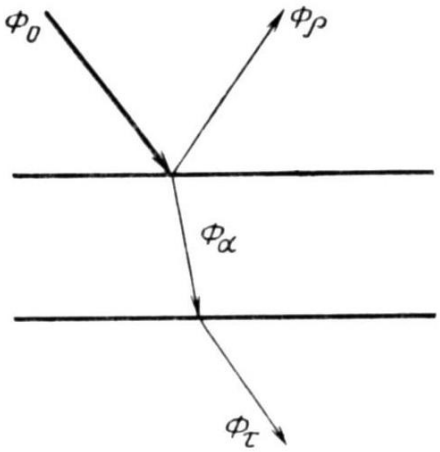
flash lamps, etc. Natural light both in intensity and in spectral composition differs from the artificial, created by different sources.

In photography the energy distribution in the spectrum is expressed by color temperature (table 1). When light interacts with an object there occurs: reflection from the body surface; absorption; transmission (fig. 5). Spatial distribution of light reflected from various surfaces and transmitted by different environments (fig. 6).

Table 1

Color temperature of different objects

Radiation source	Color temperature K
Filament lamp	2850 (more IR-rays)
Flash lamp	5500
The sun at noon	6000 (more shortwaves – UV)
Blue sky	7000–10 000
Fluorescent lamp	6750
Led lamp	4100



Fo – beam felt;
Fr – beam reflected;
F_α – beam refracted;
Fc – beam released from a transparent parallel plate

Fig. 5. Light interaction with the object

Photographic lighting. Under lighting in photography there considered the distribution of light in the object space in magnitude, direction and nature of the luminous flux.

Lighting combines two main functions: technical, pictorial. The technical function is the level of object illumination, necessary for proper image density. The pictorial function is the light pattern that is formed on the object and allows transforming the shape, volume, texture, depth of space, light and shade elements on the image (fig. 7).

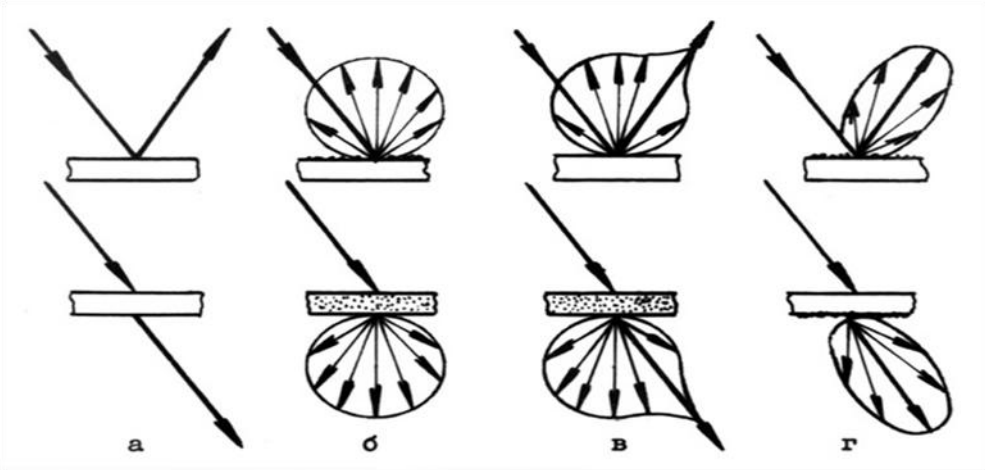
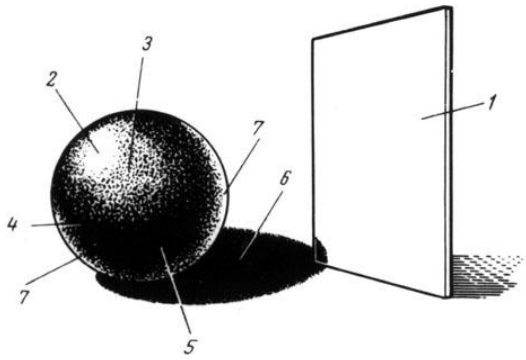


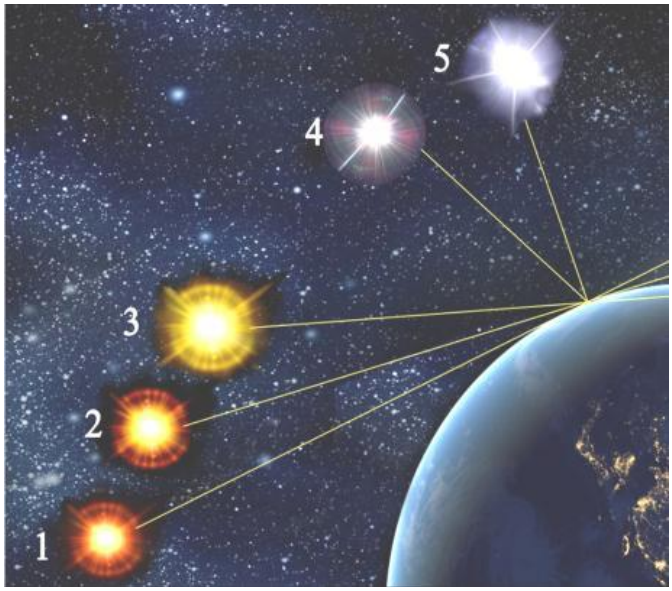
Fig. 6. Distribution of reflected and transmitted light by a variety of mediums. Top row shows not transparent objects, bellow row shows transparent objects. Arrows show the character of the light distribution (а – directed, b – scattered, в – mixed, г – directionally scattered)



1 and 3 – light;
2 – highlight;
4 – penumbra;
5 – own shadow;
6 – drop shadow;
7 – reflex

Fig. 7. Checkered light and shade elements

Types of lighting. By the nature of the light source: natural, artificial and mixed. According to the structure of the luminous flux: directed, scattered and combined. Light direction: front, side, backlit. The types of natural lighting depending on the position of the sun above the horizon presented below (fig. 8).



1 – twilight lighting – the sun is below the horizon;

2 – morning and evening low – the sun on the horizon;

3 – spectacular lighting – the sun above the horizon at 0–15 °;

4 – daylight – the sun above the horizon line at the angle of 15–60 °;

5 – zenith lighting – the sun at the zenith angle of 70–90 °

Fig. 8. Types of natural light, depending on the position of the sun above the horizon

Basic concepts and photographic means. A photographic camera – device for obtaining and fixing the still images of the material objects using the light. The scheme of classical method producing images using the camera (fig. 9) with a lens[1] as follows: light rays reflected from the object passing through the lens intersect. By placing in the focus (in the intersection of rays)[2] photosensitive material we get a reduced inverted image of the object (fig. 10).

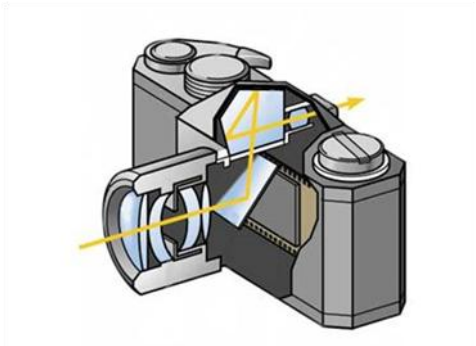


Fig. 9. Optical scheme of the mirror film camera

The traditional method of producing a photographic image contains series of sequential steps: 1) photography (photographic exhibition), 2) negative process, 3) positive process.

[1] Selivanov N. A., Eysman A. A. Forensic photography. M., 1965. P. 15.

[2] Focus is the point in optics at which the parallel beam of light rays previously passed through the optical system is obtained.

In traditional photography (physical and chemical), the image obtained by the lens perceived photosensitive layer film, plates, etc. (fig. 11).

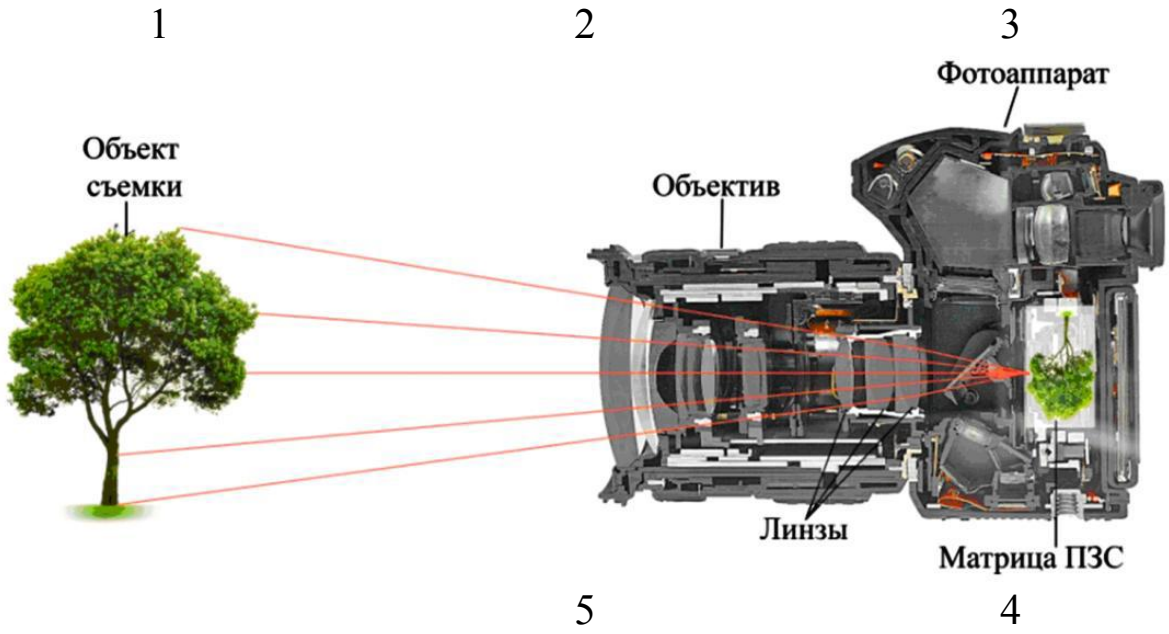


Fig. 10. The scheme for obtaining photographic images with lens (1 – survey object, 2 – lens, 3 – camera, 4 – matrix, 5 – lenses)

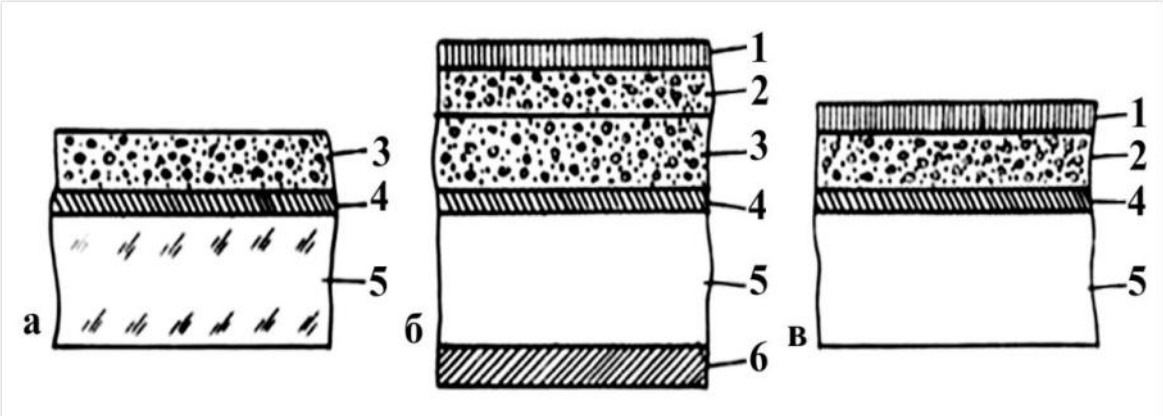


Fig. 11. Scheme of the different light-sensitive photographic material structure consisting of silver halide (а – glass plate; б – film; в – paper; 1 – backing layer; 2, 3 – photosensitive layer;4 – underlayer (barrit's layer); 5 – padded; 6 – antihalation layer)

The base of the photosensitive layer are gelatin[1] and tiny grains of silver halide. This compound, where the gelatin atom lacks one electron, while the silver halide has one extra electron. As soon as through the lens the silver halo receives a photon of light, it knocks out an extra electron, which is captured by silver ion, resulting in formation of metallic silver atom, which would be the center of the latent photography image[2].

Subsequently, it will be amplified by millions of times by chemical treatment (processing). The characteristics of photosensitive materials depend on the size of the silver micro grains: the smaller the grain, the less light sensitivity, higher resolution and contrast of the film and vice versa. Thus, in traditional photography light information recording is produced as a result of photochemical reactions in a photosensitive material.

The method for recording and reproducing optical information in electronic photography is based on the conversion of the optical signal into an electric and vice versa.

In electronic photography digital photography is a technology of the photo[3].

In digital camera (fig. 12) there is used electronic receiving-light device (photo matrix) for producing images instead of the film (fig. 13, 14). Each photon of light in the photosensitive cell is converted into electrical energy particle (electron). The brighter the image – the greater is the electrical charge. Thus, the electronic image is obtained, consisting of millions of dots (pixels), which then, via an analog- digital converter transformed in a digitized form (fig. 15) and saved on the recording source (fig. 16) as sequence of ones and zeros (binary code).

There are two types of matrixes that are used in the digital camera as receiving-light electronic devices.

In matrix CCD (Charge-Coupled Device) process of reading information from the cells occurs sequentially, that requires a lot of time (fig. 17). In matrixes CMOS (CMOS – Complementary-symmetry/Metal-Oxide Semiconductor) information is read individually with each cell, which allows digital camera the high speed image recording (fig. 18).

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[1] Light-sensitive layers, watered on a diverse basis (foil, paper, glass plate, etc.) represent a suspension of silver halides (microcrystals of salts of silver, e. g. silver bromide in gelatin).

[2] Kirilov N. I. The basics of processes of processing of photomaterials. M., 1997.

[3] Dmitriev E. N. Forensic photography: course of lections. M., 2009. P. 32.

Each matrix sensor (photosensitive cell) receiving the light (photon) reflected from the object and passed through the lens, processes only one color – green, red or blue and is absorbed by the semiconductor (fig. 19, 20).

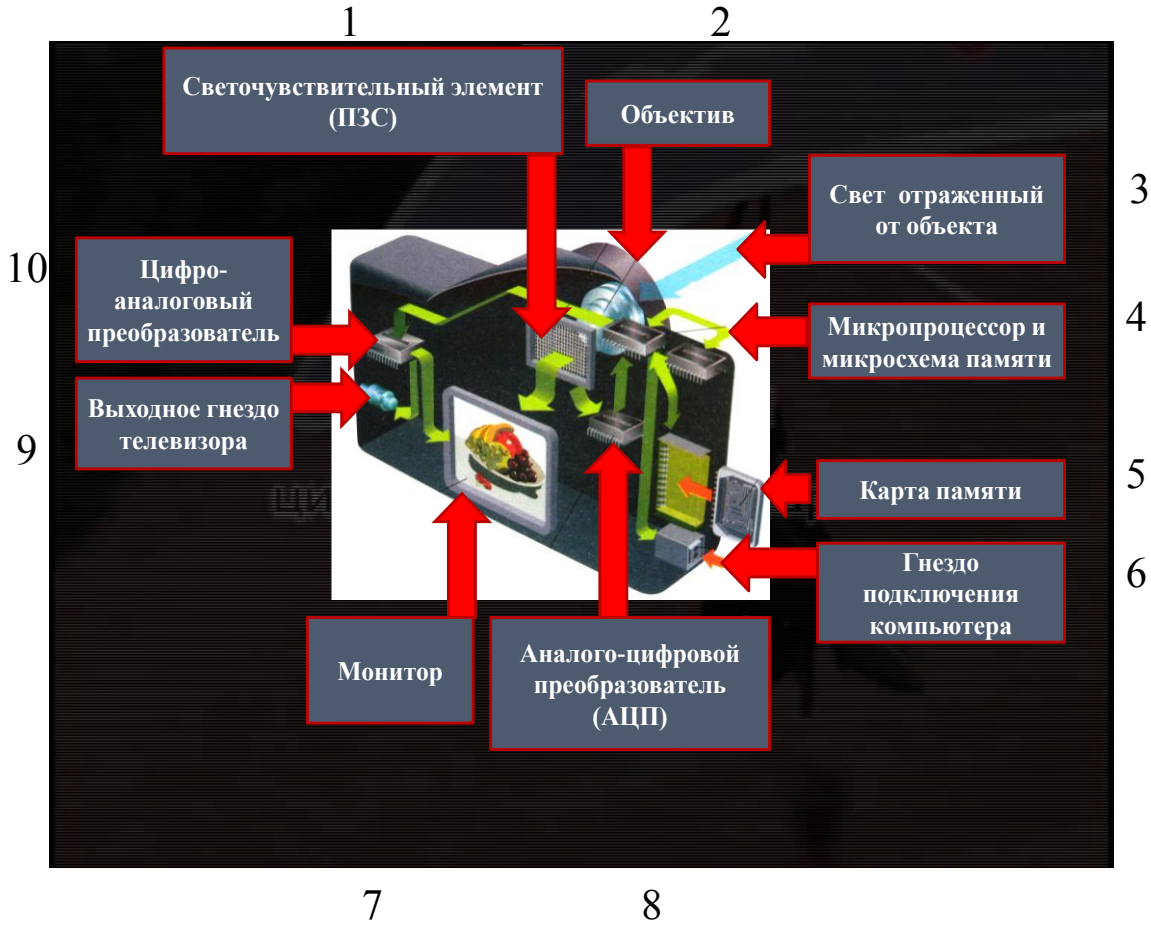


Fig. 12. Scheme of the digital photographic camera structure (1 – light sensor; 2 – lens; 3 – light reflected from an object; 4 – microprocessor and memory chip; 5 – memory card; 6 – computer-connection socket; 7 – analog-to-digital converter; 8 – monitor; 9 – the output socket on TV; 10 – digital-to analog converter)

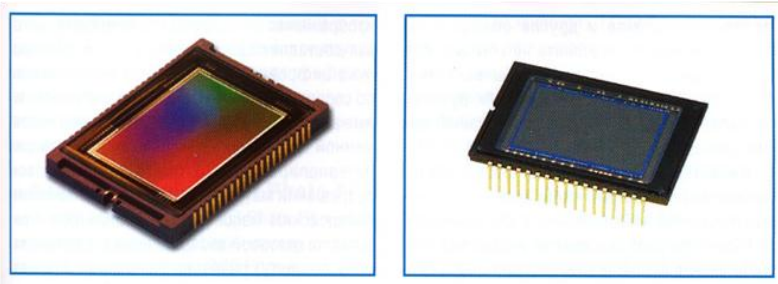


Fig. 13. Matrixes – light-receiving electronic devices

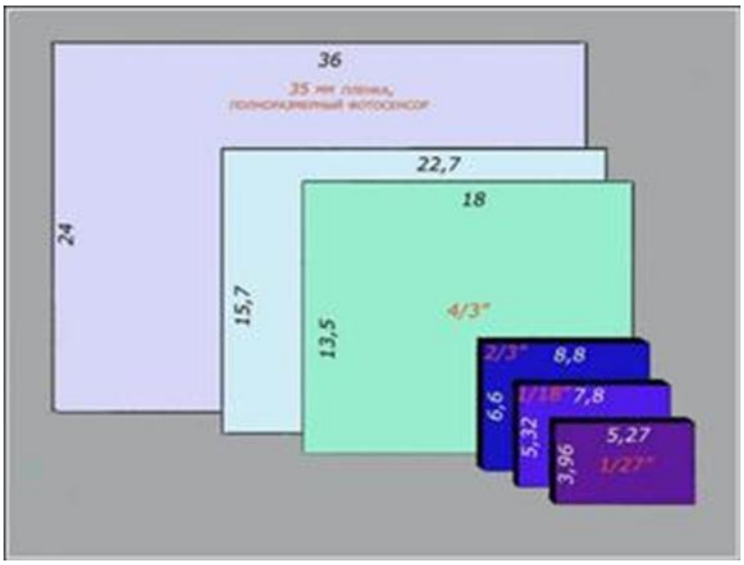


Fig. 14. Dimensions of the matrix used in a variety of digital cameras

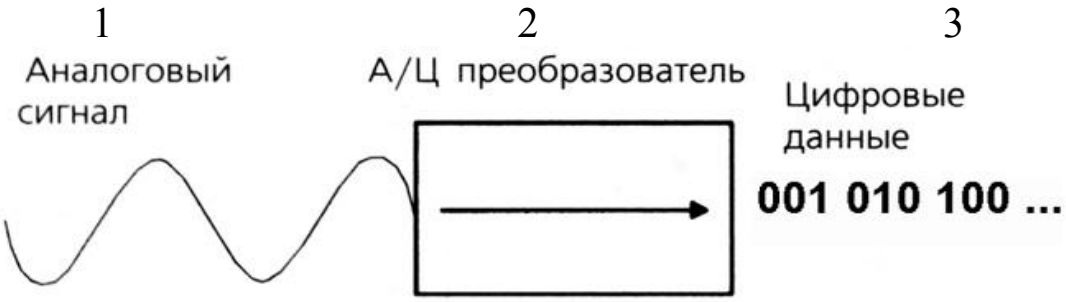


Fig. 15. Scheme of analog-digital conversion (ADC)
(1 – analog signal; 2 – analog-to-digital converter; 3 – digital data)

Secure Digital Compact Flash Memory Stick Smart Media

Fig. 16. Memory cards for recording digital information,
which are used in digital photo and video cameras

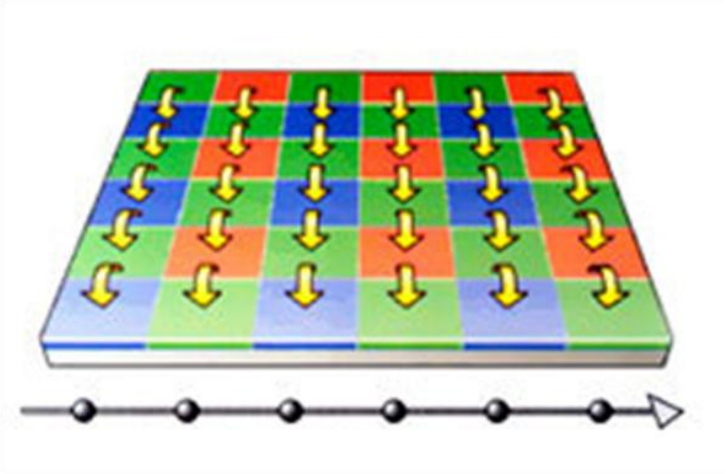


Fig. 17. CCD matrix type

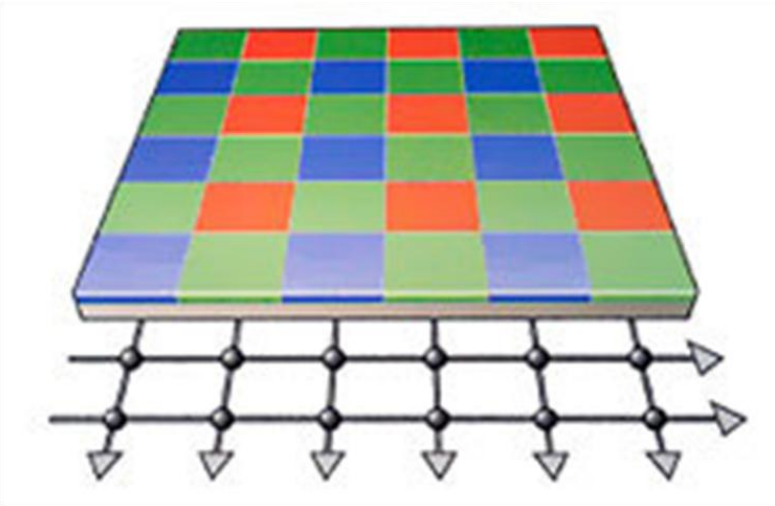


Fig. 18. CMOS matrix type

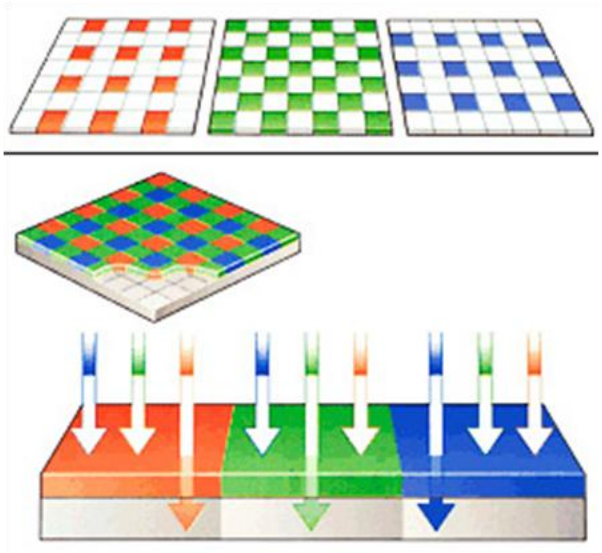


Fig. 19. The scheme of obtaining a color image using color filters covered matrixes

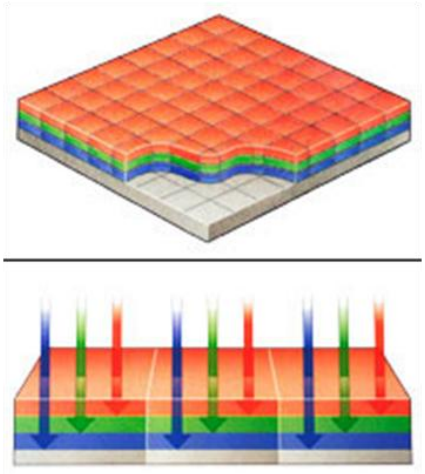


Fig. 20. The scheme of obtaining a color image by using multilayer color filters covered matrixes

Receiving-light electronic devices (matrix) can be mobile (CCD line), i. e. image is scanned by receiving-light surface by stages, element-by-element row and by the entire frame.

Another type of light-receiving device (matrix) is a fixed light detector (CCD), which forms an optical image on the entire area of the lens.

In all cases of the photographic recording it is necessary that the optical image of the object impacted on the photosensitive material (a photosensitive layer or a photosensitive matrix).

There are static and dynamic lighting effect recording methods and underlined two broad categories from general photography – conventional photography and cinematography (digital photography and digital cinema are modern technology of cinema). Physical essence of cinema is in the dismemberment of the image of a moving object on a series of snapshots of frames[1]. Physical essence of obtaining the video also includes the dismemberment of electronic or digital images on a series of snapshots of frames and junction by projecting the series on a monitor or screen and perceiving an illusion of movement.

The image recorded in digital form can be stored for a long time, which is convenient for computer processing and transmission over any distance. The image quality depends on many factors:

– photographic optical characteristics (table 2, fig. 21.1 – 21.12);
– photorecording devices (table 3, fig. 22 – 22.9);
– equipment used (table 4, fig. 23.1 – 23.3);
– recording format images (fig. 24).

[1] Chibisov K. V. Overall picture. M.: Arts, 1984. P. 375.

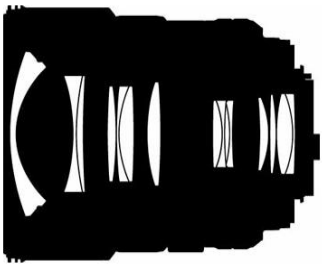
The choice of the photographic lens, the photographic camera, photographic images in the production of investigative actions and expert studies depends on the size fixed objects, their location (open area, room, etc.), lighting conditions, purposes and tasks as well as basic accounting and additional features lenses classifications lenses and photo registering devices (cameras, videocamera, scanners, etc.)

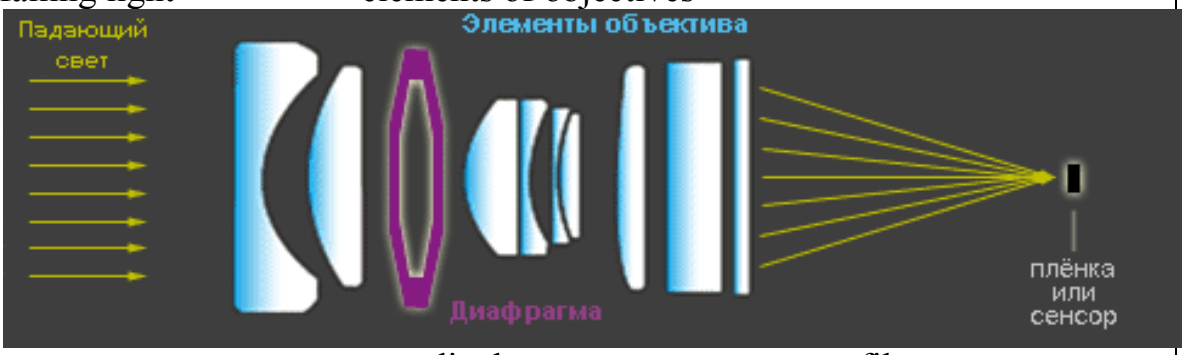
Besides digital cameras, digital input devices may include scanners (tablet or projection). To enter the flat objects (documents, surface traces, etc.) is preferable to use flatbed scanners. To enter volume objects, including large objects (i. e.: weapons, ammunition) is preferable to use digital cameras and scanners projection.

Table 2

Photographic lens and their characteristics

Photographic lens[1] – the optical system of the camera, adjusted for actual images of objects on receiving-light materials or devices.





falling light elements of objectives

diaphragm film or sensor

Fig. 21.1. The optical system of the lens elements and the scheme of falling light passing through the lens

[1] GOST (State standard) 25205-82 Photographic cameras and photographic lenses. Terms and definitions.

Key characteristics

1. *Focal length (E[1] – Focal Lenght*) – back focal length of photographic lens (E-Camer: Lens).

2. *Aperture (E-Lens stop)* – the aperture diaphragm in the photographic lens with an hole limiting the bundle of rays.

3. *Relative aperture (E-Relative aperture*) – is absolute value of the ratio of the twice distance from the optical axis to the point of reflection or refraction of the meridional ray parallel to the optical axis in the object space and passing through the aperture diaphragm edge to the back focal length of the system[2] (maximum relative aperture mark on the photographic lens).

4. *Diaphragm-number (E-F-number)* – the inverse of relative aperture[3]. Nominal aperture value constitute a geometric progression with ratio 2.

5. *Depth of field (E-Depth of field)* – the distance of objects in space along the optical axis of the lens within which blur images created photographic lens to film a variety of remote objects that does not exceed the permissible circle not field.

6. *Field of view (E-Field angle)* – an angle in the object space between the two off-axis beams passing through a photographic lens shooting, and limited diagonal aperture.

Additional features

1. *Working distance (E-Flange local distance)* – the distance between the reference plane and connecting the rim of the focal plane of the lens.

2. *Circle of confusion (E-Circle of confusion)* – the blurred image of an isolated point formed by real photographic lens and accepted as the norm when calculating the depth of field.

3. *Modulation Transfer Function (MTF, E-Modulation Transfer Function – MTF)* – the ability of the lens to reproduce fine details of various contrast, expresses the dependence of the contrast transfer of small parts of the object while reducing their size, that is an increase in their frequency, expressed in number of lines, per one millimeter in the image.

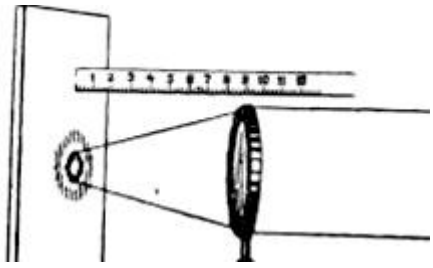
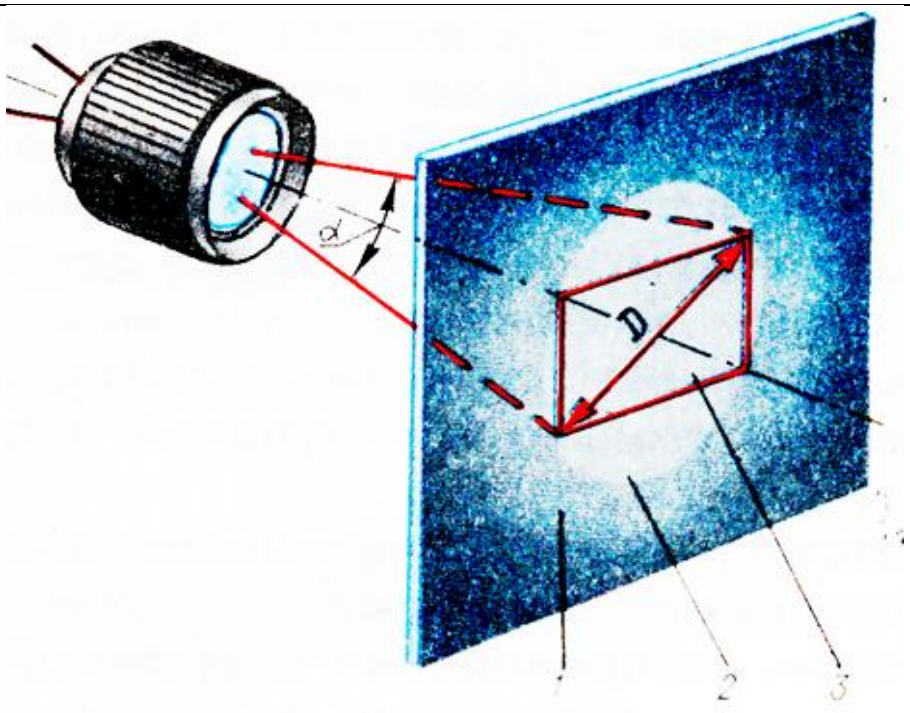


Fig. 21.2. Scheme of the rays through the lens and the focal length measurement

[1] English equivalent of standardized terms.

[2] GOST (State standard) 7427-76 Geometrical optics. Terms, definitions and letter symbols.

[3] English equivalent standardized terms.



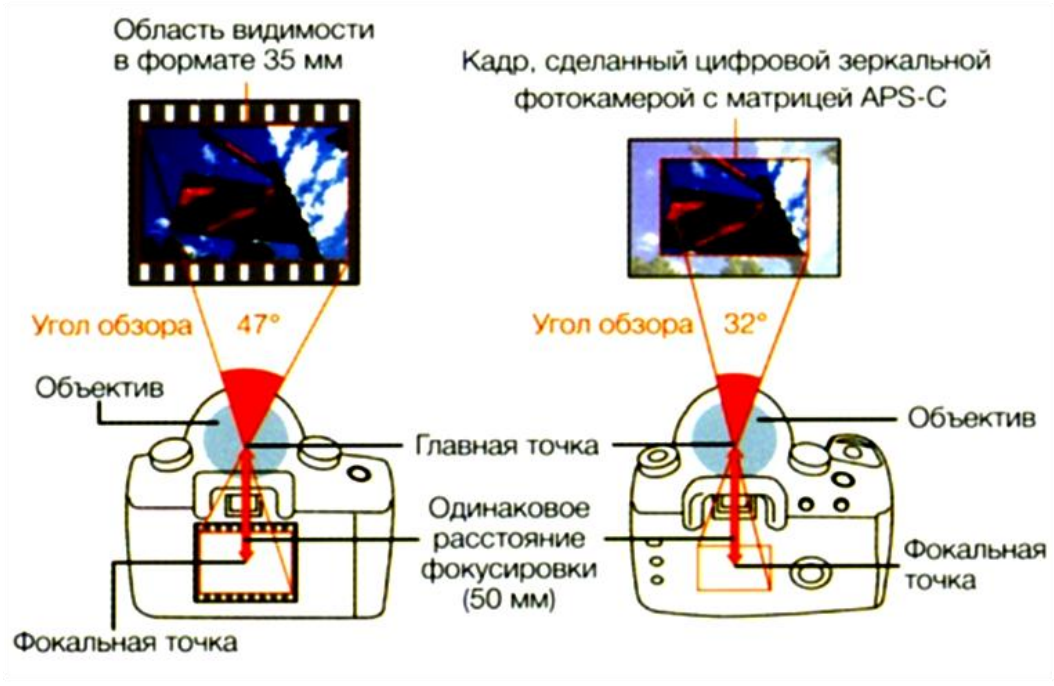


Fig. 21.3. Field of view (angle) lens (α) and diagonal (D) frame (1 – scope in 35mm format; 2 – image made by frame digital camera SLR with APS-C matrix; 3 – Lens; 4 – the focal point; 5 – same focus distance of 50 mm)

Photographic lenses classification

1. *Photographic lens «fisheye» (E-Fish-eye lens)* – a photographic lens with a field of view of 180 or more and barrel distortion.

2. *Super wide angle lens (E-Superwide-angle lens)* – a photographic lens with a field of view of 83 ° or more.

3. *Wide-angle lens (E-Wide-angle lens)* – a photographic lens with a field of view of 52 ° to 83 °.

4. *Normal lens (E-Normal-angle lens)* – a photographic lens with a field of view of 40 ° to 51 °, inclusive.

5. *Telephoto photography lens (E-Long locus lens*) – is a shooting photographic lens with a field of view of 10 ° to 39 °, inclusive.

6. *Photography lens with a movable component (E-Floating lens)* – lenses or lens groups are moved relative to each other to improve image quality when photographing with finite distances.

7. *Photography lens with aspheric optics (E-Aspheric lens)* –

Fig. 21.4. Photographic lens «Fish eye»

Fig. 21.5. Wide-angle photographic lens

Fig. 21.6. Normal photographic lens

a photographic lens, in which one or more lens surfaces are aspherical.

8. *Photography lens optics with fluorite (E-Fluorite lens)* – a photographic lens in which to reduce the chromatic aberrations there applied one or more fluorite lenses.

9. *Macro lens (E-Macrolens)* – a photographic lens, especially modified to shoot on the final short distances.

10. *Mirror photography lens (E-Mirror lens*) – a photographic lens in which the optical system comprises at least two reflective surfaces and has a constructive long, much smaller focal length.

11. *Standard*[1] *lens (E-Standard lens)* – set for this type of photographic camera lens supplied with the device

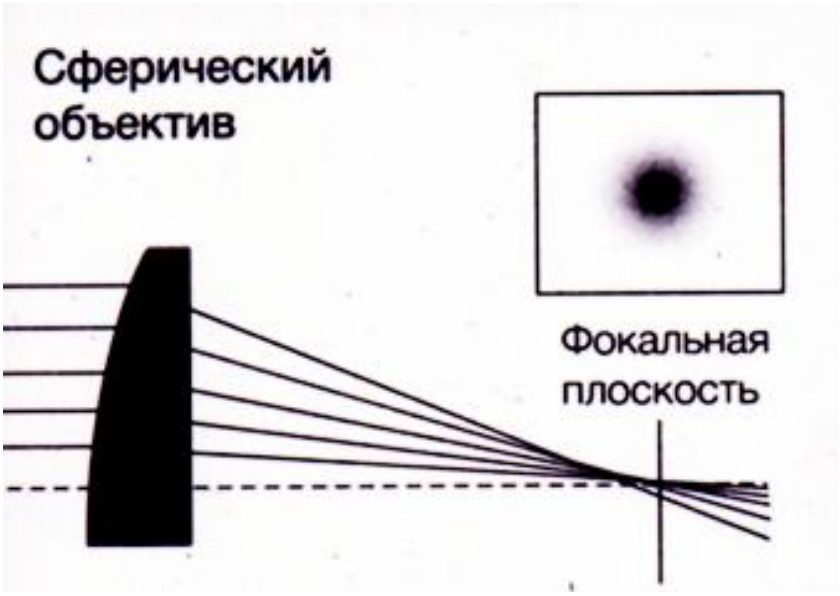
Fig. 21.7. Telephoto lens photography

Fig. 21.8. Photographic lens with a movable component

Fig. 21.9. Mirror lens shooting

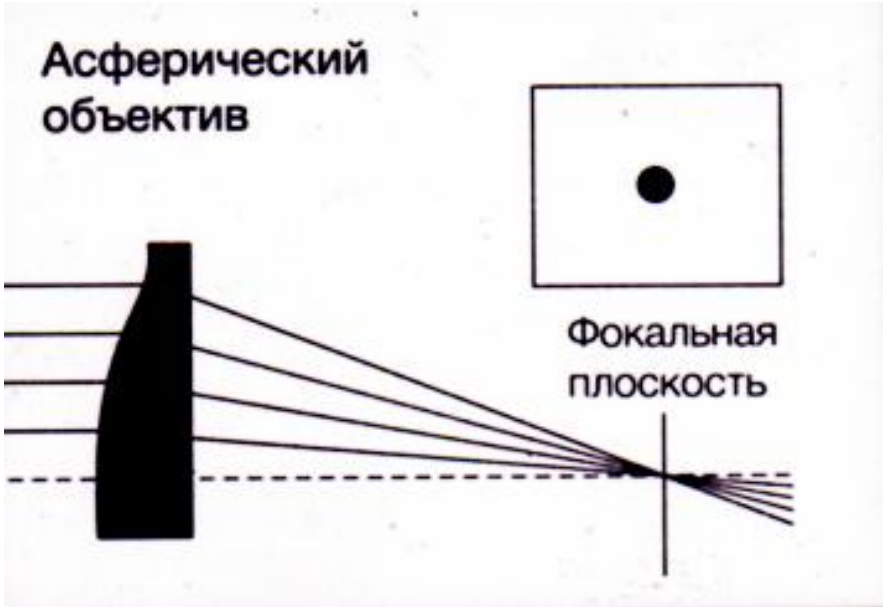
[1] Regular lens. Jargon – the kit lens (kit – com-plct), complete with a digital camera are often used for a lens with a variable focal length.

The spherical lens



Spherical optics The focal surface

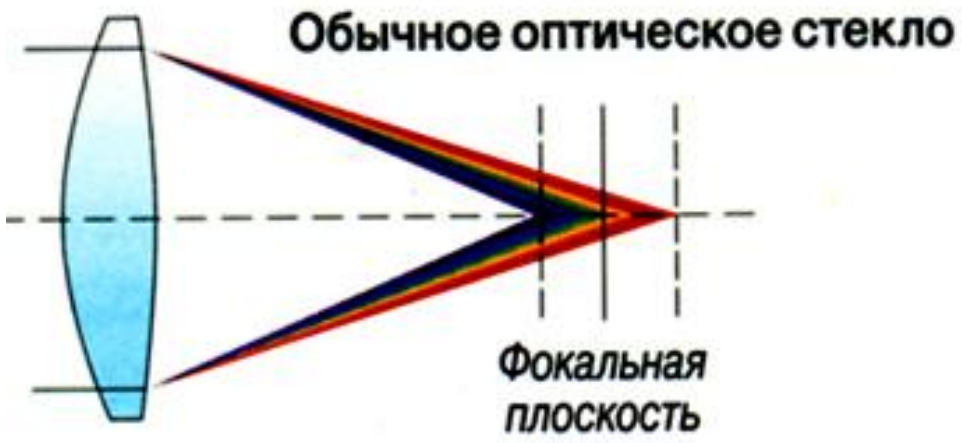
The aspheric lens



Aspheric optics The focal surface

Fig. 21.10. Photography lens

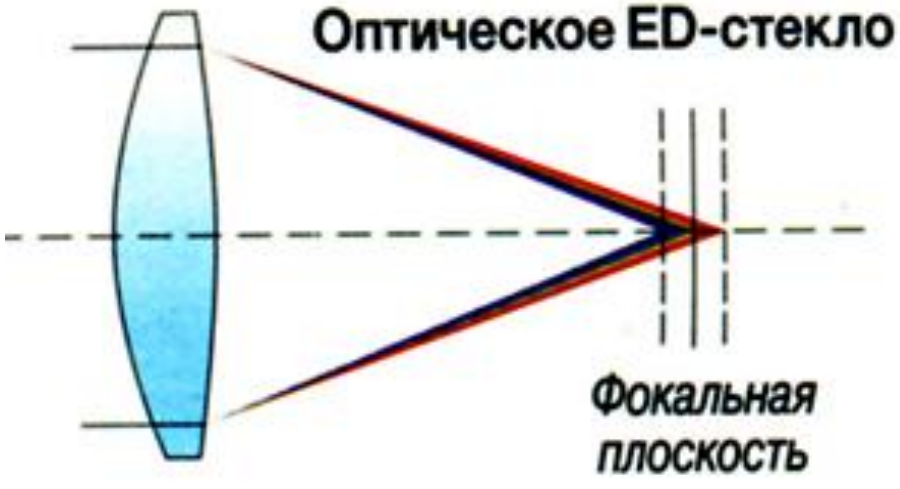
Ordinary optical glass



with the conventional optical glass

the focal plane

The optical glass



with fluorite optical glass

the focal plane

Fig. 21.11. Photography lens

Table 3

Photorecording devices used in forensic photography

Fig. 22.1.
Reflex digital camera
Canon EOS 550D

Fig. 22.2.
Digital camera
Canon PowerShot G9

Fig. 22.3. FinePix Real 3D stereo system digital camera (camera, photo frame, print)

Fig. 22.4.
Three-lens panoramic digital camera «HORIZON» D-L3

Fig. 22.5. Digital camera Pentax Optio WG-3 GPS, special rugged, equipped with a compass and allows to obtain the geographical coordinates of the photos with geotags

Fig. 22.6.
Digital camera
Canon Digital Ixus 50

Fig. 22.7. Special kit for the digital photofixation of the crime scene

Fig. 22.8. Sony camcorder

Fig. 22.9. Flatbed scanner

Table 4

Photo equipment and devices used in photography

Fig. 23.1. Tripods, flashes, photo blends, filters, etc.

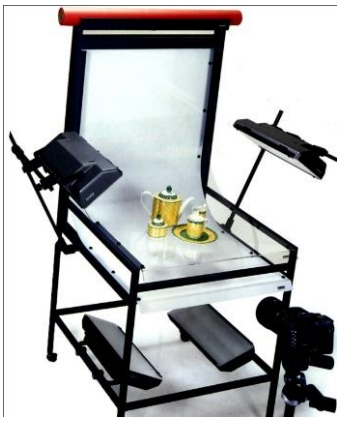


Fig. 23.2. A special table with a screen and illuminators

Fig. 23.3. Portable reproduction installation

Photographic image recording formats

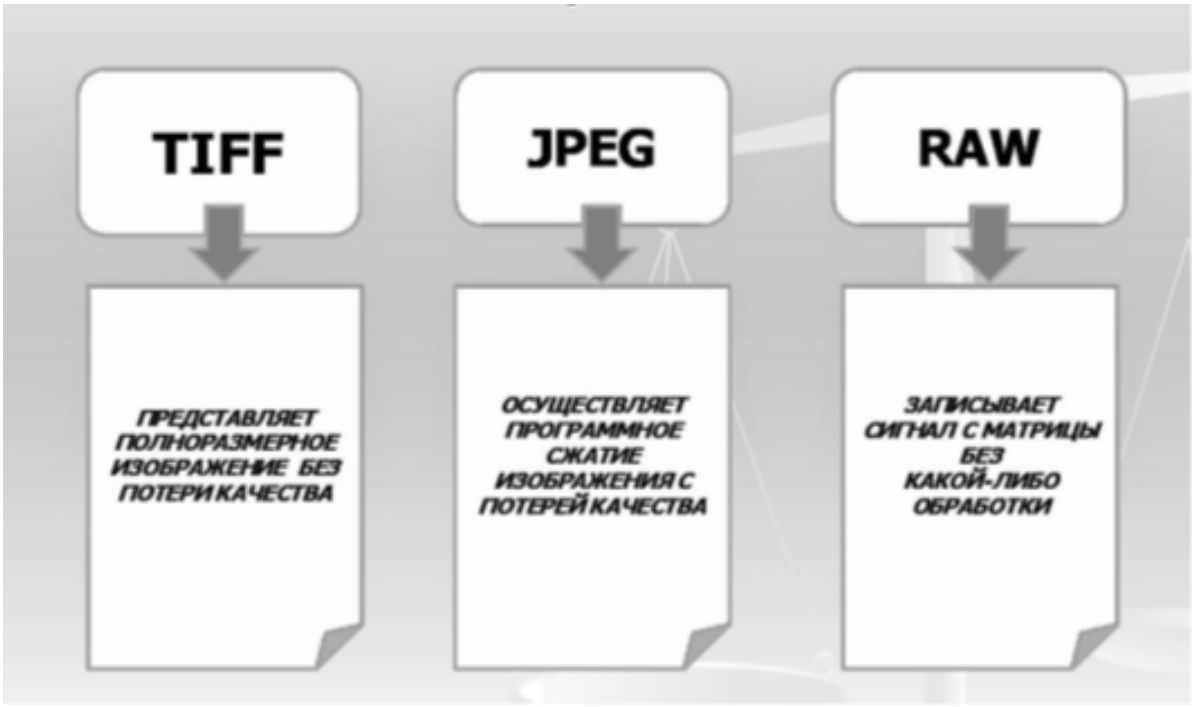


Fig. 24. Basic photographic image recording formats used in forensic photography:
TIFF – provides full-size image without losing quality;
JPEG – software performs lossy image compression;
RAW – records the matrix signal without any processing

The process of digital photography includes the obtaining of the digital image, its editing and copy printing on a solid support. Image editing is provided by the software – graphic editors. Digital processing techniques during the expert investigations of the objects in its capabilities significantly complement traditional photographic methods of investigation and perfomed using different hardware and software. For such reason there have been developed specific technical (photographic) means. These include digital image capture devices, image display devices (display and printing), the image storage devices.

Computer printing technique involves applying separated dots on the paper (fig. 25).

The printing devices (printers) generate an image of the discrete monotonically colored dots (fig. 26, 27, 28). Halftone imitation is the result of various size of the printed dot.

Inkjet printer generate an image with microdroplets special ink ejected onto the paper through the print head nozzle. Laser printer uses electrophotographic principle – the image is transferred to paper from the drum which attracts paint particles by the electrostatic potential. In thermo-sublimation printer the tape is heated to a temperature of 400 °C, wherein the dye is vaporized and transferred to the special paper.

An image display device is primarily monitors and projectors (fig. 29, 30)

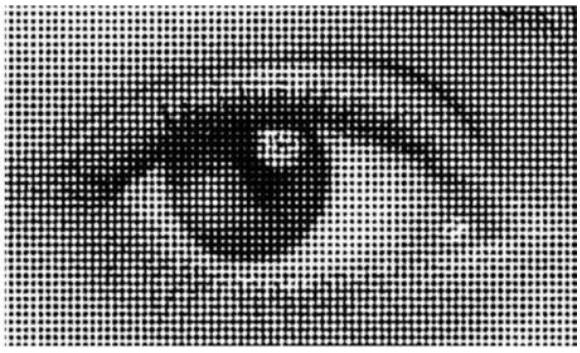


Fig. 25. Enlarged fragment pattern

Fig. 26. Inkjet printer. obtained from the separated image dots

Fig. 27. Laser printer

Fig. 28. Ethyl-sublimation printer

Fig. 29. Theatrical video projector Sony

Fig. 30. Monitor Samsung

Basic characteristics of the image. Bit of the bitmap or image color depth (bit depth) is expressed in informational units – two in raising the maximum number of colors or gradation of grey. Digital images are stored in computer memory as a set of bits[14] (the array). To represent the tonal range a certain number of bits for each pixel is emitted. To represent the two grades in digital form (black and white – Line Image) one bit is needed. For black and white image with 256 gradations 8 bits are need, for color image there should be 24 (3 × 8) bits[15]. Image resolution – the number of pixels per length unit, and its quantitative unit can be identified as pixels per inch (ppi). Higher resolution can transmit more details and reproduce the original qualitatively. Thus, the resolution value is largely determines the quality of the digital image. Image quality is set in the image input process depending on the installed resolution.

[14] Bit (bit) – a unit of digital information. Bit has two values – 1 and 0. Eight bits create a byte. Byte (byte) – the smallest addressable unit of data. Memory size – 1 pixel with 256 gradations of gray requires 1 byte.

[15] Color image is obtained on the base of mixing of three colors for RGB system – red, green and blue. Each color requires 256 gradations, i. e. 8 bits.

Storing files formats. For storage and further processing the images to a PC a «special form» of recording a plurality of bits is used. This special form is called the image format. Format significantly affects the size of the file, which in turn depends on the resolution used in the original input into the system. Depending on the type of image the compression can either be done without significant loss of image quality, and with losses. Since formats have a different structure, transferring images from one format to another may bring the loss of some information. The most common formats are BMP, GIF, JPEG, TIFF format and RAW (RAW format is understood when the data obtained directly from the image sensor without processing «digital negative.» Later it can be saved in any format). When processing with the images, be aware that the choice of graphic format must depend on the research objectives, as well as system resources available to the expert. Basic formats, corresponding to the requirements are RAW and TIFF formats. However, in some cases, JPEG format can also be used as a valid format as it is widespread and massively used in modern technology. Digital photography is suitable for fixing objects during forensic examinations. Input devices may generate a high resolution digital image.

Digital image quality depends on:

– characteristics of the lens;
– characteristics of the emulsion or the CCD;
– lighting;
– the location of the image on the frame area;
– the distance to the object;
– position of the camera relative to the object level;
– printer device;
– monitor (video projector).

The main feature of the digital photoregistration – is the choice of the optimal resolution of the photography or scanning and printing. Editing of the various image parameters such as brightness, contrast, color balance, geometric distortion, etc., can be adjusted in the camera during the photography or after, when processing the image in the graphical editor.

Digital technologies provide an easy opportunity to modify (accidentally or initially) the digital images during photography, processing, or while using such images in law enforcement. The generated images can be adjusted, i. e. editing such images when the object is perceived in a different way than in reality. This is a significant limitation of the use of digital fo-

rensic photography in the detection and investigation of crimes. Currently the necessary efforts criminologists are obtained from different countries[16] in the development of common standards that ensure the reliability of the evidence in the application of digital photography in law enforcement.

Using the digital photography and video recording during the disclosure and investigation of the crimes it is necessary to apply the technical devices which are admitted to use, adequately reflecting the fixing objects, obstruct unauthorized changes of the generated images. For example, to use the photography devices without editing option, image adjusting option or which apply the RAW[17] image recording format, or devices which provide a possibility to establish the fact of altering the original image.

4. CAPTURING PHOTOGRAPHY

In forensic photography unlike art, hobby and other types of photography, photographing and receiving results is strictly regulated by the procedural rules, for example: In Art. 166. CCP. «Protocol investigative action» in paragraph 2 indicated that the production of investigative action may also apply photographing, filming, audio and video recording. In paragraph 5 it is said that the protocol must be specified with technical devices applied in the manufacture of investigatory actions, conditions and procedures for their use, the results obtained. Thus, there are special requirements to the photographic, video and software used in the production of investigative and expert examinations to ensure the obtaining of accurate images. In modern conditions of digital data transmission[18] in various spheres of human activity, including law enforcement, digital photographic devices and graphical editors should be able to record the image obtaining conditions (tags), fix the actions undertaken to the image in «log measurements».

Photographic images obtained by digital photo cameras are stored on paper, on the digital information removable storage devices or computer information (processed by the computer). One of the ways to ensure the re-

[16] Standard Operating Procedures in Forensic Digital Imaging – F. I. S., F. S. G., NSW Police July 2002. 2. 31.

[17] RAW format is understood when the data obtained directly from the matrix without the image processing – «digital negative».

[18] Big illustrated encyclopedia. 32 volumes. T. 30. M. : AST : Astrel, 2010. P. 185.

liability of the digital images, at the present stage of development of digital technology is their detailed description in the documents (protocols, acts, expert opinion texts). Skilled experts, investigators, inquirers should describe in detail the application of technical devices, conditions and rules and the results obtained, titles of digital images files, capacity in bytes, the hash of the files[19] and software used for computing.

Capturing photography is a system of scientific statements, the methods based on them, techniques and devices used to obtain the progress and results of investigative actions, forensic facilities, as well as during operational and search activities.

Capturing photography used for fixing objects which are visually well perceived, i. e. when photographing the progress and results of the investigative actions, people and objects for registration. Photography features determined by its specificity, the methods and techniques defined by its purposes and the characteristics of the devices used. In other words, the selection of method (technique) of the photo capture will vary depending on the circumstances, the particular purpose, the specificity of the object, presence or absence of the necessary equipment, additional devices, etc. The following types of capturing photography:

– photography of the investigative action (crime scene, search, corpse, object detecting, etc.);

– photography of the humans and corpses (registration, identification, examination);

– traces (human, crime instruments, vehicles);

– physical evidence (objects, documents).

The following techniques of photo capture:

– usual black-and-white or color photography;

– panoramic photography;

– identification photography;

– measuring photography;

– stereoscopic photography;

– macro-photography;

– long-focus photography;

– reproduction photography;

The film or digital cameras, scanners or special devices are used for applying the particular method of photography.

[19] State standard R 34.11-2012. Information technology. Cryptographic protection of information. Hash function.

Usual black-and-white or color photography – a method of photographic techniques used in the amateur, advertising, artistic and newsreel photography (see fig. 31, 32).

Fig. 31. Promotional images of various objects

Fig. 32. Amateur image of a historic building

Panoramic photography – method of photographing objects significant to the extent with a large horizontal angle (see Fig. 33, 34). In cases where the image of the object in the original scale does not fit within the limits of the photo frame, a photopanoramic image is mounted with a series of interrelated images of the object. During panoramic photography, some simple basic rules should be followed that provide a high-quality image of the object. Photography is made in such a way that each subsequent image is a sequel of the previous one. To do so, the same landmark is fixed within the limits of adjacent images that will mount panoramic image. Photography device should be moved within the horizon line. In cases when the size of the object is huge not only horizontally but also vertically, i. e mountainous terrain, the horizontal movement of the photography device can be done in one, two or more storeys; wherein the same landmark should be considered in two adjacent vertical images. In such cases, the panorama is mounted with images obtained horizontally in several storeys. When photographing panoramic sectors with different illumination there should be done adjustments to the exposition of the images.

Fig. 33. Horizontal panoramic image of the terrain

Fig. 34. Vertical panoramic image of the radio tower

Pictures are made with the equal optical density with the same image scale. Depending on the object, the panoramic photography can be done either with circular or linear methods. It is appropriate to apply circular method (cyclorama) when the images of terrain or objects should obtained from the examination point from all sides. Cyclorama is performed from the same point by successive turns of the photography device around its axis. Linear method often used in cases where it is necessary to capture equidistant objects and it is not possible to choose a more distant point of photography. Linear panorama is done by moving the photography device within the object's parallel line. Digital photography devices have a special panoramic image feature, which greatly facilitates the work of a specialist.

Identification photography[20] of the humans and corpses is done for the purpose of subsequent identification, forensic examination and investigation (see fig. 35).

[20] The method of identification (signaletic) shooting proposed by the French criminologist A. Bertillon. In 1893 Bertillon gave the sample of registration card with pictures made by these rules in his book «Instructions Signalétiques».

Fig.35. The identification (signaletic) images

Images are made in 1/7 of the original size. The photography is done from the front (front view) and the right profile, bareheaded. Hair should not cover the ear, the person should be without glasses, head upright, neutral grey background, uniform illumination. In cases when the image of the person is to be used for identification or forensics examinations, as well as for certain types of investigation actions (i. e. photolibrary), the photography can be done in 3/4 turn (facing right) and upright. Typically, a 3/4 turn photography of the person is done in the guise in which it was detained. Photography in full growth is produced in 1/20 of the original size. Before identification photography of a corpse there usually take place toiletry procedures and restoration if needed. Forensic expert performs restoration. Such procedures include: eyes open, face powder, comb hair, etc. The right and left profiles should be photographed, otherwise the same rules and techniques as for the identification photography of alive persons are applied.

Measuring photography is a method (technique) that allows to determine the absolute sizes of objects and the distance between them (fig. 36, 37) by the photogrammetric image[21].

Fig. 36. Large-scale image of the detected memory card

[21] Photogrammetry is a scientific discipline that studies the shapes, sizes, positions of objects by its photographic images/

PLAN
of mutual arrangement of the objects
and detected traces (1, 2 stereo pairs)

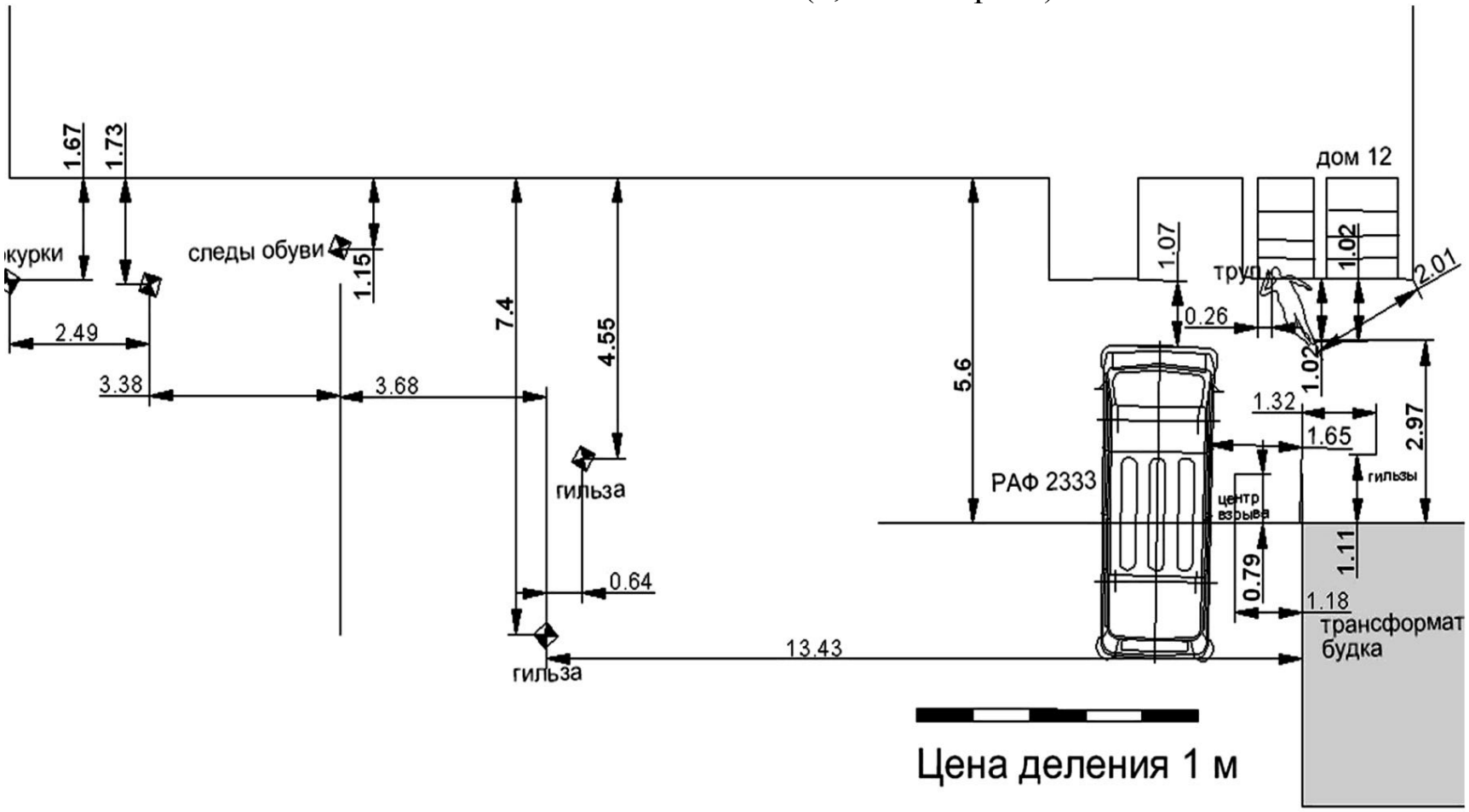


Fig. 37. Stereoscopic image of the crime scene and the plan of the photographed terrain

Photogrammetry techniques are used for fixation of various investigative actions and during expertises and examinations. The advantage of photogrammetry is the ability to fix the crime scene in extreme conditions, when access to facilities is difficult or not possible, time limit, when it is unclear which features and concrete items are required for further investigation, in cases when the approach to objects is considered dangerous. In forensic photography there used such methods of measuring photography as large-scale photography (with a scale ruler), metric photography (with a depth scale, which can be tape or square) and stereophotogrammetric or monophotogrammetric photography. To establish the authentic dimensions of the photographed objects, images should be decrypted. Decryption is used to establish mathematical relationships between the image's dots and the photographed objects, as well as the use of appropriate methods of processing photos. The easiest and most common method of measuring photography – photography with a scale ruler (scale photography); wherein, the scale ruler is located nearby and in the object plane. The optical axis of the lens extends through the center of the object and perpendicular to its surface. Lighting should be uniform over the entire surface of the object. The scale ruler used in forensic photography, should be certified by the Russian State Standard as one of the technical means, referred to measuring instruments. Scale ruler length is known in advance. Measuring its length in the image, you can determine the correlation between the length of a scale ruler in the image and original size. If, for example, a scale ruler is reduced by 3 times, hence, photographed object also reduced by 3 times. Calculation is based on the obtained quotient linear values. Actual scale size should be determined, which is divided by the scale of the photographic image or its part. The obtained quotient is the required ratio. Then the size of the photographed object or its parts is measured. The obtained means are multiplied by a measurement quotient. The result is the original object sizes in absolute values.

Large-scale photography is used not only for photographing the crime scene and during other investigative activities, but also in the process of examinations and expertise, when general view of the objects, their individual characteristics, traces or microtraces are needed to be obtained. Depth scale photography is based on the fact that if the distance from the objects to the device is known in advance, the sizes of these objects could be calculated by their images, because the image decreases as far as the distance from the object to the lens increases, and this values could be cal-

culated according to specified formulas During measuring photography by the depth scale measuring method tape or square scale can be used. In law enforcement practice use of depth scale measuring method is not widespread because of its complexity and inconvenient calculations when using small-format cameras and is not currently applied.

In modern conditions to determine the sizes of the photographed objects and the distance between them there used photogrammetric devices, for example, «FOMP-K»[22], «Fotomer» or «FARO Laser Scanner» certified by the he Russian State Standard as technical measurements (fig. 38, 39, 40).

Fig. 38. Photogrammetric device «FOMP-K»

[22] Photogrammetric complexes application in the field of road accidents. Toolkit. RIO GU NPO «Special equipment and communication» MIA of Russia. M., 2003.

Fig. 39. Photogrammetric device «Fotomer»

Fig. 40. 3D laser scanner for examination of the crime scene «FARO Laser Scanner»

Photography is made according to certain rules. Determining the sizes of the objects and the distances between them by the obtained images is done with the special software that enables to create a scale plan of the photographed terrains, facilities, objects. «FARO Laser Scanner» also creates a 3D-model.

Stereoscopic photography. Stereoscopic photography is based on the vision ability of forming an integral three-dimensional image of the object by the two different images coming from the right and left eyes at the same time providing the spatial perception of objects in three dimensions (see fig. 41).

While reviewing the images when the left eye sees only the left image and the right eye only the right image, the viewer perceives a common picture. There is a feeling of depth of space that allows obtaining a full information about the shape, sizes and interposition of the photographed objects in all three dimensions. Stereoscopic photography is performed with special devices or stereo nozzles, but it can also be done by usual camera. In these cases, the device is moved horizontally along the basic distance (65 mm), conditions of photography should be the same during the procedures. For examining these images there used special stereoscopes, filter glasses, etc.

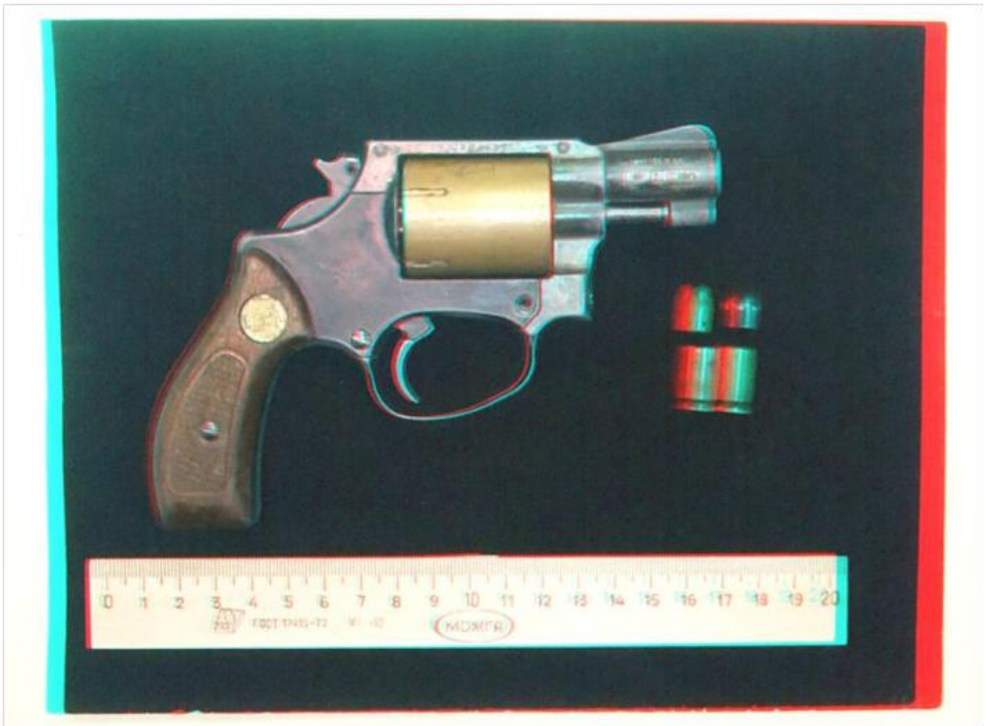


Fig. 41. Stereo photographs of objects obtained for examination

Currently there are photography methods, providing stereo effect without special optical devices. One of the methods to obtain stereo images is lenticular raster using special film. Photocopying is produced by two lenses, placed apart on the basic distance. When the image is perceived with both eyes there appears a stereoscopic effect. Stereoscopic photography used in forensics for photographing the crime scene, evidences, examinations as well as for measurement purposes (stereo-photogrammetric method of photography). To do this, the obtained stereo pair (two photographs of one object, obtained from two different places) is placed in stereophotogrammetric device that allows the observer to see the spatial (stereoscopic) image and measure the distance between points, objects, determine their sizes, etc.

Macro-photography – method of obtaining full size images of small objects or their magnification without using microscope (see fig. 42).

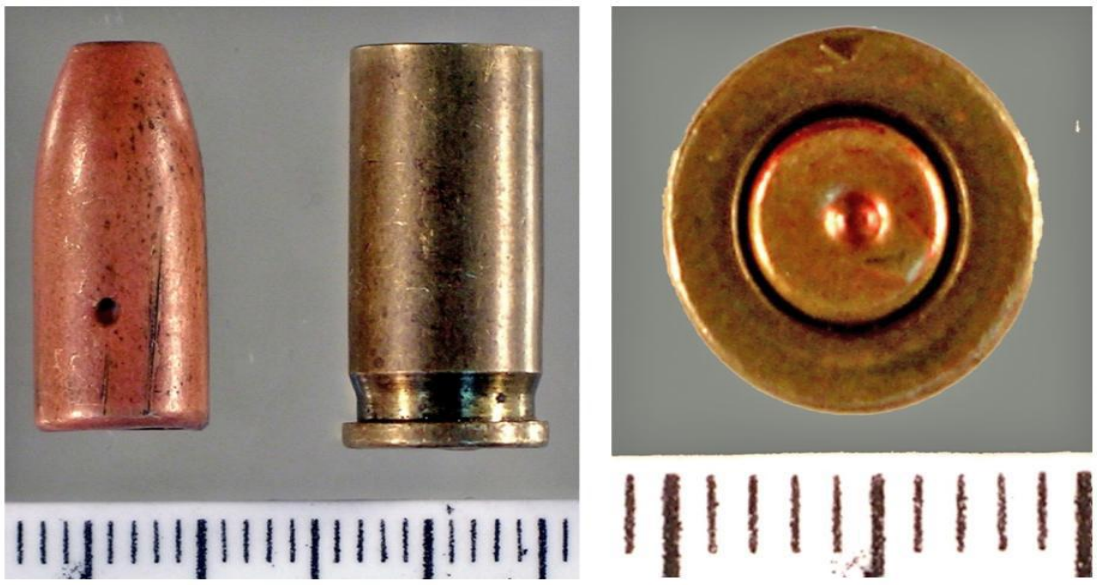


Fig. 42. Scale microphotographs of obtained objects

Usually small objects in forensics are traces of fingers papillary patterns, cartridge bullets, shells, hacking tools traces, etc. To obtain high-quality images by macro-photography it is necessary to place object close to the lens and provide uniform illumination, receiving-light surface (film, sensitivity matrix) – should be placed on a greater distance than while amateur photography. The exposition and object illumination should also be increased. Light-receiving surface of the device should be parallel to the object, the main optical axis of the lens should pass through the center of the object, the object and the device should be quiescently while photo-

graphy. During macro-photography of the crime scene there used extension tubes. Set of extension tubes (consisting of 4 different height tubes) is included in a set of technical tools for crime scene examination (case of the investigator, etc.). Digital photographic cameras have the macro feature that allows photographing small objects more quickly and accurately.

Long-focus photography – method of obtaining images of distant objects in the desired scale using long-focus lenses (see fig. 43).

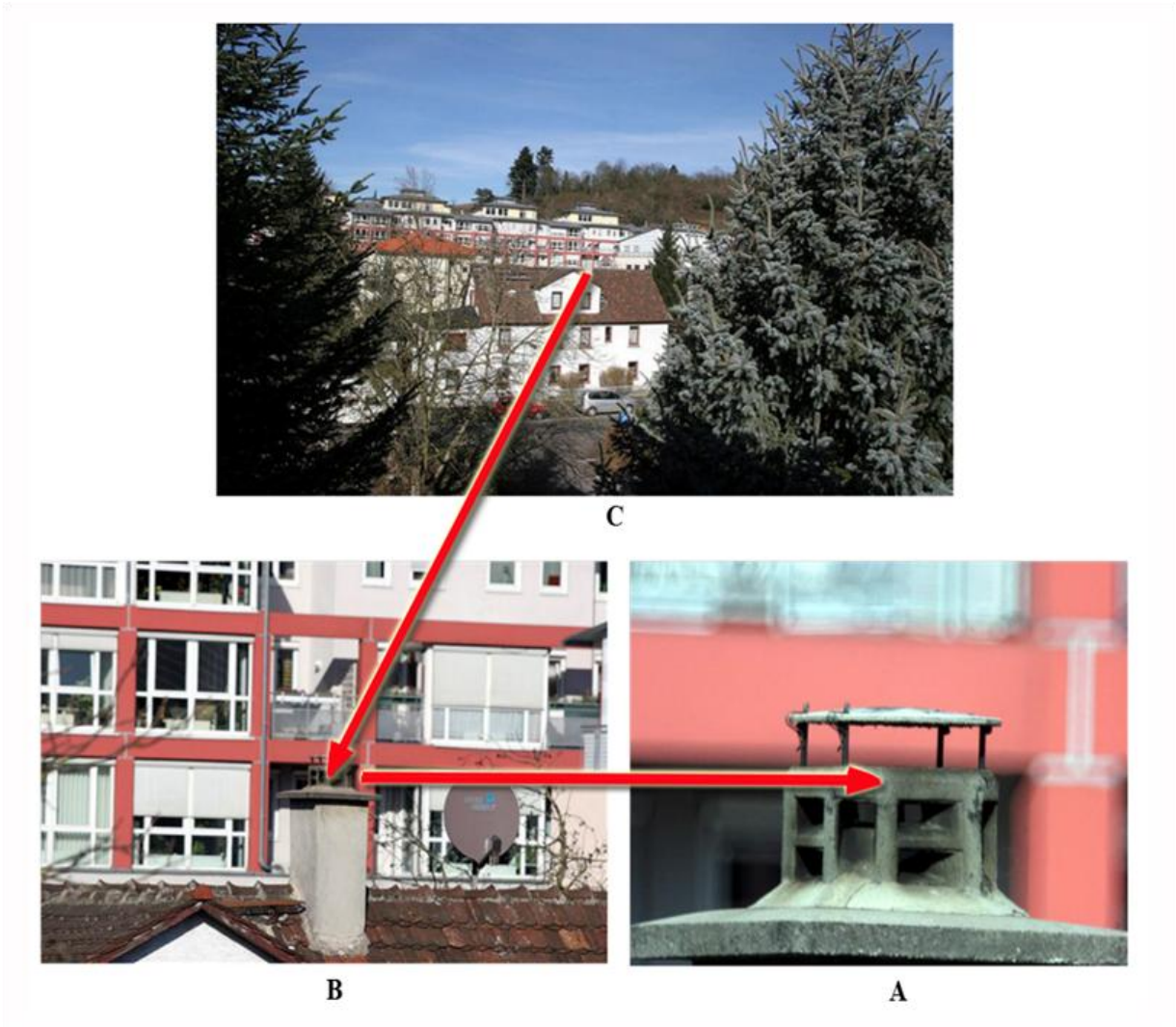


Fig. 43. Pictures taken from the same position by different long-focus lenses (A – long-focus lenses 1000 mm (long-focus photography); B – with a focal length 200 mm; C – with a focal length 17 mm)

Reproduction photography – reproduction of flat originals (texts, pictures, graphics, drawings, diagrams, schemes, documents) for obtaining their content, the general view full-sized, magnified or minified. (see fig. 44).

Fig. 44. Reproduction images

Orienting photography – made for the purpose of obtaining the general view of the crime scene including the surrounding environment and the main landmarks. Photography can be performed by panoramic method, and the photography point is selected as high and distant as possible from the object, in result an orienting image gives a large amount of information (see fig. 45). In case of using cameras with GPS, geographic coordinates of the crime scene photography should be determined and recorded to the protocol of the crime scene. The obtained results of geographical coordinates should be linked to the landscape map including used software and also be applied to the protocol inspection of the scene (see fig. 46)

Fig. 45. A panoramic picture of the place of discovery of the VAZ car with the state number _x00xx00 near by the lake Svetloye of the district

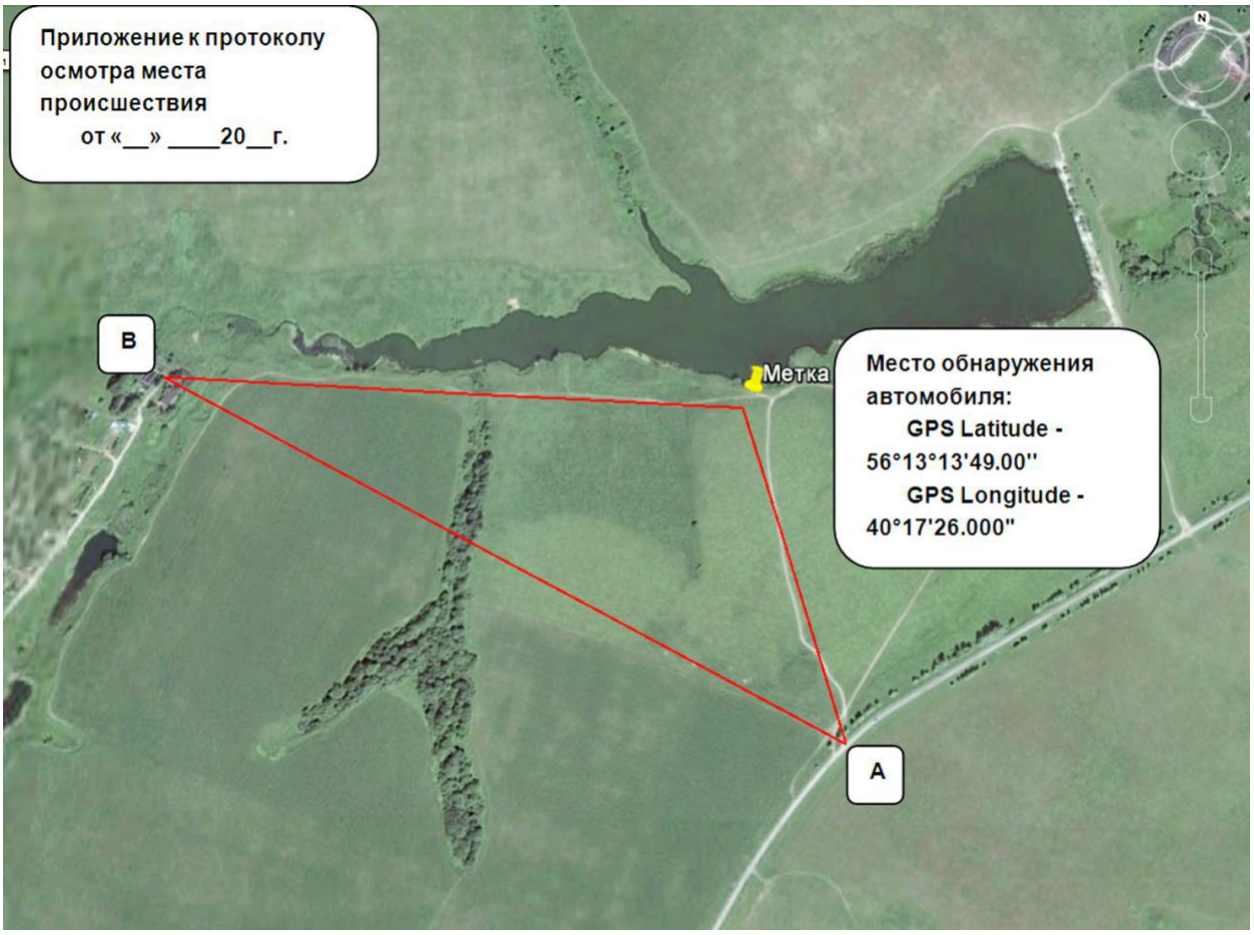


Fig. 46. A screenshot from the monitor screen
of the map of the area «N» navigation system «___».
Placemark marks the spot car detection and specified geographic coordinates;
distance between tag and point A – 454 m; tag and point B – 796 m;
point A and B – 1030 m

Overview photography is for capturing the crime scene without environment. The scene is photographed from different angles depending on the specific conditions. In some cases, the measuring methods of photography are used (fig. 47).

Nodal photography is used for capturing the node (i. e. a separate object, group of objects, tracks, relative positions of the objects relevant to the case), to provide a possibility to determine the shape, nature of the surfaces and the relative position of objects and tracks. The number of pictures depends on the amount of objects and their relative trace. Different methods of forensic photography can be used in nodal photography (fig. 48).

Oriental, overview and nodal photography fix the objects and traces in the position and form in which they were detected at the time of examination.

Fig. 47. Explosion site is photographed from the north, west, east and south sides

Fig. 48. Localization of lesions on the right side of the vehicle
(arrows indicate the enlarged photographs of similar parts of the vehicle)

Fixed objects on oriental, overview and nodal images should be reflected and linked so that it was possible to establish their relative positions and tracks on each of them. Thus, all photographs must be interrelated (on the principle from General to specific). The objects depicted in all interrelated photographs, should be reviewed and, if necessary, the detected objects and tracks are marked with numbers or arrows on the dynamic stage of inspection**.**

Detailed photography is used for close-up capturing the separate objects or traces, which considered to be the sources of evidence and should be obtained. Detailed photography is done using scale method that allows to obtain the original sizes of the captured object (fig. 49).

Fig. 49. Scale images of explosive submunitions traces on the right side of the vehicle

Additional lighting is used to reveal the specific details of the shooting objects and traces. For this purpose, various kinds of reflectors, screens and lighting methods to achieve the required illumination of the object (fig. 50–55).

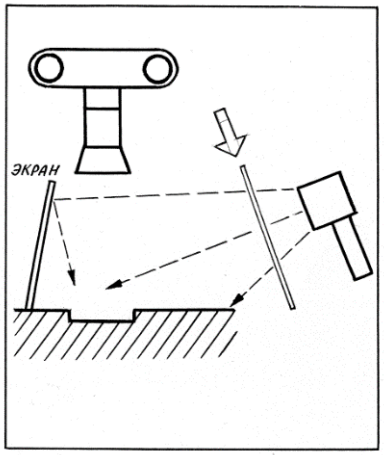


Fig. 50. Illumination by a directional light using shader and reflector

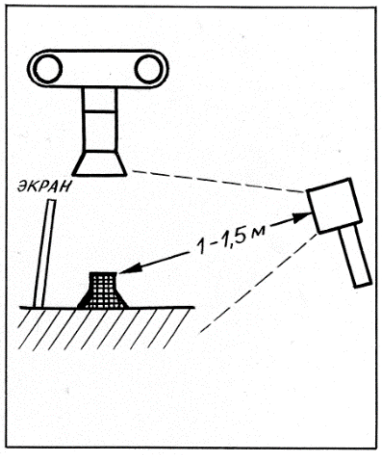


Fig. 51. Illumination by a directional distant light source using the screen

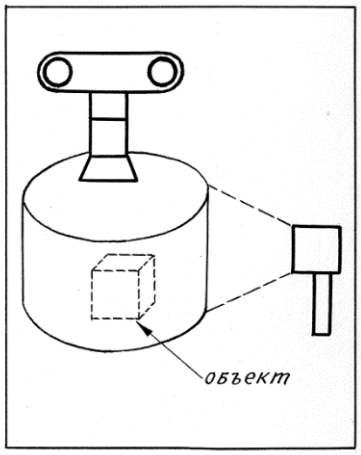


Fig. 52. Illumination by a the side scattered light source using the screen

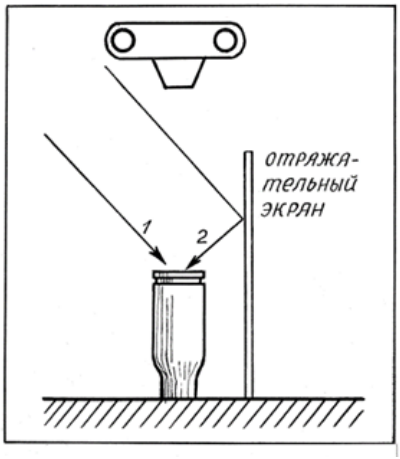


Fig. 53. Illumination by a side scattered light source using baffle

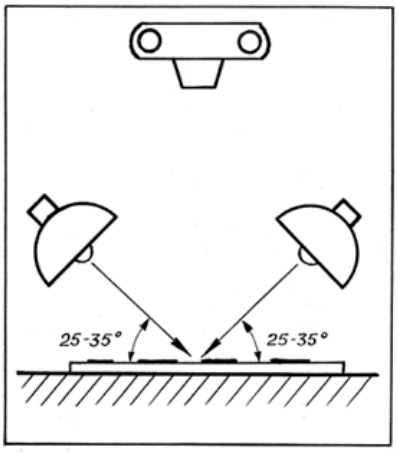


Fig. 54. Illumination by bilateral uniform light

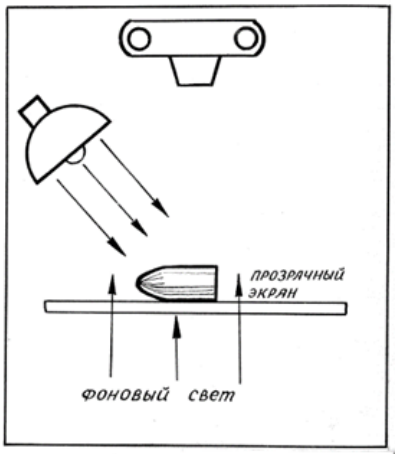


Fig. 55. Shadowless illumination on a light background

There are also other photography techniques used, such as:

– **counter photography** – photography device alternately located on the both ends of the line segment, mentally drawn through the capturing place of investigative action (fig. 56);

– **cruciform photography** – when the scene of photography mentally squared (or rectangled) and the device is placed in the vertexes of the corners or in the middles of the sides (see fig. 57);

– **frontal photography** – photography of the object is made from the central point perspective;

– **diagonal photography** – photography of the object is made from the displacement point perspective;

– **normal point (normal foreshortening) photography** – horizon line divides the frame approximately half-part;

– **upper point (upper foreshortening) photography –** horizon line does not divide the frame half-part but significantly raised beyond;

– **lower point (lower foreshortening) photography** – horizon line lies under the frame.

In forensic photography, the correct frame compositional structure, the choice of photography direction, skillful use of contrasts and illumination provide the quality, reliability and informational capacity of obtained images of forensic objects.

Below are the basic rules of manufacturing and design of illustration (photo tables), applied in investigative action protocol.

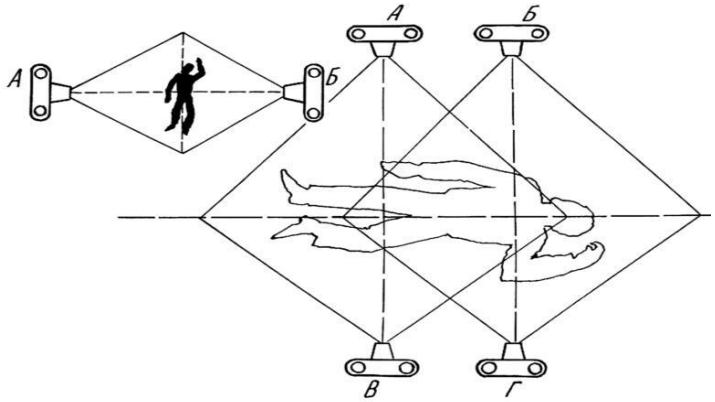


Fig. 56. Counter photography

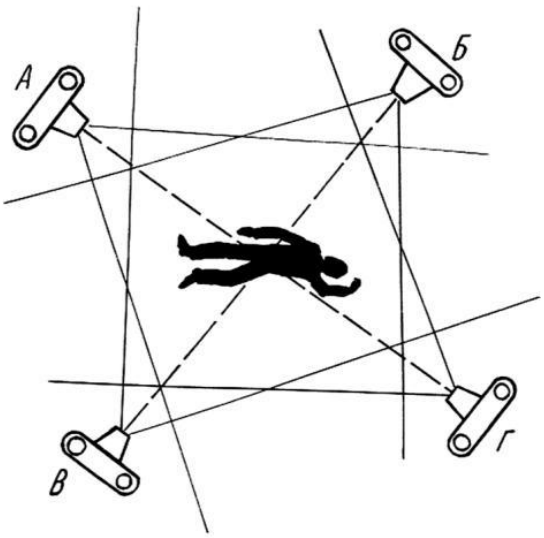


Fig. 57. Cruciform photography

Phototable

Application 1 to the protocol of the crime scene upon trespassing into the premises of the exhibition hall «Solntsevo» on March 13, 2015

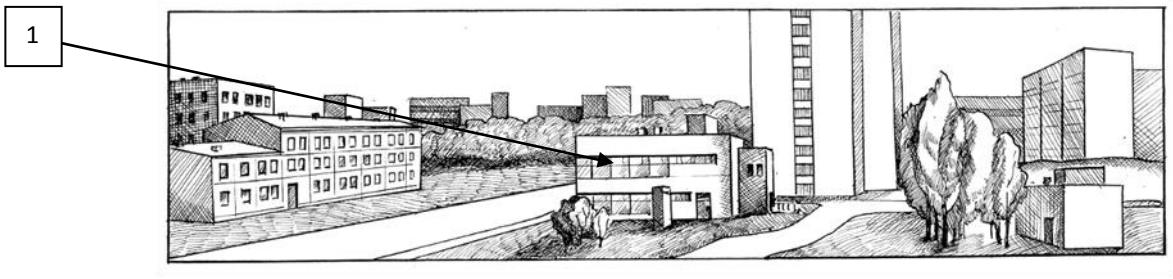


Image № 1. The southern part of the residential area located at the beginning of Solnechnaya st. Arrow № 1 points house № 2 on Solnechnaya st., where an exhibition hall is located.

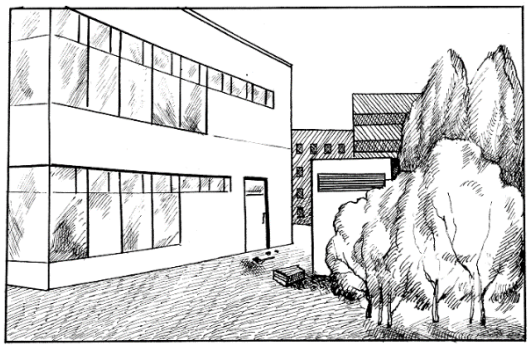


Image № 2. Entrance to the exhibition hall. Photography is made from the south-east side

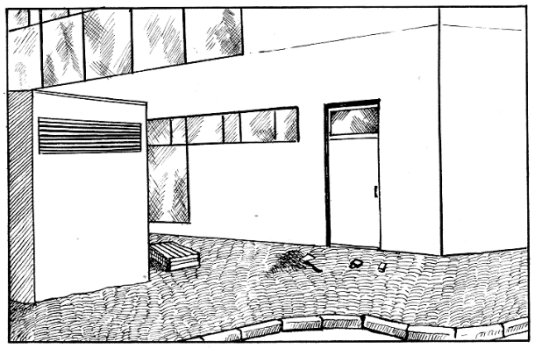


Image № 3. Entrance to the exhibition hall. Photography is made from the south-west side

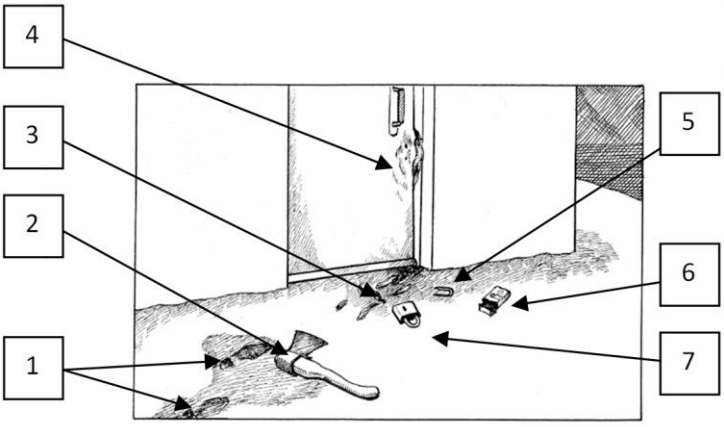


Image № 4. Part of the exhibition hall front door with traces of burglary and part of the sidewalk with the detected objects and traces. Arrows indicate: 1 – footwear traces; 2 – ax; 3 – shell; 4 – traces of tampering; 5 – clamp; 6 – pack of «LM» cigarettes; 7 – padlock

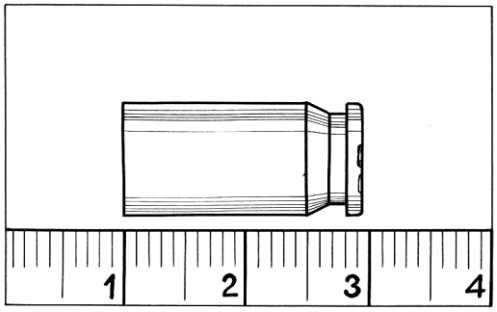


Image № 5. Shell, found near the front door of the exhibition hall

Note: For producing images for illustrative table files №№ 1264_IMG.jpeg on 1271_IMG.jpeg are used. Files hash-sum are calculated according to the formula specified in the MD5 and recorded in protocol.
Photo table done: _____ place; date _____; time _____.
Investigator: Specialist: Witnesses:

When using digital wireless the kit (camera + printer or camera + computer + printer) all actions made with images (illustrations to the protocol of investigation action) including at the scene, should be strictly adhered to demands of the CPC, recommendations of criminology and of this manual.

When producing photos with the use of the kit (camera + computer + printer) all actions taken with images (photo images) the change of brightness, contrast, measure, etc., should be recorded in the change logs of those programs with which they were treated, and attached to the protocol of investigative act or conclusion of expert. Optimal number of images required for full perception of the entire course of the investigative actions in order it was carried out (crime scene, detected traces and objects) are managed in the photo table.

All images placed in photo table must be interconnected. If it is an application to the examination of the scene objects captured by using orienting images should be observed on the overview images, in turn, objects captured by using overview images should be observed on the nodal and detailed images.

Photo table should have remarks, for example: «Images for crime scene examination protocol, March 13, 2015 upon trespassing into premises ECD-25 at Solnechnaya str., 2. Application № 1».

All photographs should have single sequential Arabic numbering, concise and clear explanatory inscriptions[23] under the photographs (what is shown, side of the photography, what is marked by arrows, marks). Example: «Photo № 5 scale image of the shell, detected near the front door ECD-25».

Pages with images certified by the stamp of the investigator or forensic expert unit (FEU), where the image was made. Expert, investigator and witnesses should sign each page.

Procedural and technical photographs registration. Images, photographic negatives, films, video tapes, computer hardware obtained during the investigative procedure are applied to the protocol or are the part of the expert conclusion and considered as a source of evidence. Procedural re-

[23] State standard 7.32-2001. Paragraph 6.5. Illustrations.

gistration of forensic photography during adversarial process requires adherence of the principle of equality of the parties and ability to check the obtained results. In this regard, there is an importance of strict adherence of the criminal procedural law. Process of obtaining images as a source of evidence consists of the set of actions, both technical and procedural. Technical actions provide informational content. First of all, it is the fullness of the fixed object. There should be seen details of objects and elements of the investigative action scene, the presence of the larger number of significant features capable to identify individual objects and traces of their relative positions etc. The image should be sharp, rendition, optimal brightness, contrast and color should adequately reflect the captured objects. Illustration should have a common title, which specifies its application as a protocol of investigative action, the criminal case, date, etc.

Conclusion of the expert includes the illustrative materials, confirming the findings of the expert. References to applications with illustrations are recorded in the research part of the conclusion. It is allowed to place images directly in the text of conclusion. Illustrations registration is produced by mounting the obtained images on special forms or cartridge paper or images imprinted on the application form consistently. Placing pictures in accordance with the progress of the investigative action or expert examination based on the principle from general to the particular. First, the orienting photographs are placed; overview; nodal images. Detailed images are placed after nodals. Images should be interrelated, i. e. object on a detailed image should be visible or shown by marker or arrowed on the nodal and orienting images, objects on the nodal image should be displayed on the overview and orienting photographs. If any important details, traces are not distinguishable enough, they are marked by arrows, letters, numerals and indicate their location. Arrows are numbered, explanatory texts notes include pointing information. Pictures should be sequentially numbered in Arabic numerals. Under each photograph explanatory text is placed, which states that image, from what point it was made (photography device position in the production of orienting and overview images is marked on the scheme of the crime scene), which is explained by the arrows, numbers. When using a digital photo it is necessary to specify the name of the file containing the printed image. Explanatory text to images must match entries made in the record of the investigative action or the research part of the conclusion. Phototables negatives or digital media disk images, which states: number of negatives, image files, etc. are attached in a sealed envelope.

Procedural actions provide photographs as evidence of such properties as the relevance, admissibility, reliability and sufficiency. All photographs appearing in criminal proceedings must be directly relevant to the case and of real interest to ensure it is the correct trail decision. All the techniques employed are obliged to guarantee the objectivity of the results, this should indicate the relevant regulatory documents (State standards, certificates of compliance; licenses, etc.).

To meet the requirements of criminal proceedings in the record of the investigative action reflects the application of photo – video, making illustrations; communion materials taken to the criminal case. In the report of the investigative action, during which applied photographing or video states:

– information that the participants are instructed about the use of technology;

– information about the technical means (stamp used camera lens and its main characteristics, the name filter and extension tubes, photosensitive materials used);

– the conditions and procedures of their use (during photography, the exposure, the number of captured frames for digital photos indicate basic metadata – EXIF, number of file, its capacity and other parameters stored on the file with the image of the photographed object);

– which objects are photographed, which methods and techniques are applied in their photography (panoramic, measuring, macro, etc.);

– the results obtained.

For digital photo cameras there should be considered digital imaging features and the ability to edit them. In this connection digital imaging technology are used to ensure their protection against unauthorized processing. In the report of the investigative action, some of the above information should be disclosed more fully than using galogensilver photos. For example, specify the application, technical means: view; model; manufacturers of the used device and its serial number (Make: Canon, Model: Canon EOS 20D, Lens Type: 28–105 mm; Camera Serial Number: 1731000553); certificate of conformity № ROSS JP. BZ02. B00004 issued 19.07.2013; media – type, species, size, number (solid card SanDisk, № 5070032, 16 Gb); photography conditions. Information about the conditions obtaining image contains a file on the media with information about the image[24]. This important information can be viewed in some models of

[24] EXIF-information is stored with each image. It includes: time, exposure modes, the light source, object distance, aperture, focal length, aperture, whether the flash is activated, etc., up to 80 positions, including the serial number of the camera, the geographic coordinates of where it was made photography and other /

cameras right on the monitor unit, or by special software. View metadata (information about the file containing the description of the image), can be used by the program Adobe Photoshop CS3 and other EXIF-data can be viewed with a special software «ShowEXIF», «Opanda PowerExif», etc.

To ensure the integrity, authenticity of digital information in accordance with the standard procedure[25] and the algorithm of computing the hash function for any sequence of binary symbols, as well as any digital image is written to the binary symbols, the hash function can be used to protect digital images from a non – sanctioned intervention. Subsequently, the checksums of files can be at any stage of the investigation to verify the identity of those files. Since checksum files are created based on each bit of information in the file, and if one bit in the file will be changed, check of the checksum will not match the file. Record of investigative action or expert judgement basic information about the file with the received image and the hash sum (checksum of file) will ensure the reliability of the obtained image and its continued use in the investigation.

Procedure for the use of technology. In this part of the protocol should describe the actions of the expert or the person conducting the survey on the shooting conditions, image acquisition, making pictures in the investigative action, or transfer them to another drive using recording devices, its packaging, etc.

Subject of filming. This part of the description is the same as with conventional photography. For example, «made orienting survey of the terrain where the body was found c. N., on the south side, in a manner cyclorama (4 pictures) with reference to the high post number 231, and the like».

Results. In this part of the protocol should specify the results of shooting. For example, on which information carrier, in which folder, the number of files (from the № … to № …). Computed checksum files (hash sum). For example: all source files and processed images obtained during investigative proceedings (from № … to № …) were achieved (archive is blocked), calculated checksum (hash sum) 9125c25cd32aed9dd93d55de59d7e928 (amount calculated by the formula using the MD5) by the Total Commander 7.56a, recorded in the file (img_000.md5) in the presence of witnesses, by the above PC to write-once disc with matrix disk number 00000000 and with a closed session. Before recording, a special black felt-tip pen on the broken surface of the disc was made handwritten entry «Application 2. WMD to the protocol from 02.05.2015. _____ investigator, expert _____ witnesses_____», made colorant _____ color. In the presence of witnesses, the recording quality has been tested on the same PC, the disc is packed in an envelope with the

[25] GOST (State standard) R 34.11-2012/

same handwriting and handwritten signatures of the same individuals, sealed envelope printing № _ (print transcript) and certified by the signatures of members of the investigative action.

The same procedure must be performed while maintaining digital images, and all electronic materials expert conclusion.

Making illustrations (phototables). If on-site production of the investigative action produced photographs indicate how they were obtained with the help of some devices, how many were made, what material and decorated as when and who manufactured them. In order to avoid changes in the digital images in the production of investigative action, shooting and production of pictures must be in the presence of witnesses who certify their own signatures. To obtain the images can be used by printers that are connected directly to the device without a computer or printer, built- in shooting machine. In this case, the obtained pictures are mounted on the blank in the same applications as previously indicated. In some cases, can be used mobile special photoset equipped with a laptop and a printer or a special recording devices that can record digital images obtained using disposable CDs. In the manufacture of photos and illustrations to design application source images (digital negatives) and processed images should be stored in separate folders. Processing images in graphic editors made changes to the protocol enabled, preserving detail in the report record metadata of the image file and a text file[26].

The record indicates that it was done with digital imaging. Thus, when using the digital photo – video cameras, to be attached to the minutes of the investigative action at the venue, made two copies of the images. First copy on paper manufactured using a printer, a second copy of a file in a graphical format saved on the media computer information – CD-ROM (see above). When making the protocol a copy of the first and second images to certify the signatures of participants inspection. And also in the production of expert studies the presence of two copies of the image (on paper and in digital form), as well as a special order of their receipt does not allow fake images obtained. In this case, there will always be an opportunity to verify the authenticity, integrity, digital information content component of the digital image, it is possible the validation of the document.

[26] More information about text entry in the protocol, see: V.A. Gazizov On the use of digital technologies in fixing the progress and results of investigative actions // Bulletin of criminology. – 2007. – № 2 (22). – P. 70.

5. SURVEY PHOTOGRAPHY

Survey photography represents a system of scientific principles, and based on them the ways, methods and techniques that are used for identifying and fixing the invisible objects and their attributes in the course of examinations and investigations.

Photography is used for:

– survey of the general form of the objects (see fig. 58, 59.)
– it can use the methods and techniques imprinted photographs;
– detect invisible and low identifiable attributes of the objects;
– imaging for comparative research facilities;
– illustrations in visual form conclusions expert as a result of the study.

Fig. 58. Photograph of a bullet that was received for the examination

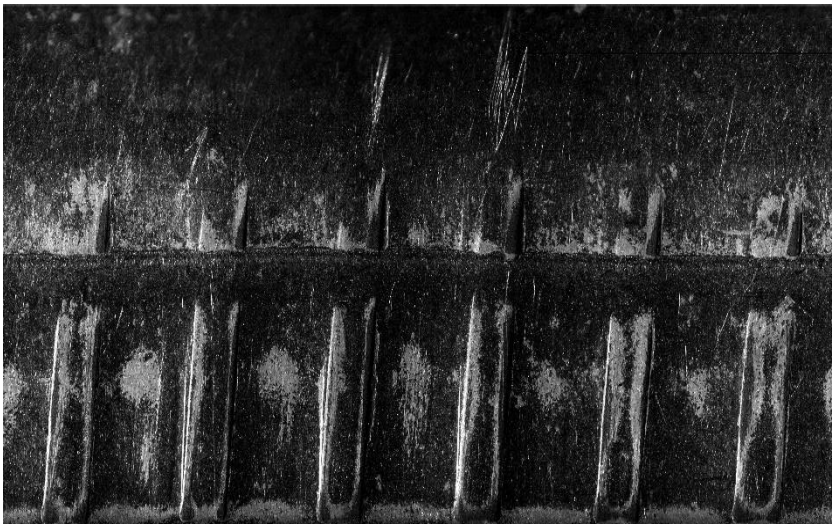


Fig. 59. Photograph sweep side of the bullet that was received for analysis. Survey was made by using ballistic scanner «Papillon BS-7»

In the research photos, along with imprinted shooting methods are used special photographic techniques that are used in the production of forensic examinations: photomicrography; comparative survey; color-different survey; contrasting survey; Infrared survey; survey in the ultraviolet; survey in X-rays; high-speed survey.

Photomicrography is the method of producing photographic images of small objects in a given scale using a microscope coupled with a film unit. It uses special techniques micrographs[27] (fig. 60, 61).

[27] Fedin .L.A., Barskiy I.Ya. Photomicrography. L. : Nauka, 1971.

Fig. 60. Photograph bottomed shell with an object micrometer

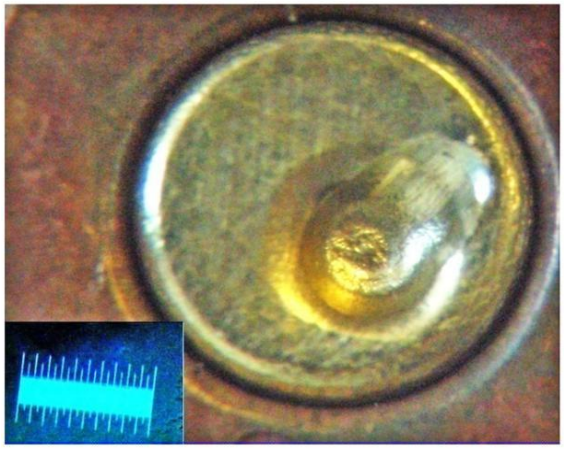


Fig. 61. Photograph track striker on the primer to the shell with a micrometer

Comparison survey – is the survey subjects of expert study, performed for the purpose of a comparative study of the resulting images to identify them (fig. 61). There is number of requirements that are observed to obtain images suitable for the production of comparative research photographed objects and their parts, while surveying them:

– images of the objects must be in the same scale, in one perspective, in the same conditions;

– the photographs must be edited on a single screen or on illustrations, which compares by applique or overlay;

– check images of objects that are used in a comparative study, persist;

– compare features are marked by numbers.

Color-make out survey – is a special kind of photo that is used in research to increase or decrease the contrast between objects having weakly visible or invisible to the eye the difference in color (fig. 63).

This survey is needed to identify strokes wiped, washed out, etched, faded text, seal impressions, images and the like, as well as strokes to finish in altered numbers and letters that do not differ appreciably from the original color of strokes.

Contrasting survey – is a set of techniques and methods of photography and processing of materials received, having the ultimate goal of increasing the brightness and color contrast of the image (fig. 64).

Survey in infrared – is a method of producing photographic images of objects using infrared rays to detect signs of the object that is not perceived vision in visible light. This method allows you to see the text, filled with some dye, and the differences in color or brightness of the substances that are similar in their optical properties (fig. 65).

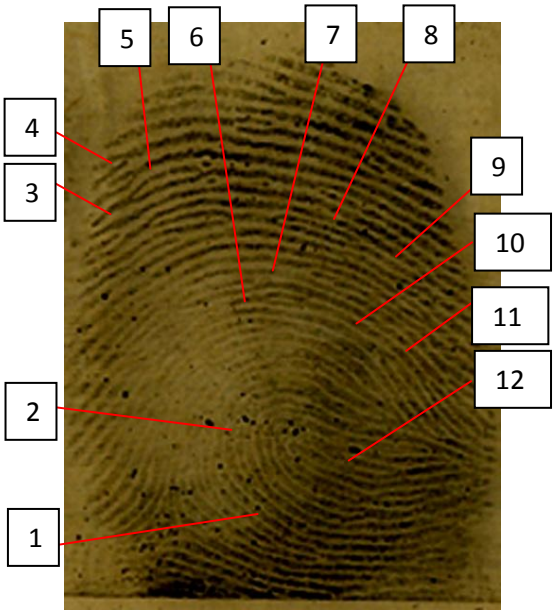


Photo number 1.
Photograph track finger that was found at the scene

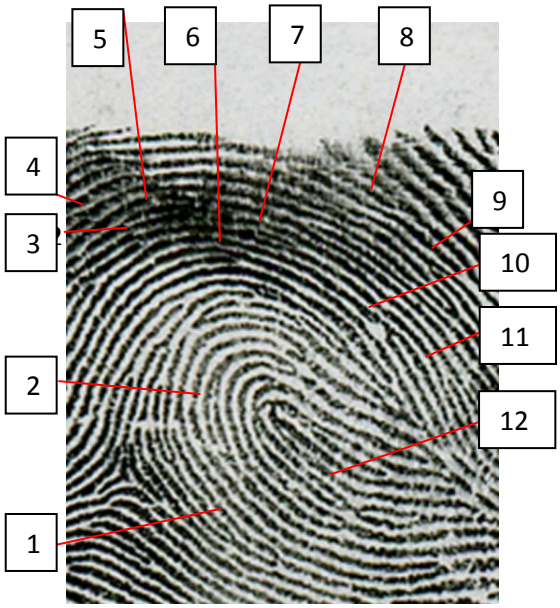


Photo number 2.
Photograph print right index finger with a fingerprint card

Note: The red arrows homonymous marked matching individual features.

Photo number 3. Control photo trace of the finger that was found at the scene

Photo number 4. Control photographs papillary patterns print right index finger with fingerprint cards

Fig. 62. Fragment illustrative table of expert opinion with comparative photographs

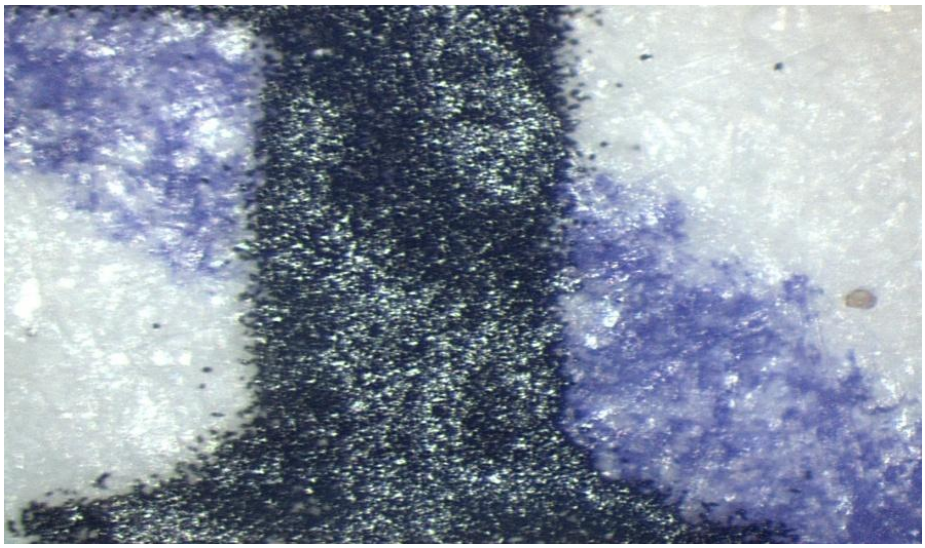


Fig. 63. Color-make out image of the strokes in the test document

Fig. 64. Contrasting photographs document fragment

Fig. 65. The photograph of the document fragment in infrared luminescence

Survey in ultraviolet rays – is a method for obtaining images of objects and their attributes using ultraviolet rays, that are not observed in visible light. Using this method allows you to see the etched or faded text, additional tracks shot at the barrier, etc. (fig. 66, 67).

Fig. 66. Document fragment flooded with numeric and alphabetic entries

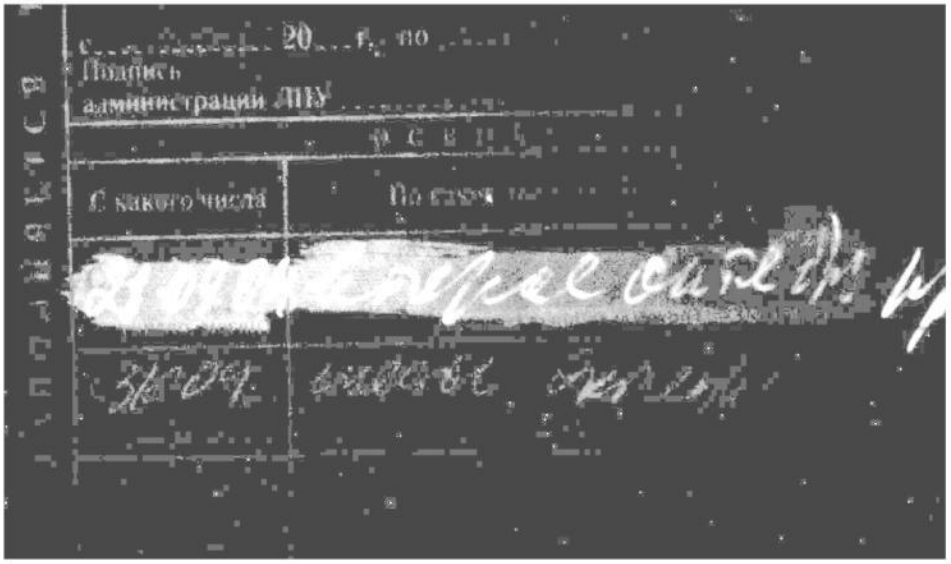


Fig. 67. Alphanumeric entry identified by the method of ultraviolet photography

Survey an X-ray – is a method of producing photographic images of objects at the moment of an expert study of radiographic their gamma-and-beta-rays, as well as spectral analysis (fig. 68).

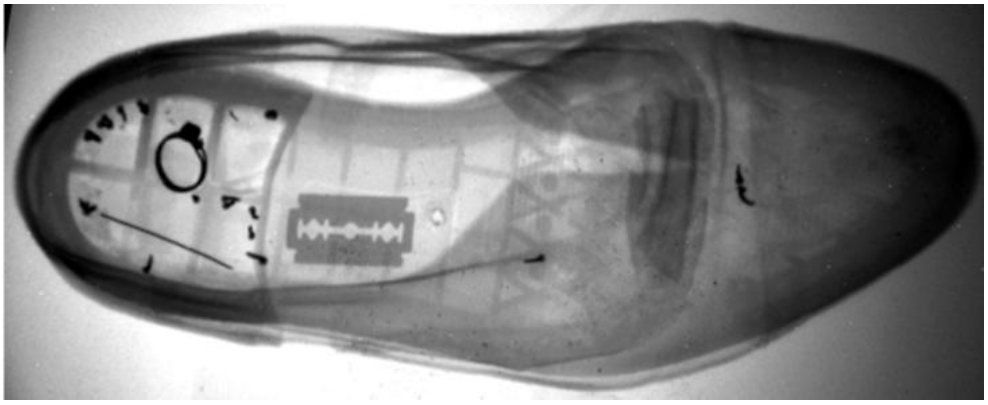


Fig. 68. X-ray photograph of the object that was delivered for examination

High-speed survey – is survey of rapid processes with expert study (explosion, structural failure, etc.). Recording is performed with special equipment, allowing, for example, get a picture of the bullet in flight (fig. 69).

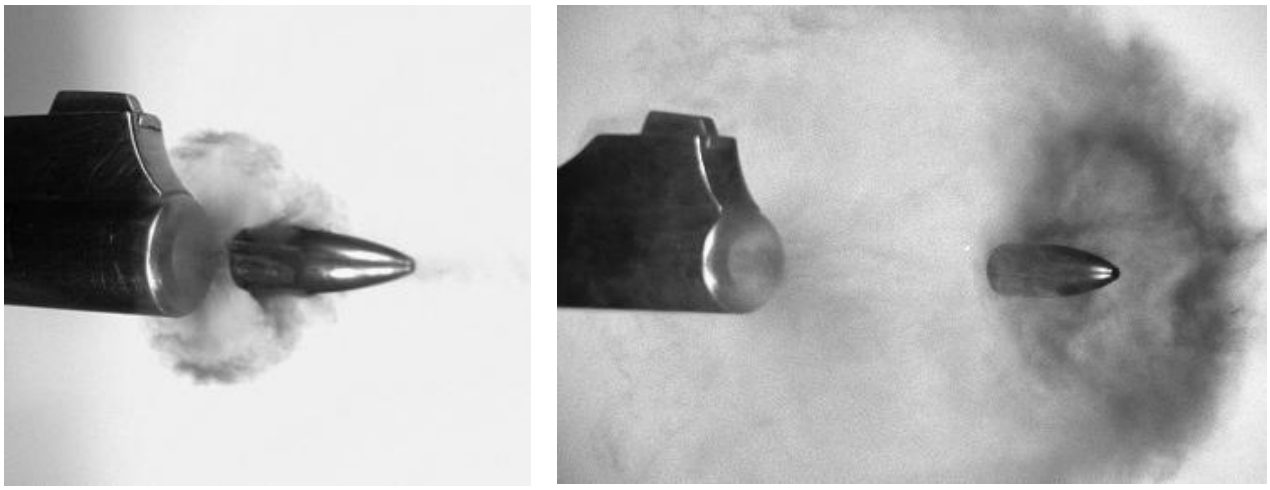


Fig. 69. High-speed shooting action of the shock wave of the powder gases at the moment of exit of the bullet from the barrel and the beginning of its flight

In modern conditions, the use of digital photography in survey photography opens new possibilities for studying the hidden information on a new basis for science and technology, which in turn, requires improving old photographic techniques. So now the digital image processing techniques that becomes applied to achieve effective results with much less time-consuming compared with photographic methods using silver-halide photographic processes. In the study by digital photo processing images of objects forensic examinations, the resulting image may be subject to significant change based on the objectives of the study. Thus, results of digital image processing must necessarily be supported by conducting special protocol processing (more detailed see V. A. Gazizov, P. A. Chetverkin. Probative value of digital photography in the production of expert studies in criminal proceedings // Expert-criminalist. – 2008. – № 1).

Basic knowledge of general photography, forensic photography and electronic photography, knowledge of methods and techniques that use in fixing the situation of the scene, forensic examinations, as well as knowledge of new methods for digital image processing and complement traditional photographic methods and open up new opportunities for capturing and forensic studies objects, which significantly increase the effectiveness of crime investigation. Ensuring authenticity of digital images in forensic and digital photography is possible with the high quality work of specialists, in strict compliance with the procedures of digital image processing that should be completely transparent and open to re-analysis. The original image must be preserved. All processes that change complementary to image (quality improvement, cropping, filtering, etc.) should be recorded. Forensic photographers must strive for the highest standards in their work, which will significantly improve the efficiency of investigation of crimes.

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4. Murakhovski V. I., Simonovic S. V. ABCs of digital photos. SPb. : Peter, 2005.

5. Practical guidance on the production of forensic examinations for experts and professionals: a practical guide. M. : Yurait Publishing, 2013.

6. Standard Operating Procedures in Forensic Digital Imaging – F. I. S., F. S. G., NSW Police July 2002. 2.

7. The Practical Methodology of Forensic Photography, Second Edition. 2000 Redsicker; David R.

Websites where you can find a variety of materials on the history of development and use of the photographs in the detection and investigation of crimes:

URL: http://www.forensic.ru/index.html.

URL: http://www.school-of-photo.com.

URL: http://www.formation-photo.com.

URL: http://www.stop-system.com.

URL: http://www.pixoclock.com.

URL: http://www.pixpartners.com.

URL: http://www.photography-websites.com.

URL: http://www.portail-photo.net.

URL: http://www.formations-photo.com.

URL: http://www.petitesannoncesphoto.com.

URL: http://www.stopsystem.info.

URL: http://www.prophot-numerique.com.

URL: http://www.pix-partners.com.

URL: http://www.rleggat.com/photohistory/index.html.

URL: http://www.speos.fr.

URL: http://www.speos-photographers.com.

URL: http://www.photo-paris.com.

URL: http://www.photography-ads.com.

URL: http://www.prophot-numerique.com.

URL: http://www.niepce.org.

URL: http://www.saintloupdevarennes.com.

URL: http://www.speosphotographers.com.

URL: http://www.photography-paris.com.

URL: http://www.photographyads.com.

URL: http://www.pixoclock.com.

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BASICS OF FORENSIC PHOTOGRAPHY

FOR LAW ENFORCEMENT AGENCIES OF FOREIGN COUNTRIES

Tutorial

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