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# Some aspects related to digitization of glass plates

Archival glass plates pose some difficulties, both in terms of preservation, as well as storage and digitization. This text discusses basic aspects related to digitization of such plates, security, digitization methods, equipment selection and configuration, practical steps, developing outcomes, quality and information contained in a digital image.

## 1. Risks of the digitization process

The basic criterion for choosing digitization method of plates is thermal and mechanical security as well as time and intensity of light which a plate has been exposed to. Increased temperature during the process may lead to separation of the emulsion from the underlay, deterioration of existing damage, local bulges or even smoke stains.

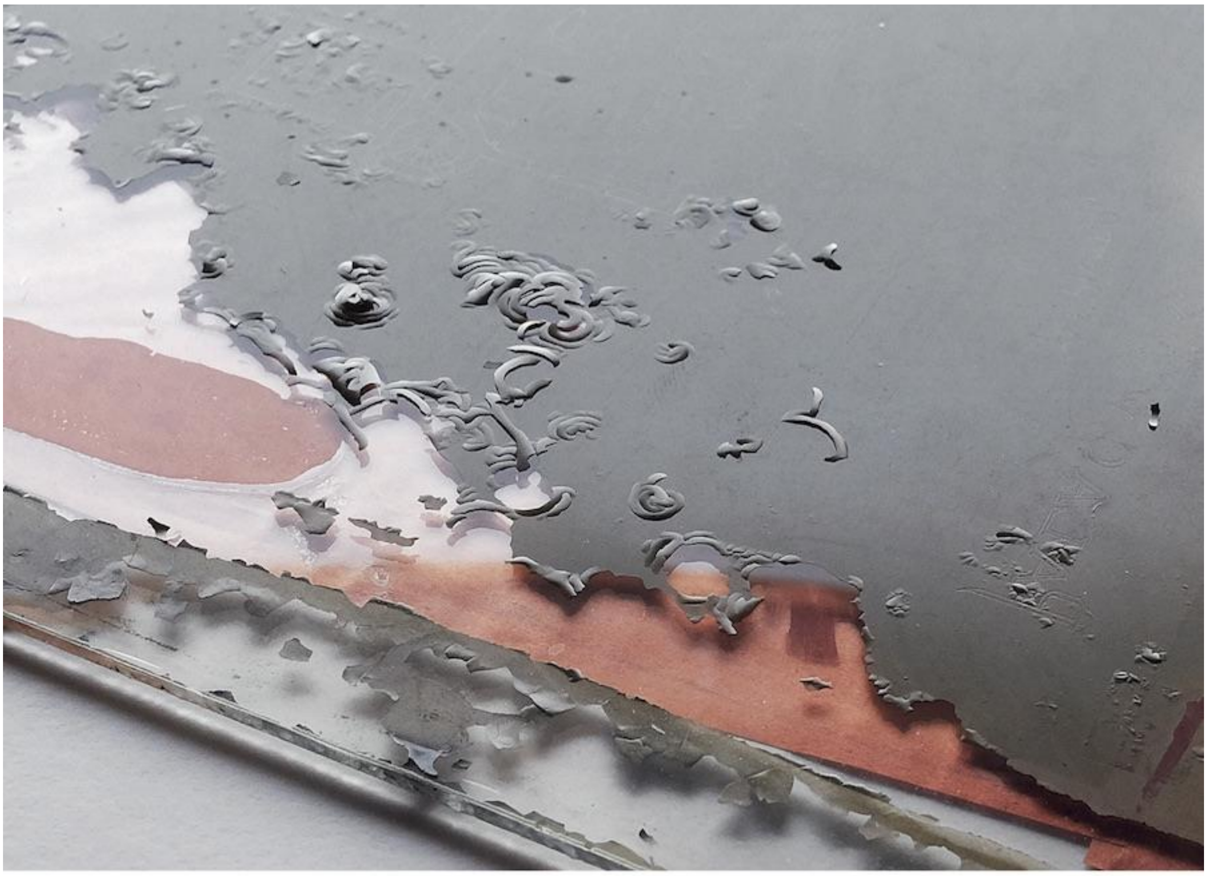


*Photo.1 Sample emulsion damage on a glass plate. Negative from the collections of MHK. Developed by W. Pyzik*

Emulsion on a plate is prone to mechanical damage, e.g. as a result of moving, unpacking or placing on a device. Mainly however, it may be mechanically damaged when wrong reproduction technique is applied. It is crucial that a plate is located on a work stand with emulsion facing upwards so that the weight of the plate does not ruin the emulsion. Emulsion must be directed towards a recording sensor.

*Photo.2 A glass plate with emulsion separated from the underlay. Putting such a plate with damaged emulsion on a glass will result in its damage. Negative from the collections of MHK. Developed by W. Pyzik*

Simple and, apparently obvious, steps that considerably improve the security of glass plates in the process of digitization include:
- ensuring proper humidity and temperature at the studio,
- providing sufficient room with soft pads to unpack, prepare, and put plates back following the process,
- applying protective gloves, because a finger print left on an emulsion will damage it for good, whereas sweat contains substances that cause chemical reactions and degrade emulsion,
- finding an adequate way to raise the plate from a reproduction stand (one plate may stick to another glass plate, thus leading to crumbling or breaking of a thin plate
- minimizing light exposure of a plate.


*Photo.3 Reproduction of a plate with damaged emulsion presented on Photo.2. Negative from the collections of MHK. Developed by W. Pyzik*

## 2. Acquisition methods of digital images from glass plates

Other criteria taken into account when selecting a digitization method are: capacity to correctly register details in the darkest areas of the negative, i.e. D-max rate, maximum optical resolution, type of target file (TIFF or RAW), possibility of stitching, possibility of performing a high dynamic range representation, i.e. HDR. *

**Comparison of two digitization methods of glass plates.**

1. Scanning using flatbed scanners adjusted to support transparent materials:

**Scanners** have a constant Dmax (optical density) rate, which may be insufficient to attain proper image, even when applied flatbed scanners are of high quality. **

**In scanners** optical resolution is defined by parameters of the optical converter, i.e. recorder. This is a constant rate for individual scanner models.***

2. Photographic method in transmitted light:

**Photographic technique** in transmitted light allows for changing light intensity; consequently one may adjust the Dmax rate, which is only limited by the power of applied lighting.

**In the case of digital cameras,** maximum resolution for reproduction of an object of certain size will be determined by its image sensor parameters.****
This value is constant for every camera model; however we may apply a higher camera model here or use one of the methods described above.*

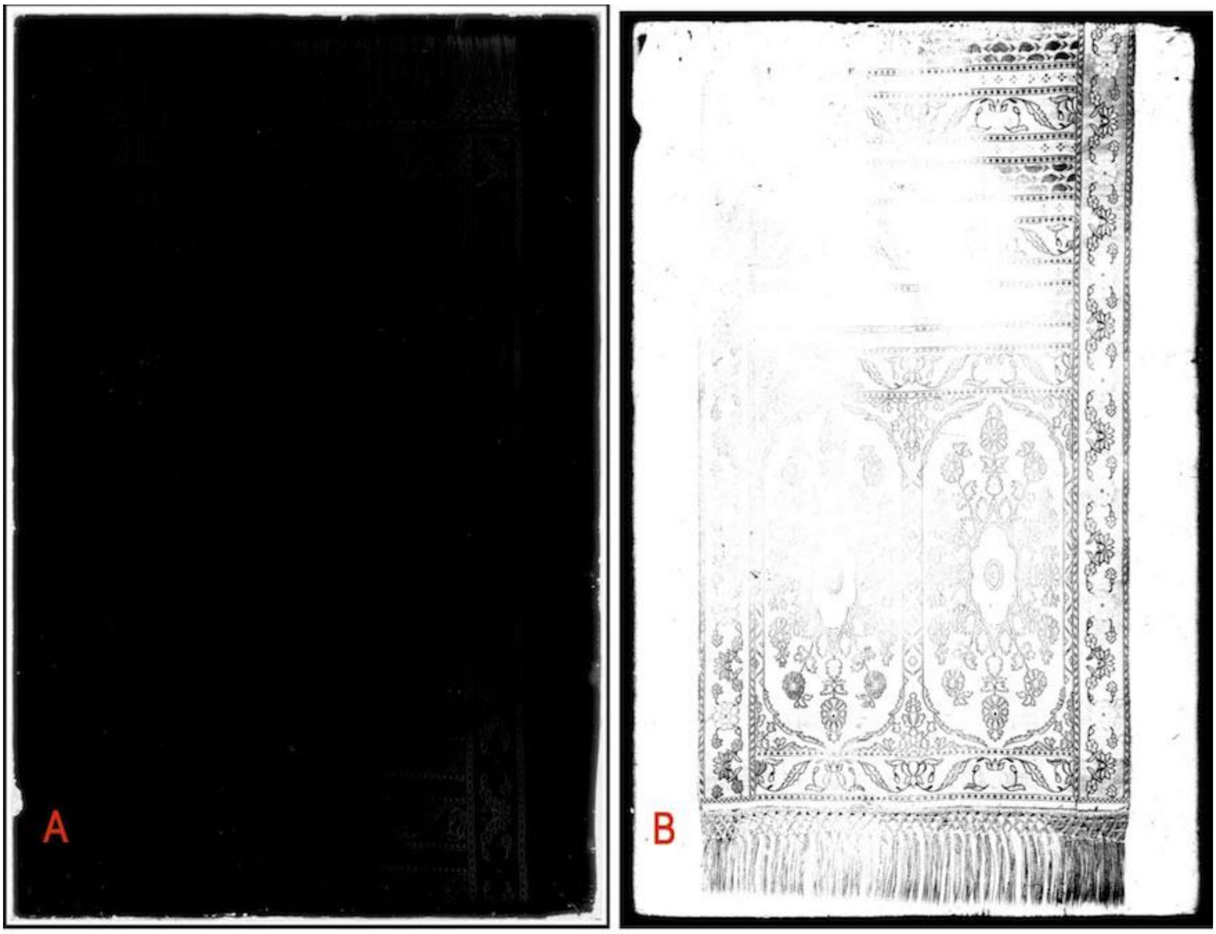
** Digitization formula does not allow for using a stitching or HDR methods. However, in some cases they must be applied to obtain very high resolution, e.g. for detail identification or to obtain an image from an extremely high-contrast plate. In such situations, two files will be created: one using a standard method with the best quality and the second one, using of the methods indicated above. Then, our reference image will be the first file, whereas the second one will be an auxiliary image.*

***Optical density D for transparent materials is a physical property that equals decimal logarithm of the ratio of incident light intensity ($I_p$) do transmitted light intensity ($I_k$),*
$D = \log ( I_p / I_k )$. *Consequently, Dmax=3.8 (a professional scanner A3 Epson Expression 10000XL) allows for correct recording of a signal weakened by 6,300 times. In the case of Hasselblad X5, which is a scanner dedicated to celluloid negatives, Dmax equals 4.9 which permits to properly record a signal weakened by 80,000 times.*
**** E.g. the number of recording elements, i.e. pixels on a strip amounts to 20000, whereby the maximum scanning format is A3 (29.7 x 42cm). since the recording strip is at the shorter side and moves along the longer one, the figures will be as follows:*

*29.7cm : 2.54 = 11.69 inch (1 inch = 2.54 cm)*
*20000 pixels: 11.69 inch = 1710.86 ppi [pix/inch]*
*In this case, the scanner's optical resolution will be 1700 ppi. In practice, every scanning device operates at native resolution characteristic of a given scanner model. Native resolution is always lower than the optical one and can be determined only in the course of individual tests of a given scanner model.*

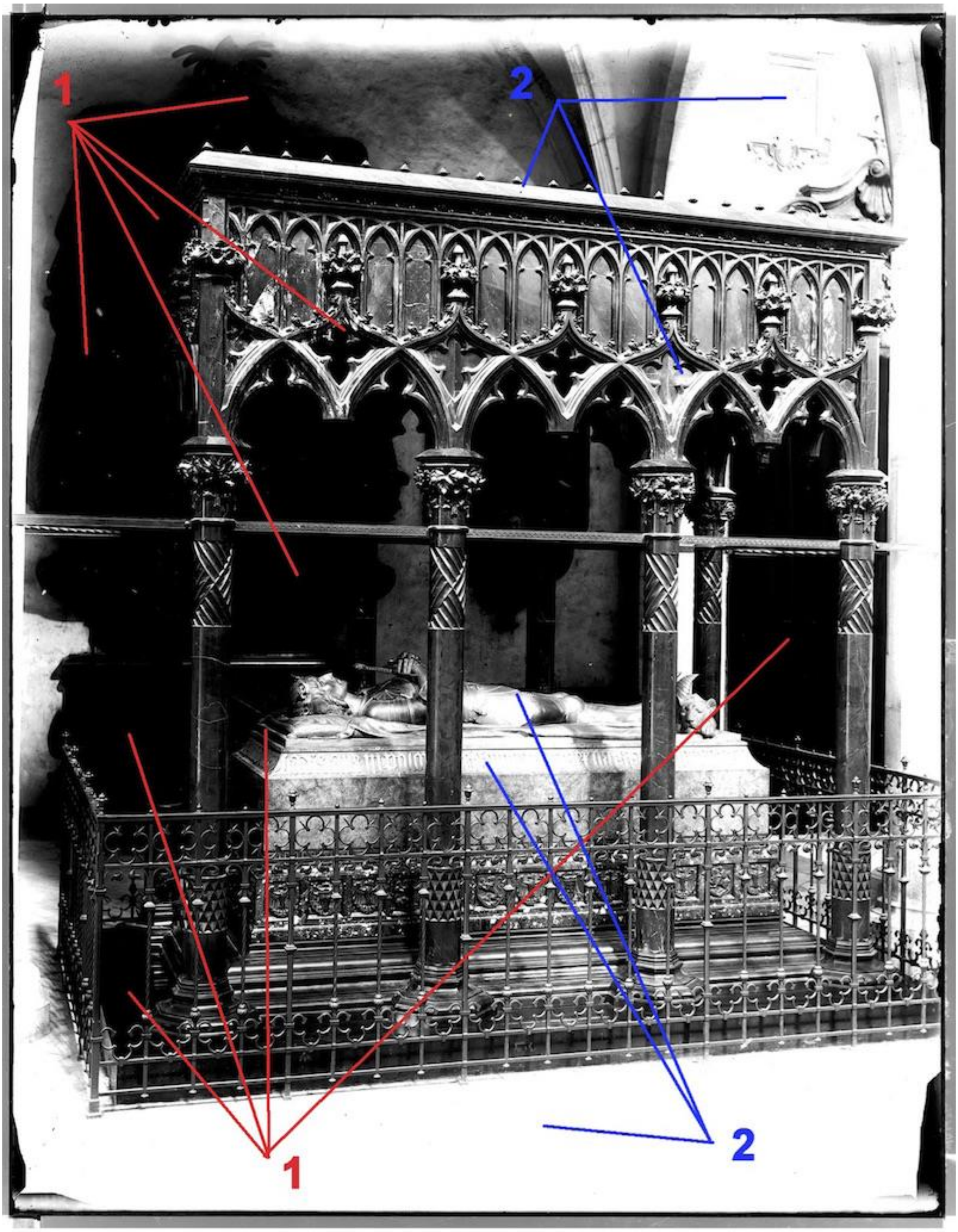
**** *E.g. camera Canon EOS 5DsR (used to make reproductions of the photos in the text) has resolution amounting to 8688 x 5792 pixels. This means that an object whose size is 23cm x 27cm ( 9" x 10,62") may be digitized at maximum resolution of 8688 / 10.62 = 820 ppi.*
*When four parts of an image are reproduced and merged into one, we will obtain an image whose size will be [(8688 x 2) – 20% of a bookmark] x [(5792 x 2) – 20% of a bookmark] = 13900 x 9270 and so the ultimate imaging resolution will be 13900/10.62 = 1310* *

## 2.1 Sample outcomes of negative digitization using scanning and transmitted light photography.




***Scan 1.*** *Scan of a very dense negative and an attempt to develop it. It is clearly visible that the optical density Dmax of the scanner is too low. Scanner Epson* ***Expression*** *10000 XL. Negative from the collections of MHK. Developed by W. Pyzik*
*A-negative; B-developed positive*


***Photo. 4*** *Photograph of a very dense negative and its development. With the possibility of adjusting transmitted light intensity (and thus of Dmax) and recording in the RAW format, one may obtain a correct reproduction: digitization of the object. Digital camera Canon EOS 5DsR. Negative from the collections of MHK. Developed by W. Pyzik.*
*C – RAW file;  D – developed positive*




*Scan 2. Scan of a high-contrast negative. Scanner Epson Perfection 10000XL. An attempt to develop a positive. The markings show characteristic image fields which the scanner failed to properly process. 1 - shadows; 2 - lights.*
*The same fields are marked on Photo. 5. Due to a low range of optical density, white and black stains have emerged without any details in the fields of shadows and lights. Negative from the collections of MHK. Developed by W. Pyzik.*


*Photo. 5. Photograph of a high-contrast negative. A positive developed out of a RAW file. Digital camera Canon EOS 5DsR. Similar fields have been marked as on scan No. 2.*
*1 - lights; 2 - shadows. Details of lights and shadows are visible. Correct reproduction – digitization of a negative.*
*Negative from the collections of MHK. Developed by W. Pyzik.*

## 3. Device selection and configuration

At the Historical Museum of Kraków, the project of glass plate digitization was preceded by an analysis of the aspects described above. It was agreed that the glass plates in our collections, including plates by Krieger, would be digitized using the transmitted light photography method. For this end, a special work stand was prepared to reproduce transparent materials based on a proprietary design.

### 3.1 Design characteristics

**An applied device should:**

- be solid and stable to eliminate shocks and ensure precise adjustment,
- ensure precise and repetitive adjustment of settings,
- use as the main light a flash, among others in order to eliminate effects of system vibrations,
- ensure reproduction of glass plates to the 40 x 50 cm format,
- ensure precise adjustment of the camera location in three dimensions,
- make it possible to move the camera quickly and precisely both vertically and horizontally (facilitated cropping),
- make it possible to illuminate the plate in a safe, low-temperature way, with the option of intensity adjustment (necessary to set the focus),
- ensure correct exposure settings by adjusting transmitted light intensity (working light), assuming that time, aperture and sensitivity rates are constant,
- ensure the possibility of accurate positioning of the plate and masking damaging light,*****
- safeguard the photographed object against the ambient light and direct reflection,
- allow for high work productivity as well as easy and ergonomic use.

**Requirements regarding photo equipment:**

- digital camera with highest possible resolution (in this case: Canon Eos 5DsR),
- work with the lowest native ISO sensitivity,
- work is performed using fixed macro lenses (in this case: Zeiss Makro-Planar T* 100 mm),
- work is performed using lenses with precise manual focus adjustment (in this case: see above),
- work is performed using apertures described by the manufacturer as optimal (in this case: f/8),
- work using sync speeds adjusted to studio flashlights (in this case: 1/100s)

**The whole equipment (device + camera + IT infrastructure)** should :

- allow for utilization of best technical capacities such as tethering, Live View, remote triggering, mains power supply, instant preview of an exposure in the form of a negative or a positive,

- ensure smooth support of large files,
- support existing graphic software (in this case: Photoshop, CaptureOne PRO),
- make it possible to precisely set the parallel between the image sensor of the camera and the glass plate,
- make it possible to optimize the amount of light falling onto the plate.

***** *Harmful (undesired) light is a strong light falling directly into the lens aside from the photographed object. It may lead to various types of flares or smoke stains on the recorded image, reducing contrast and causing discoloration.*

## 3.2 Work stand for glass plate reproduction

The photo below presents the second version of equipment, following modifications and improvements.

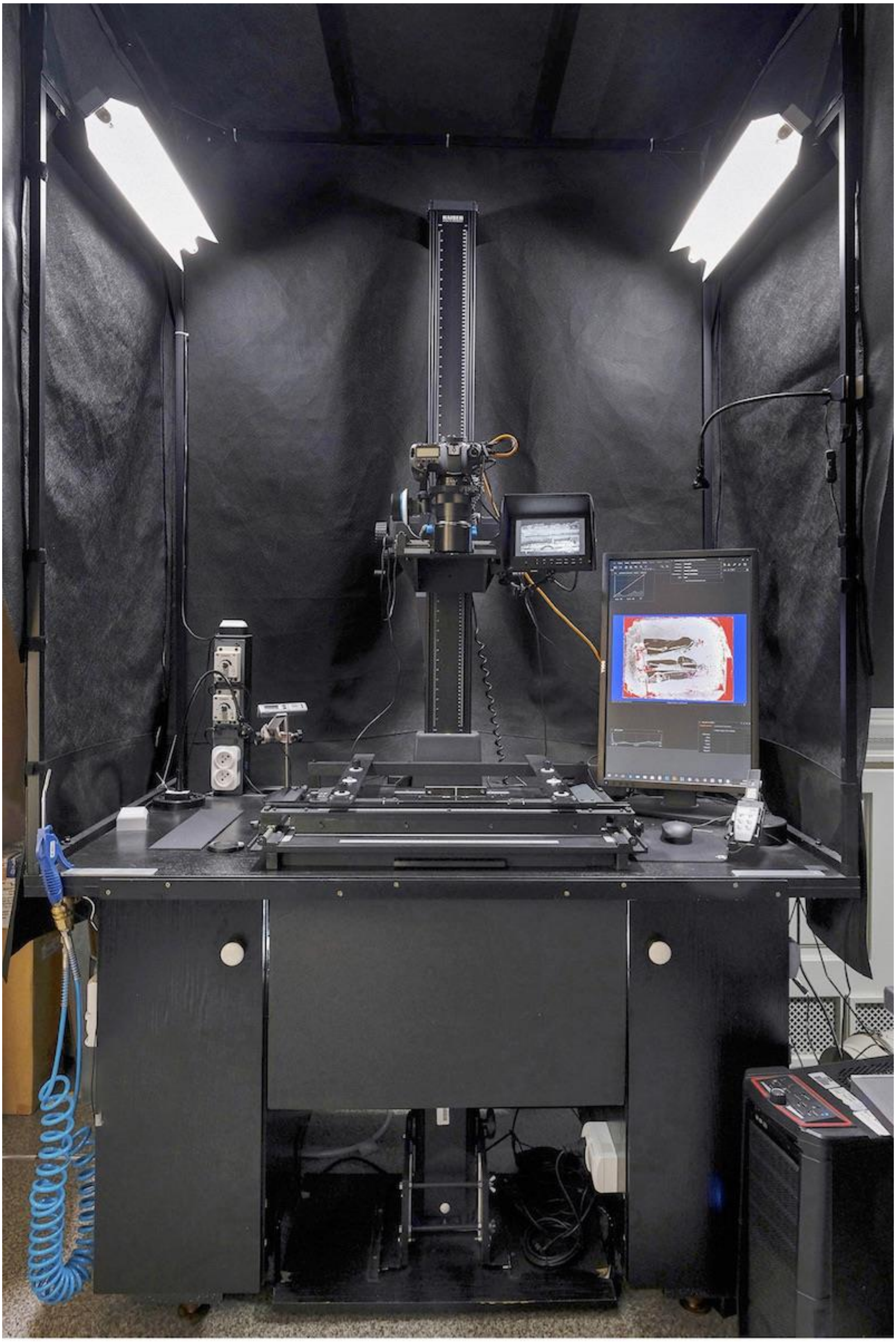


*Photo. 6. Work stand for glass plate reproduction. Visible side lights are auxiliary technical lights which are switched off during the process. Developed by W. Pyzik*

*Photo. 7. Work stand for glass plate reproduction. The protective hood visible in the photo is intended to protect the plates from ambient light, and in particular from reflecting directly the upper light. Visible side lights are auxiliary technical lights which are switched off during the process. Developed by W. Pyzik*

*Photo. 8 Work stand for glass plate reproduction including a computer station. Developed by W. Pyzik*

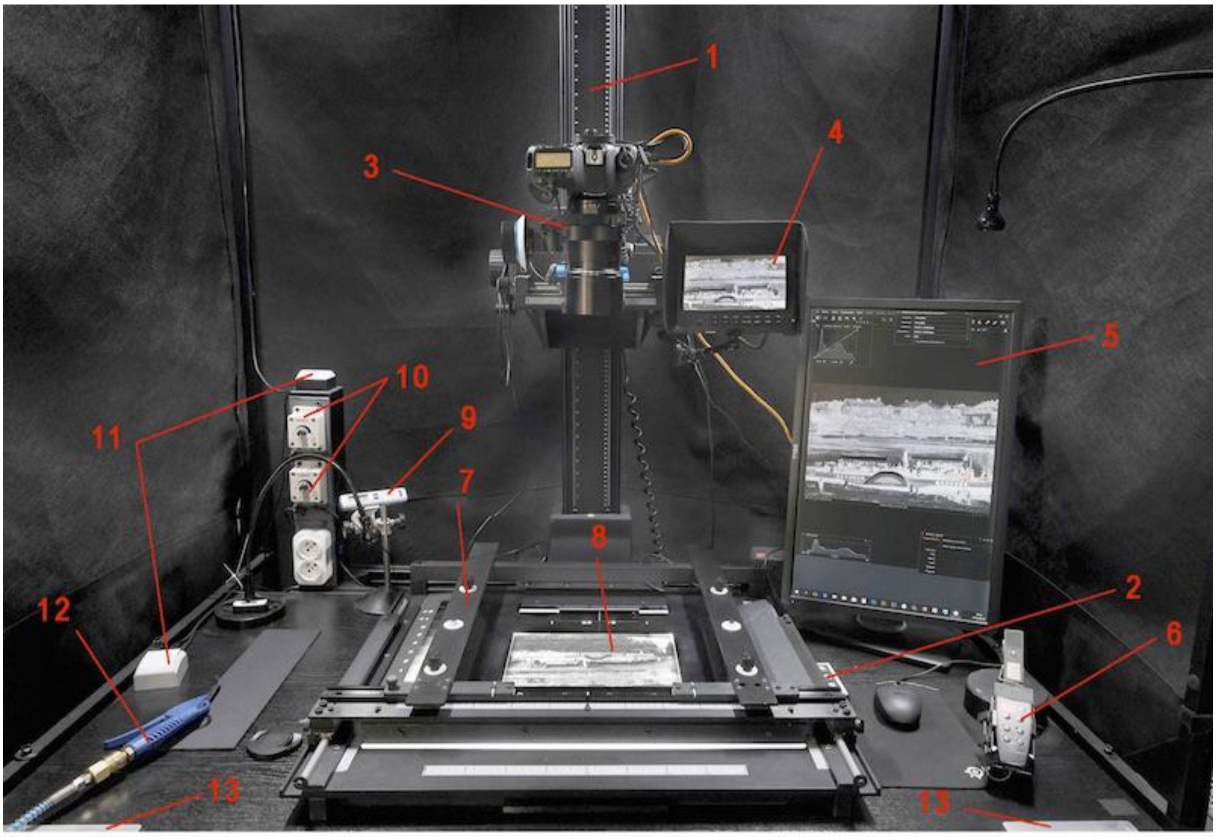



*Photo. 9. Work stand for glass plate reproduction: the working part. Developed by W. Pyzik*

*1. Kaiser rePro motion reproduction column*
*2. Column engine controller*
*3. Photographic head coupled with a digital camera*
*4. Monitor for focus setting through Live View*
*5. Monitor to preview exposure*
*6. Setting of working light (in this case: 1200Ws flashlight)*
*7. Cover*
*8. Working surface*
*9. temperature sensor with a probe located just below the working surface*
*10. Setting light intensity of the LED lighting booth*
*11. Light switches to control auxiliary technical lights*
*12. Compressed air installation*
*13. Touch switch of the lighting booth*

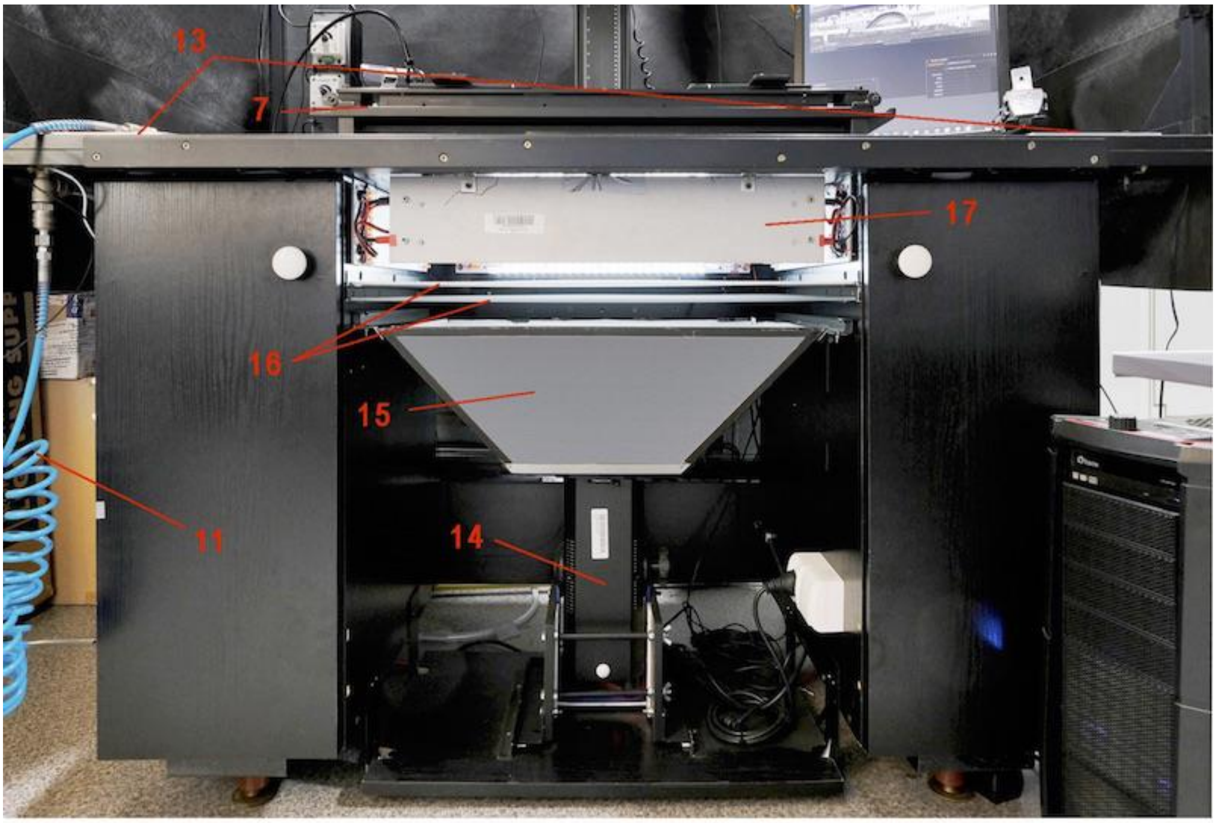



*Photo. 10. Work stand for glass plate reproduction – source of the working light, diffusive filters and LED the lighting booth. Developed by W. Pyzik*

*7. Cover*

*11. Compressed air installation*

*13. Touch switch of the lighting booth*

*14. Source of the main working light (1200Ws flashlight)*

*15. Mixing chamber for the main working light*

*16. Light diffusing filters*

*17. LED lighting booth to adjust focus using the Live View functionality*

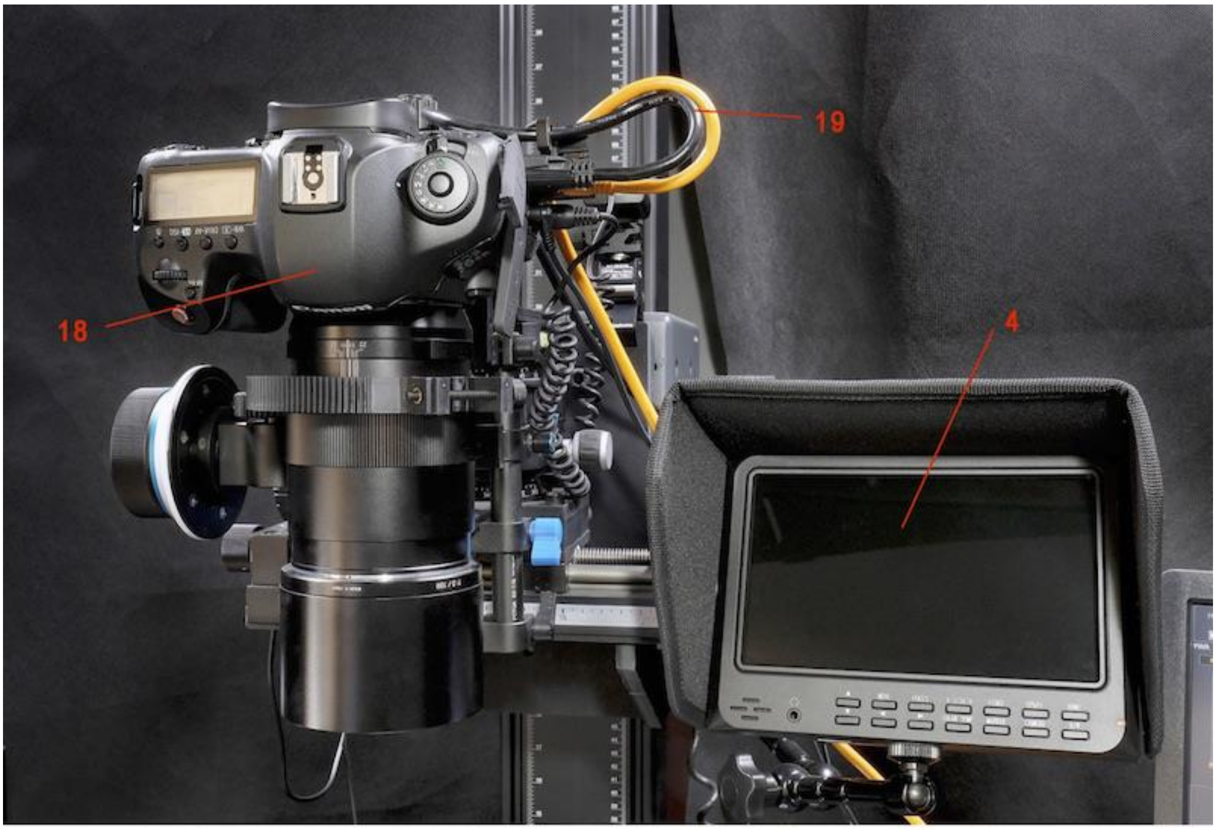



*Photo. 11. Photographic head coupled with auxiliary equipment.* *Developed by W. Pyzik*

*4. Monitor to adjust focus using the Live View functionality*

*18. Digital camera; lens*

*19. HDMI cabling, Tethering, remote trigger, flashlight trigger*

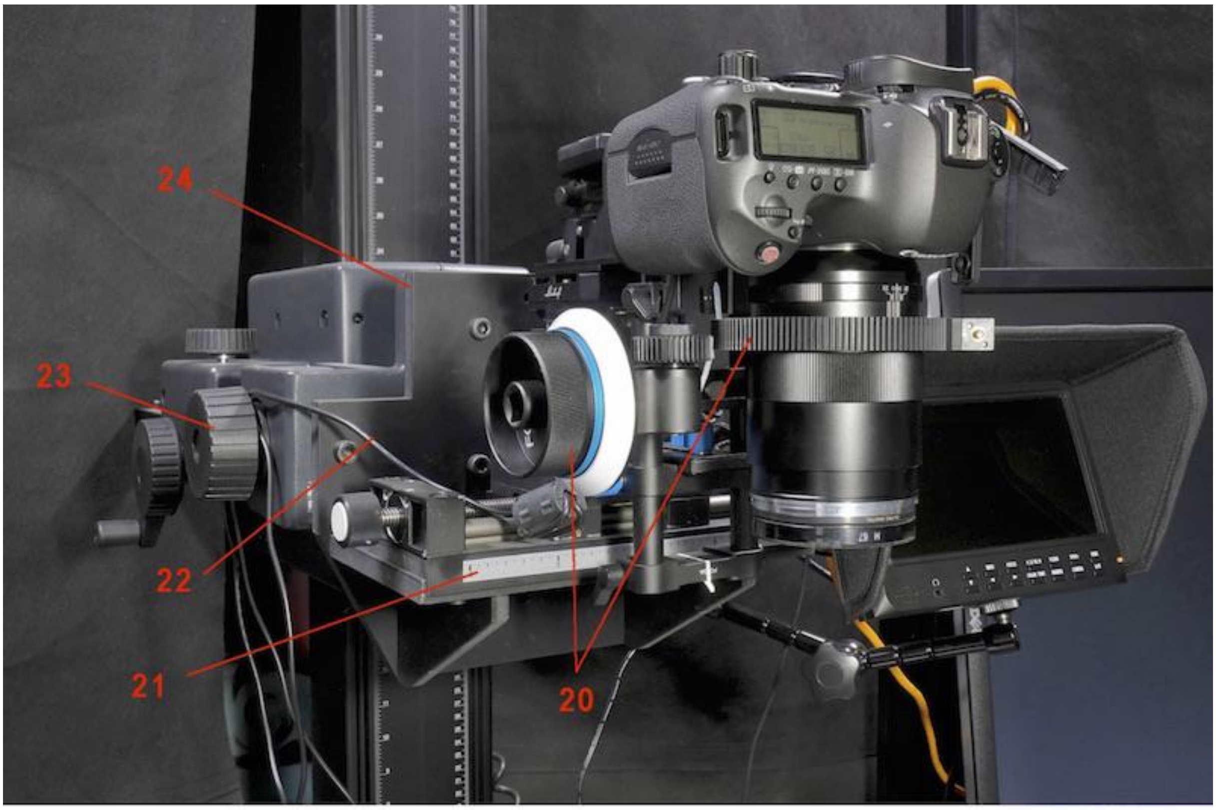



*Photo. 12. Photographic head coupled with auxiliary equipment. Developed by W. Pyzik*

*20. Follow Focus – a tool used when filming, allowing for setting focus in photographic lenses. Such Focus ring manipulation is very accurate, facilitating and accelerating work*

*21. Adjustment sledge on a threaded axle for precise positioning vis-à-vis the plate*

*22. Cabling of mains power supply for the camera*

*23. Horizontal adjustment of the head system vis-à-vis the plate*

*24. Engine chamber to position the head system vertically*

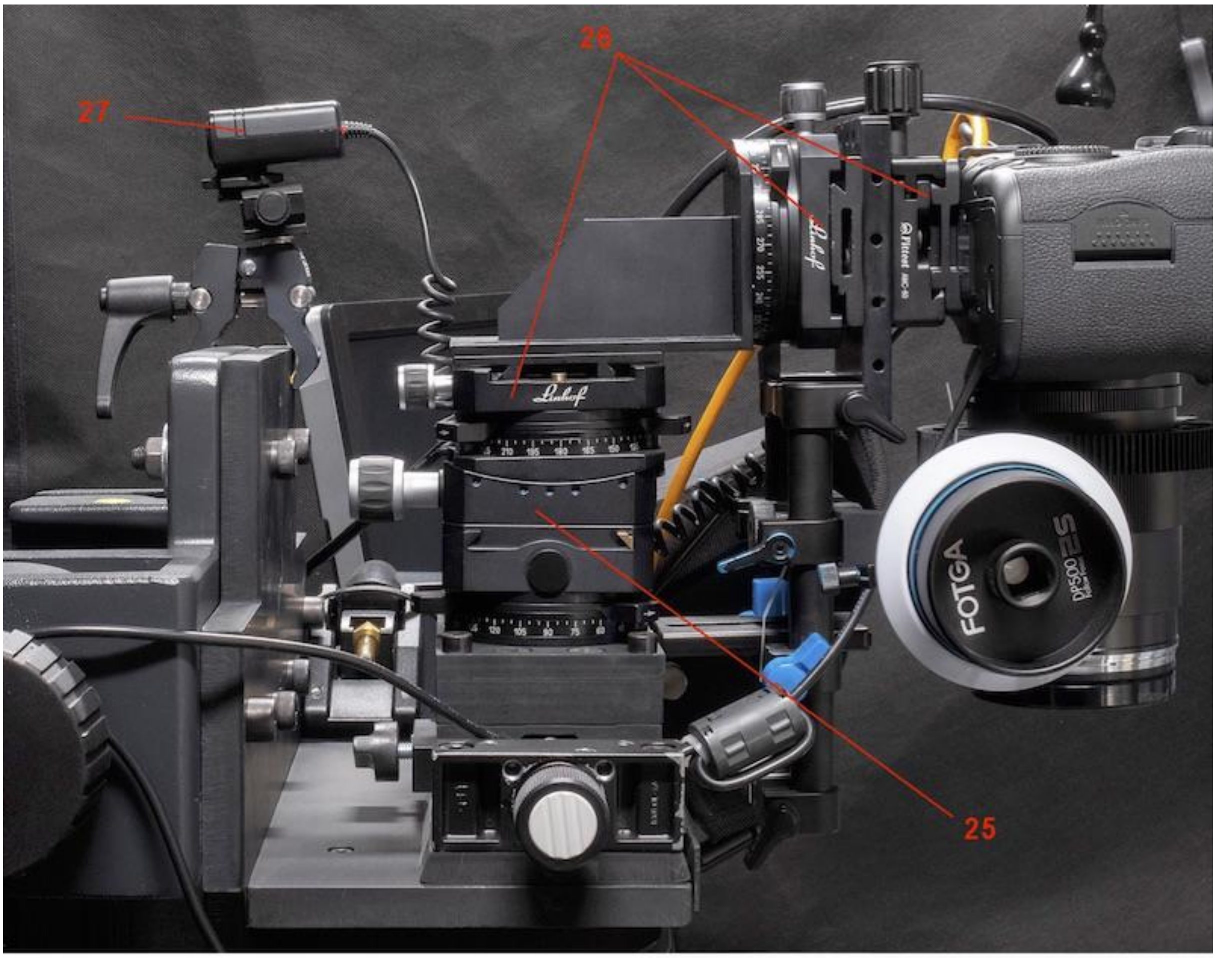



*Photo. 13. Photographic head coupled with auxiliary equipment. Developed by W. Pyzik*

*25. Linhoff photographic head with three degrees of freedom. Gear units make it possible to position the camera with high precision.*

*26. Arca Swiss type quick-release couplings*

*27. Control of remote camera release*

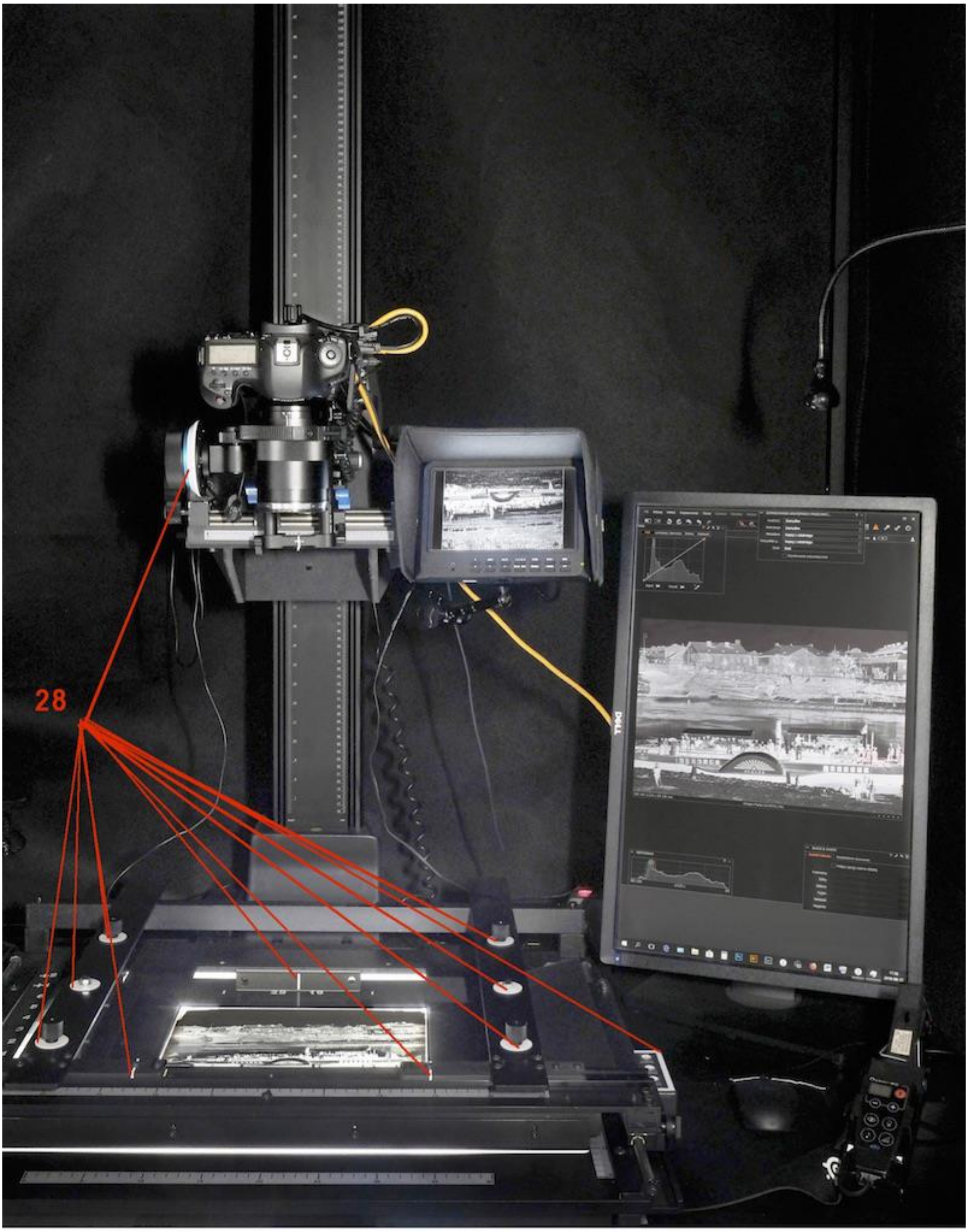



*Photo. 14. Work stand for glass plate reproduction. Part of the working area. Developed by W. Pyzik*

*28. White markings on key elements considerably facilitate the work in dimmed light of the studio.*

## 4. Scanning practice

When testing the design of the equipment, it proved necessary to solve a number of issues in order to ensure a correct and secure digitization process.

### 4.1. Focus setting using the Live View functionality

When setting focus manually, proper image lighting is required. For this purpose, a lighting booth has been designed based on LEDs. High light output, the possibility to adjust intensity and low operation temperature of LEDs allowed to achieve to objectives – ensure sufficient lighting and thermal security.

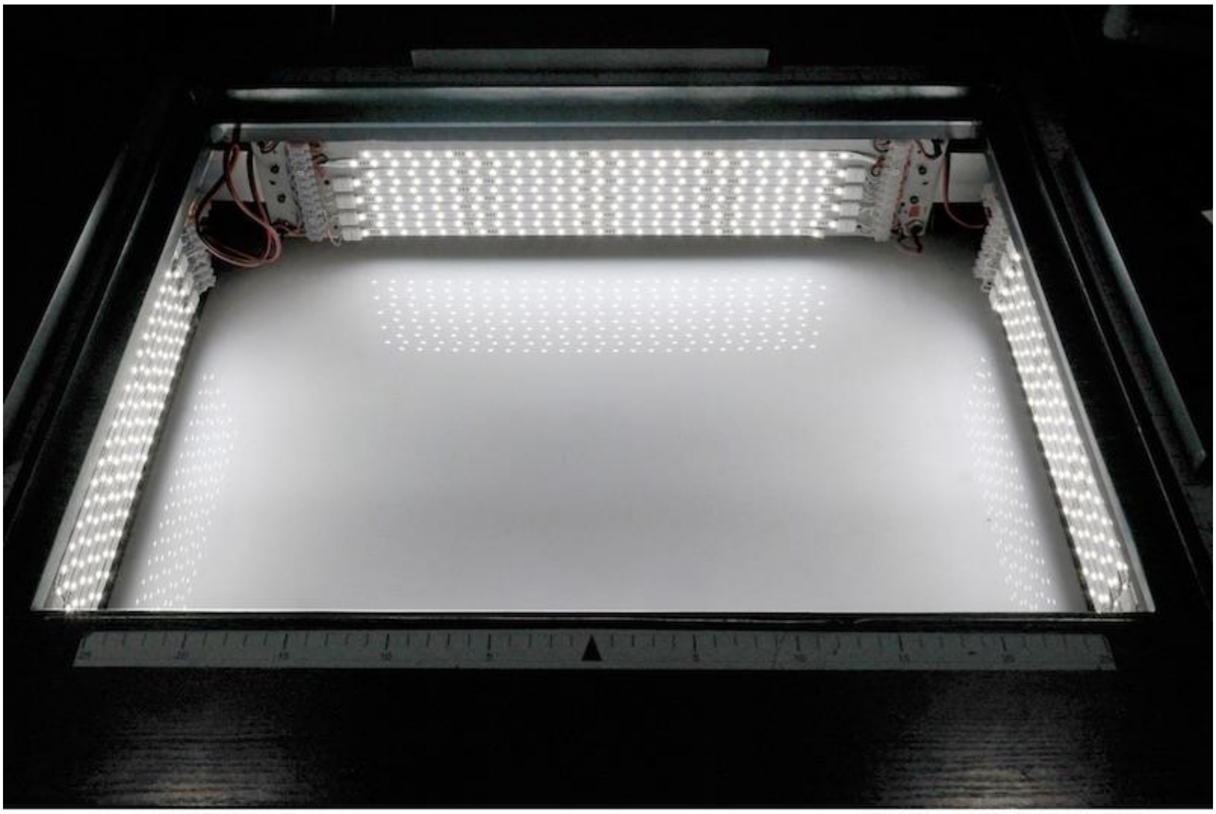


*Photo. 15. LED-based lighting booth. The bottom part of the booth is at the same time a reflective plane for LEDs and filter diffusing the light from the main flashlight. Light intensity of the booth is adjustable. Developed by W. Pyzik*

## 4.2. Optimizing the amount of light falling onto the plate.
## A method of preliminary estimate assessment of negative blackening

For this end, a method for preliminary estimate evaluation of plate blackening has been designed, using a grey wedge graduated against the flashlight.

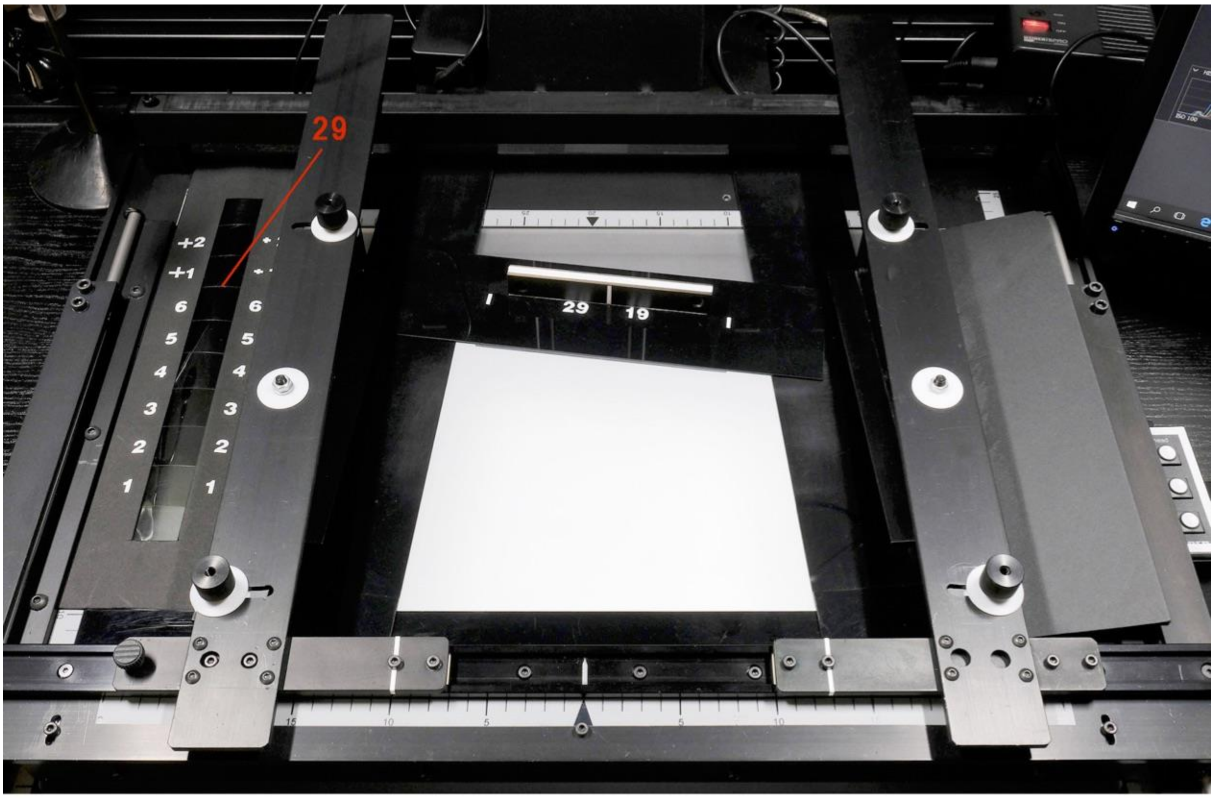



*Photo. 16. Cover with the grey wedge. Developed by W.Pyzik*
*29. Grey wedge*

A grey wedge featuring 8 fields has been created, by putting 8 stripes of 1F grey neutral film (reducing light exposure by one aperture).
Each field on the grey wedge was assigned with a particular flashlight power rate. In this case 1,2,3,4,5,6, and 6+1F, 6+2F ("in emergency" apertures 5,6 and 4.0}


*Photo. 17. Grey wedge with assigned flashlight power rates*

When looking at the glass plate against the grey wedge, one may preliminarily evaluate exposure, comparing local density values with greyness areas of the wedge (thus determining preliminary flashlight power settings).

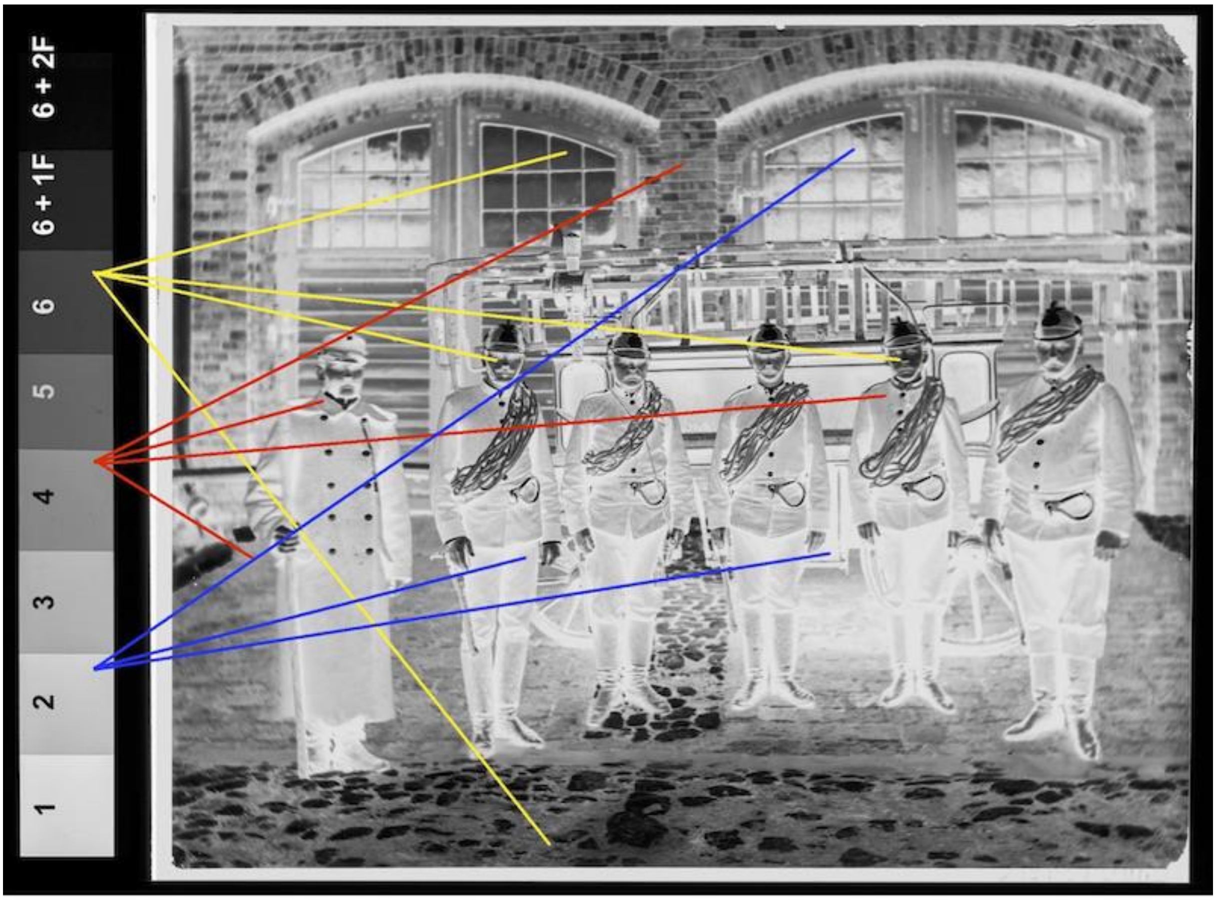



*Photo.18. Glass plate negative with the grey wedge. Color lines indicate areas of similar density.*

*Red marking signifies suggested lower range of the flashlight settings, rate 4*

*Yellow marking signifies suggested upper range of the flashlight settings, rate 6*

*Blue marking signifies a secure shadow range, flashlight rate 2*

*The plate has been properly copied at the flashlight rate amounting to 5.0.*

*Negative from the collections of MHK. Developed by W. Pyzik*

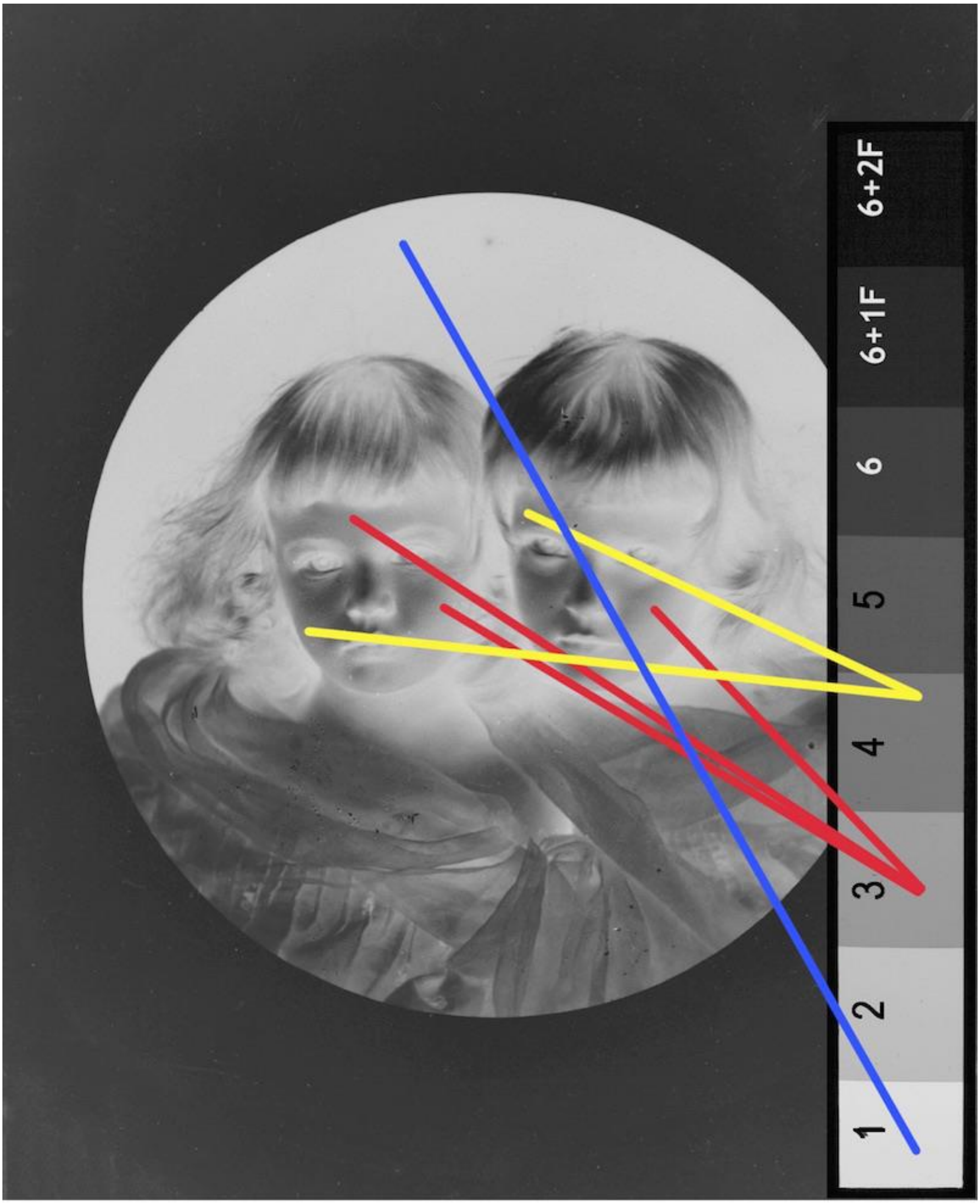



*Photo.19. Glass plate with the grey wedge. General coverage has been determined as regular, i.e. within the medium range. Color markings show similar density values.*

*Red marking signifies suggested lower range of the flashlight settings, rate 3*

*Yellow marking signifies suggested upper range of the flashlight settings, rate 4*

*Blue marking signifies a secure shadow range, flashlight rate 1*

*The plate has been properly copied at the flashlight rate amounting to 3.8.*
*Negative from the collections of MHK. Developed by W. Pyzik*

## 4.3. Masking harmful light *****

In any photographic situation one should minimize the amount of harmful light. In the case of reproduction in transmitted light, in order to do this, one must perform accurate masking. This means one should screen areas on which there is no image in the frame.

Glass plates frequently do not have a rectangular or square shape, but are quadrilateral. Thus, a standard cover will not cover elements whose angle is other than right. For this purpose, a cover was designed with three movable arms, ensuring the possibility of changing the angle between the arms to a considerable extent. The cover was based on linear guides allowing for adequate and repetitive manipulation of movable parts.

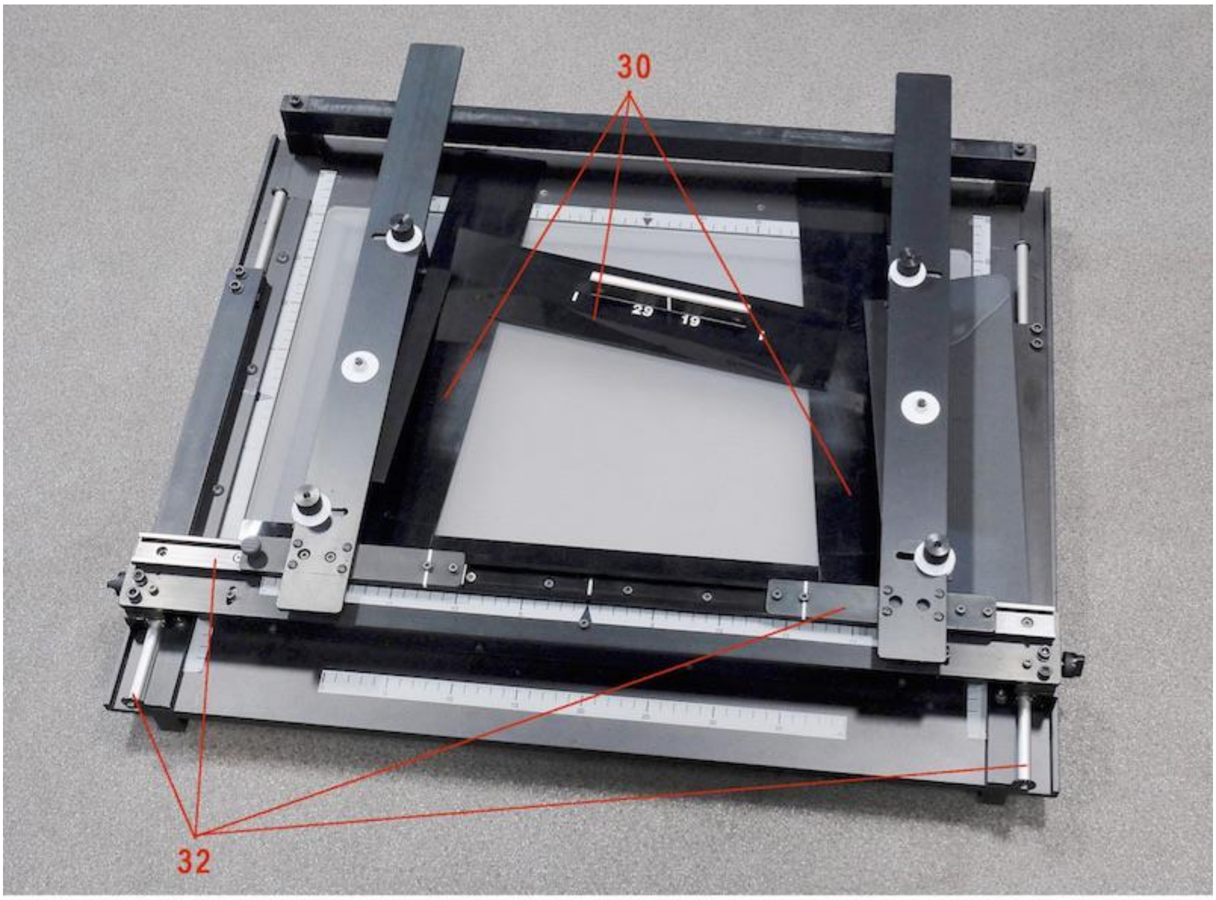



*Photo. 20. Our dedicated cover allowing for covering plates with different angles and providing accurate and repetitive line settings thanks to the adoption of linear slides. Developed by W. Pyzik*

*30. Movable arms ensuring covering undesired light*

*32. Linear slides*

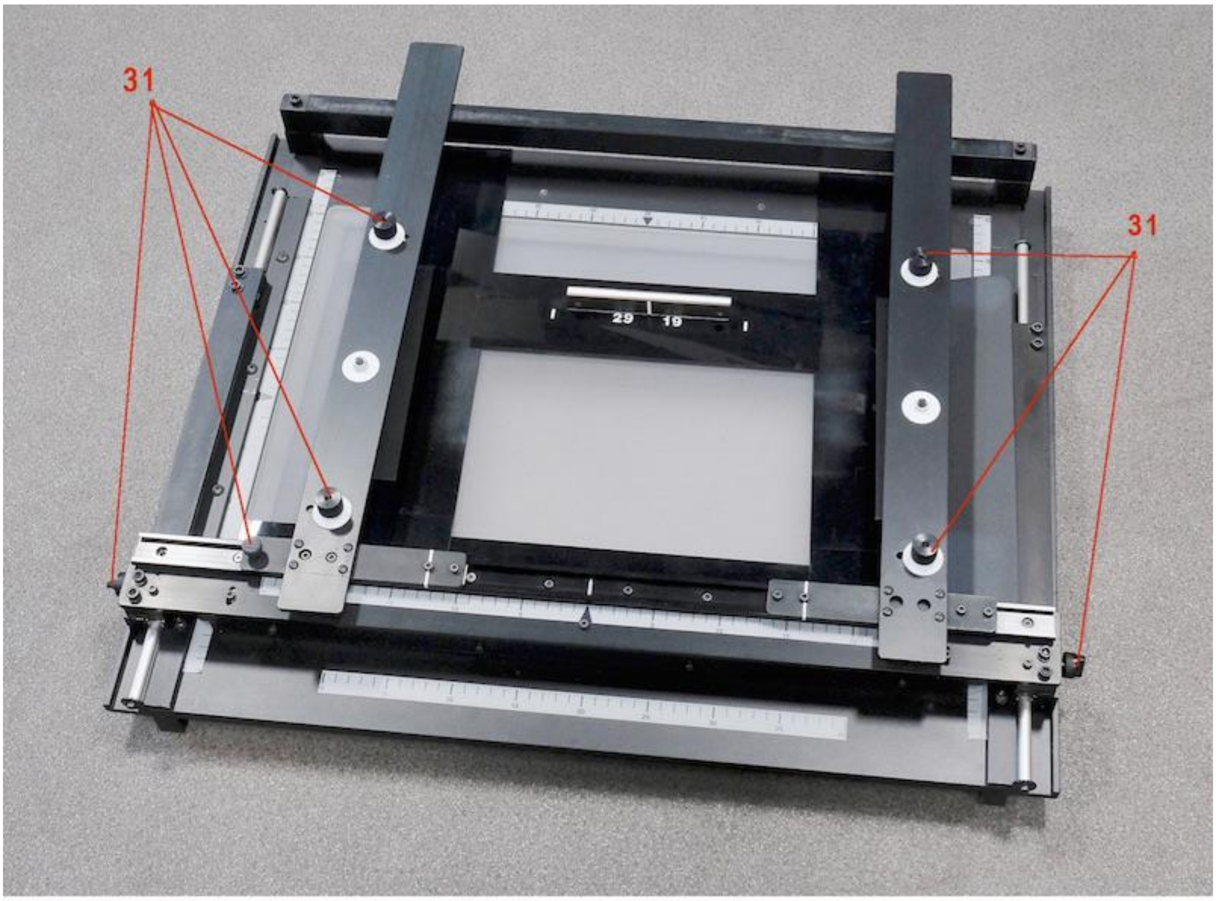



*Photo. 21. Our dedicated cover allowing for covering plates with different angles and providing accurate and repetitive line settings thanks to the adoption of linear slides. The picture shows a different setting of arms (compare with Photo. 20). Developed by W. Pyzik*
*31. Linear movement and rotation lock*

## 4.4. Leveling the image sensor of the camera relative to the working plane

One of the challenges when configuring a work stand for reproduction regards positioning the camera relative to the working Surface, i.e. the reproduced glass plate. These elements must run in parallel. As a result of parallel positioning the Focus Surface will overlap with the object Surface, and image geometry will be mapped in a correct manner. Even a tiny inaccuracy will result in locally blurred or distorted image. Methods applied so far included observation through the camera viewfinder or performing test exposures of the geometric model, correcting distortions by moving the camera. However, such methods were tedious and one could easily make mistakes.
In the project carried out by MHK, also a collimator was included, which is a laser device whose operation is based on the principle that the incidence angle equals the reflection angle.
With a collimator, one may accurately determine whether the elements in question run in parallel.

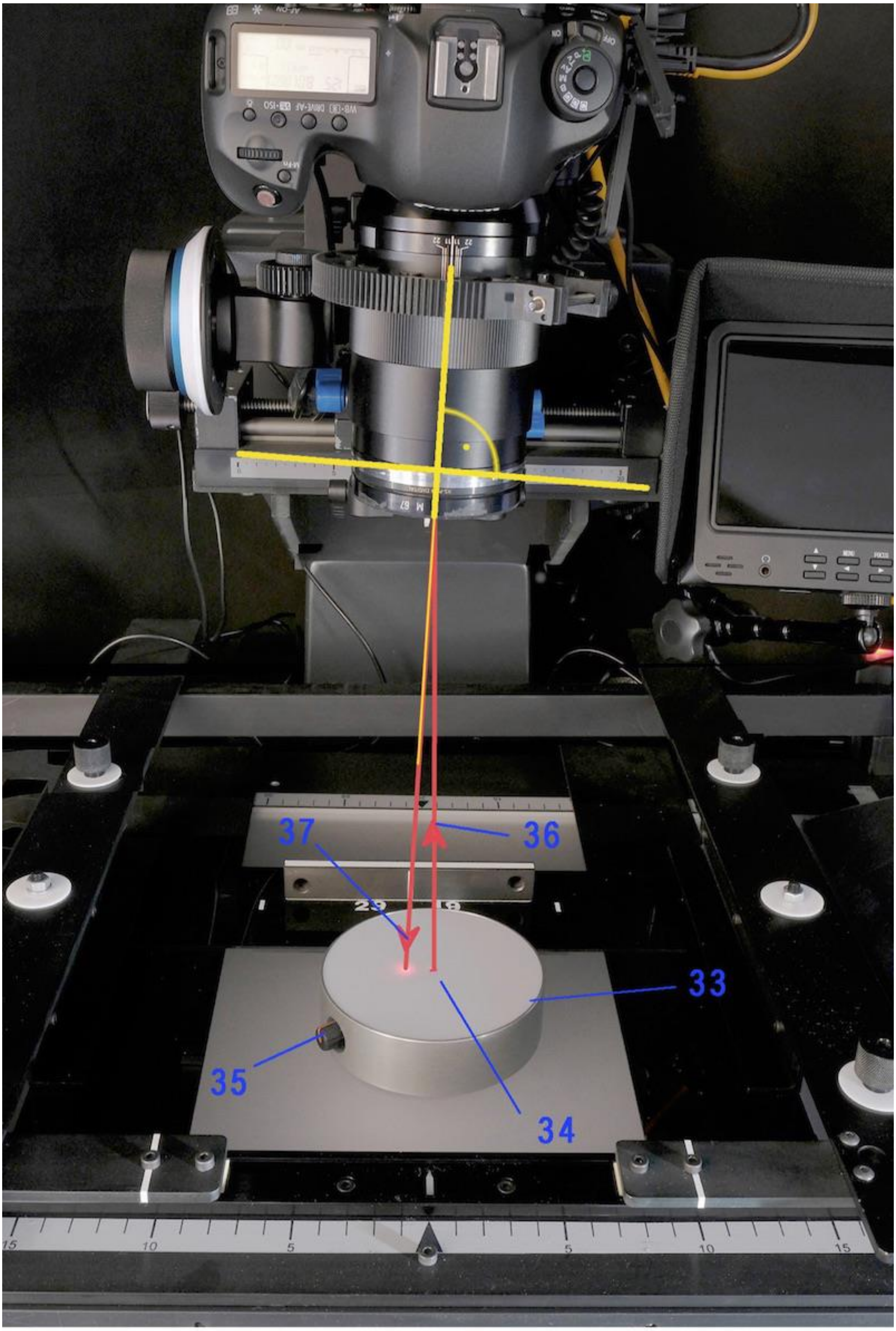

37
36
33
35
34

*Photo. 22. Laser collimator. On the working surface the device is placed that emits a laser beam perpendicular to the bottom. The ray reflected from the lens surface (parallel to the image sensor of the camera) returns to the device surface. In this photo, the beam incidence angle is not perpendicular to the lens surface (and the surface of the image sensor)*
*Developed by W. Pyzik*
*33. Laser collimator*
*34. Laser beam*
*35. Setting laser beam intensity*
*36. Laser beam falling on the surface of the lens*
*37. Reflected beam*

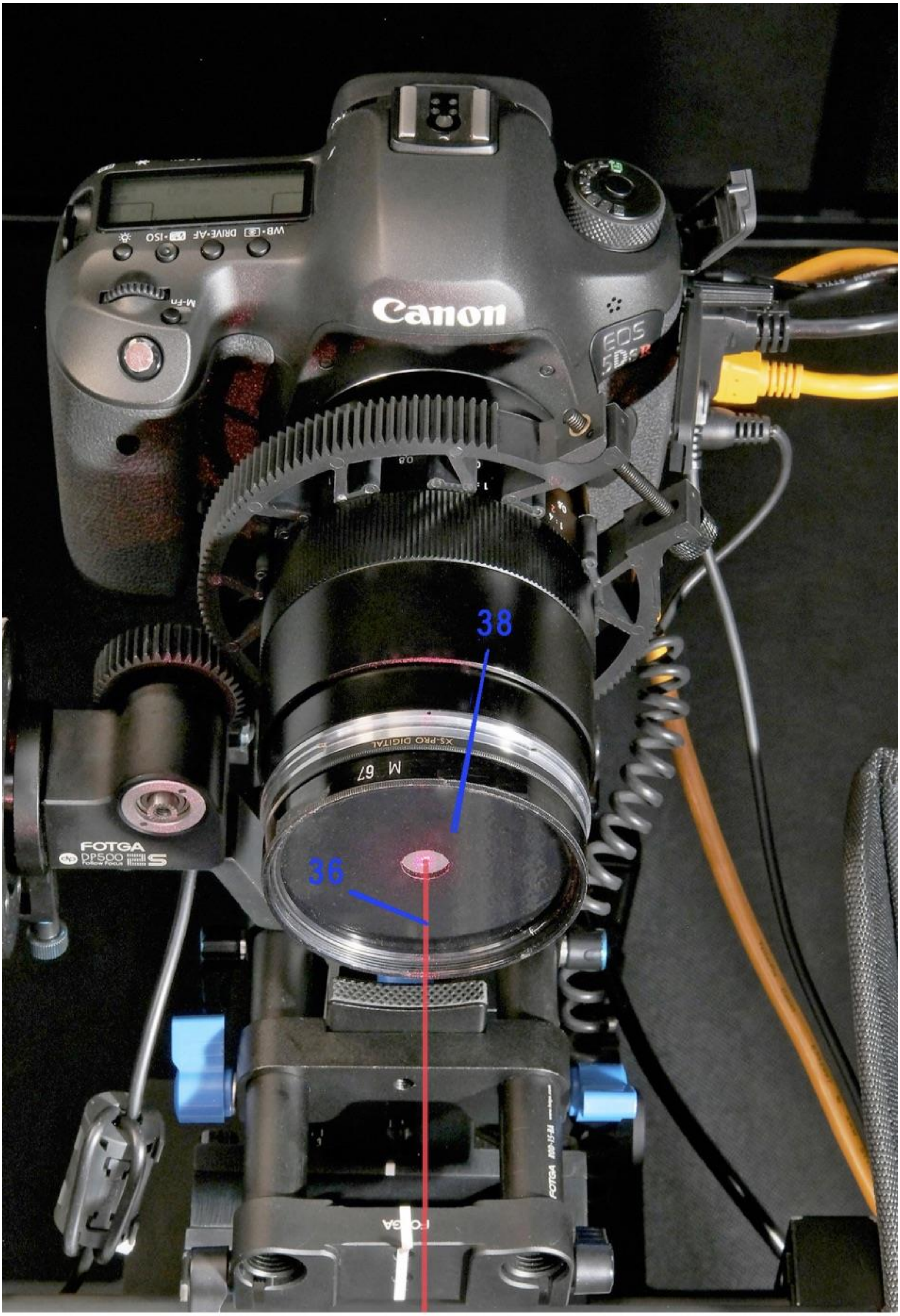
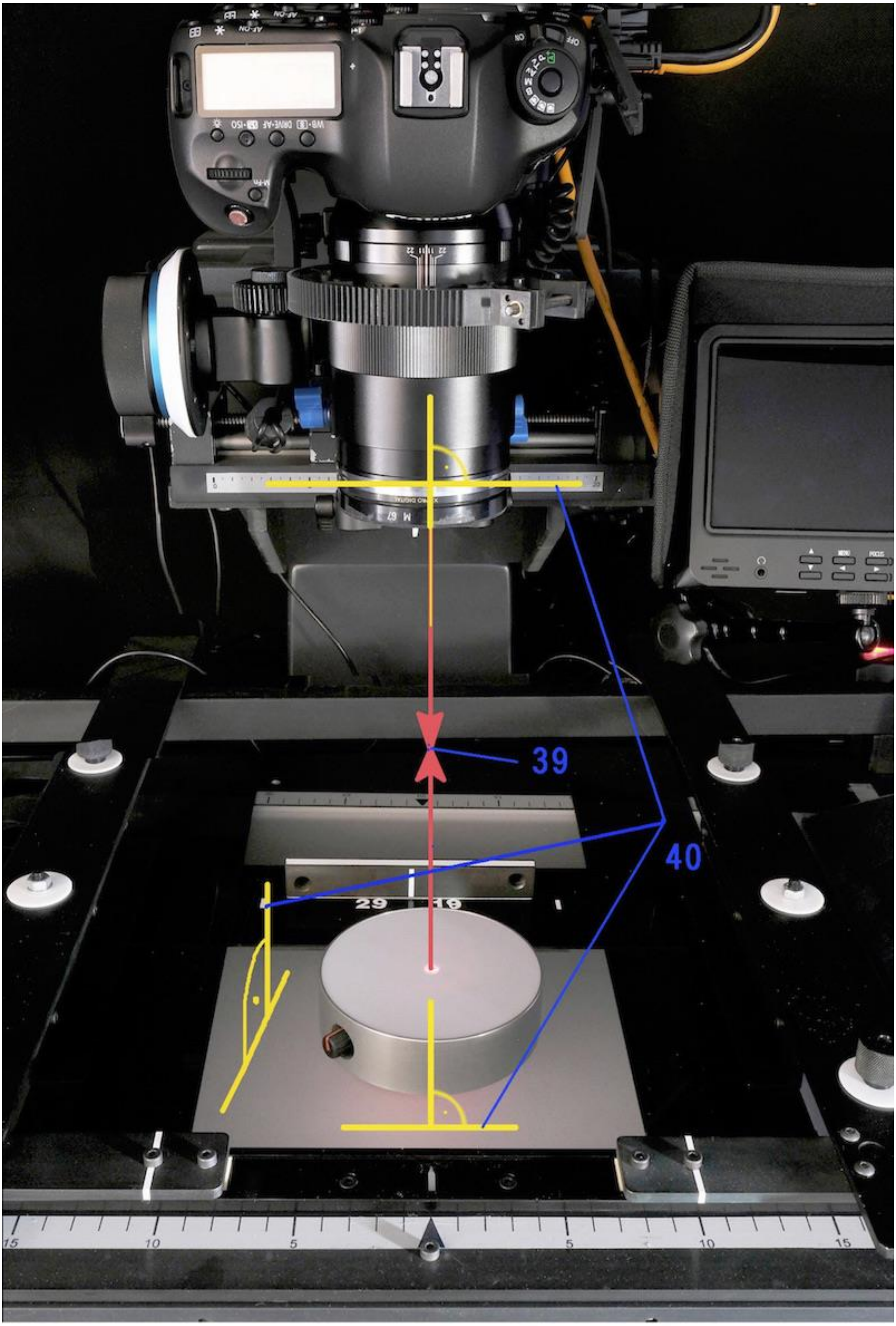



*Photo. 23. In the filter frame on the lens, a mirror is located that reflects the laser beam. Developed by W. Pyzik*

*36. Laser beam falling on the surface of the lens*

*38. Mirror in the filter frame*



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40

*Photo. 24. Laser collimator. Laser beam reflected at the angle of 90$^o$, returning to the starting point. Correct parallel setting. Such precise positioning of the camera is possible thanks to the photographic heading with gear units. Developed by W. Pyzik*

*39. Laser beam reflected at right angle coming back to the starting point*

*40. indication that the working surface, i.e. the glass plate, is positioned in parallel to the camera image sensor.*

## 5. Developing transparent materials

In the case of transparent materials, the developing process becomes trickier. Patterns for slides may be only regarded as reference points, whereby only a grayscale may be applied to negatives. To attain proper results for slides, we may use as a guide the actual, positive image. For negatives, there is no original, i.e. a positive. **The most frequently applied simple change from a negative to a positive may not reflect the actual condition**, meaning that not all data on a negative will be rendered back. Therefore, it is necessary to take interpretative, creative actions. For this, one must have an excellent feel and expertise on digital, analogue photography, chemical processes related to developing negatives, as well as knowledge of the author's style and photochemical possibilities of a given epoch. Crucially, one must have a great command of the graphic program applied in the process, including its tools and their effects.

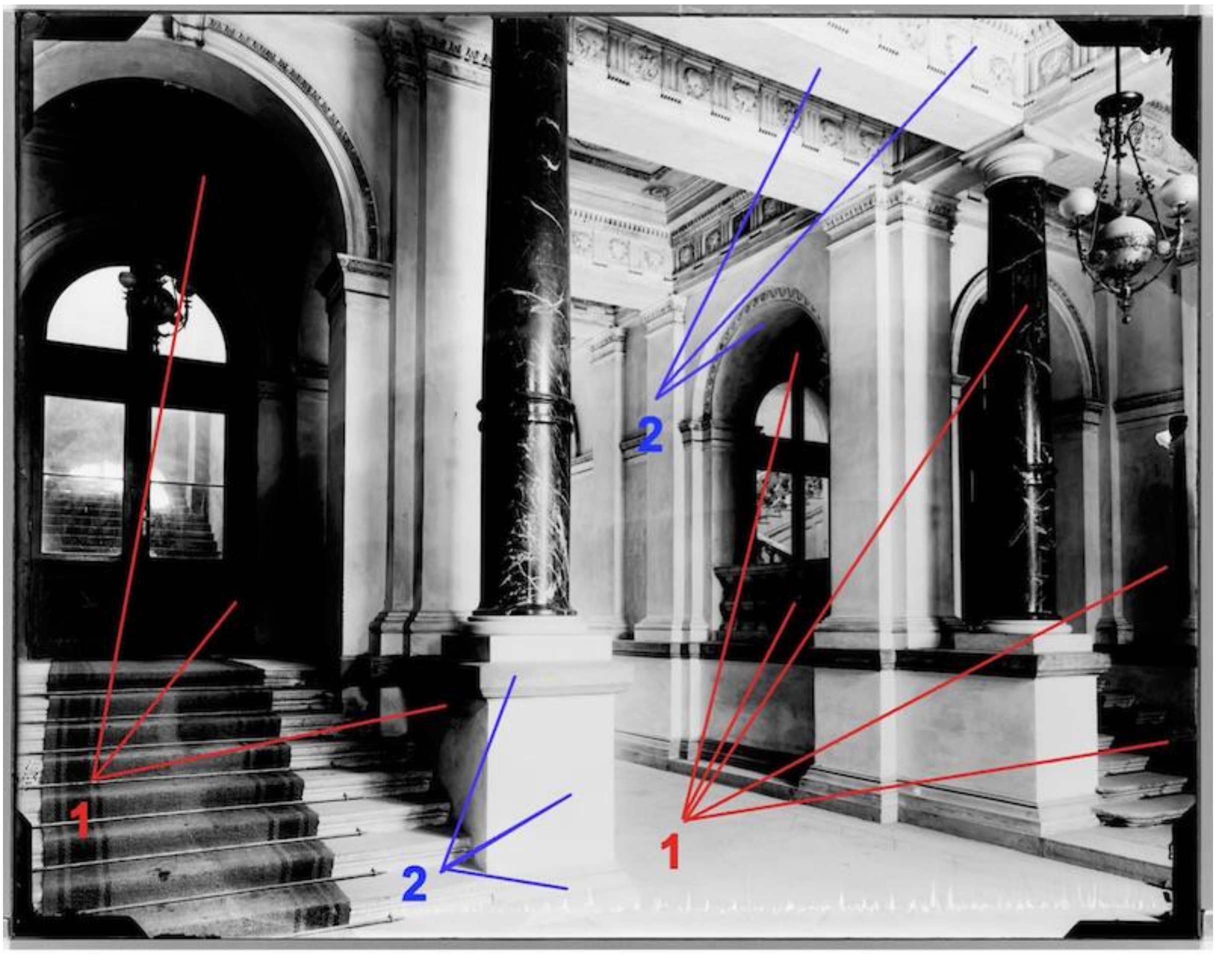

*Photo. 25. A glass plate: negative turned into a positive by reversal, without further development. One may see very dark and light areas without details, as compared to the areas marked with numbers in Photo. 25 and 26. 1-shadows; 2-lights. Negative from the collections of MHK. Developed by W. Pyzik.*

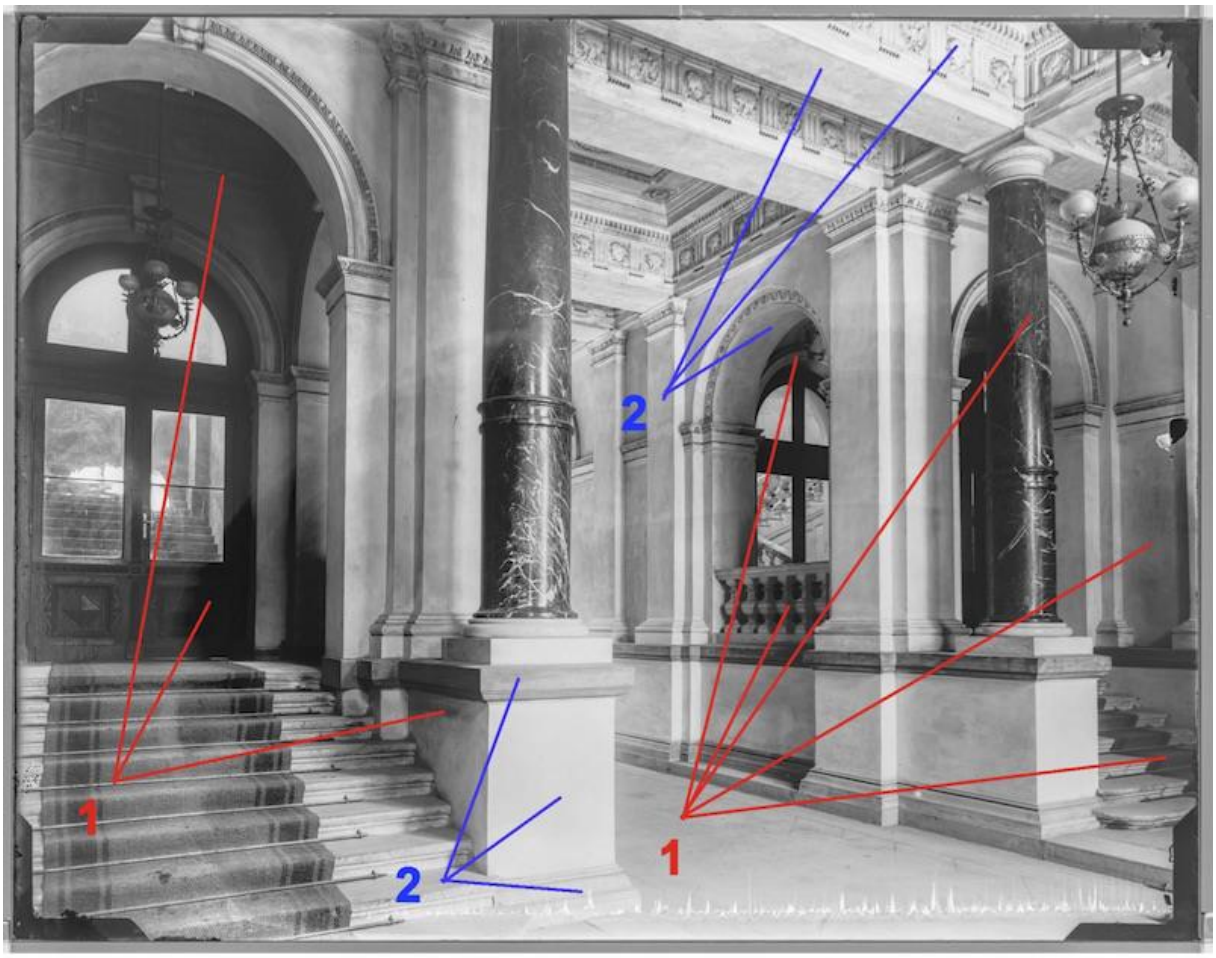


*Photo. 26. A glass plate: negative developed as a RAW file. In light and dark areas on the image, details are well visible. Compare with characteristic areas marked with numbers in Photo. 25 and 26. 1-shadows; 2-lights.*
*Please note that in this case HDR was not applied and the changes in density were performed using a graphics program, globally, without covering anything. Negative from the collections of MHK. Developed by W. Pyzik.*

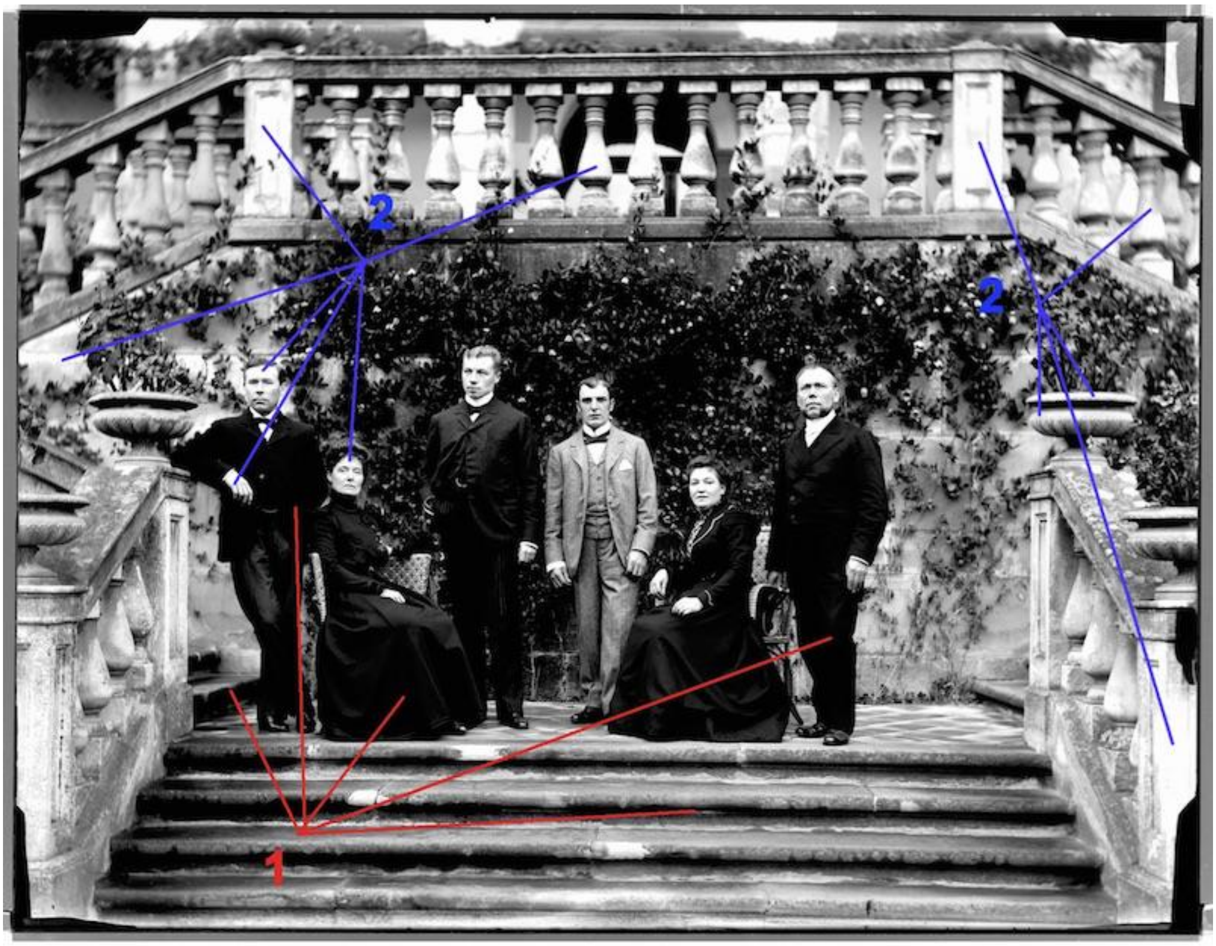


***Photo. 27.*** *A glass plate: negative turned into a positive by reversal, without further development. One may see very dark and light areas without details, as compared to the areas marked with numbers in Photo. 27 i 28.*

*1-shadows; 2-lights. Negative from the collections of MHK. Developed by W. Pyzik.*

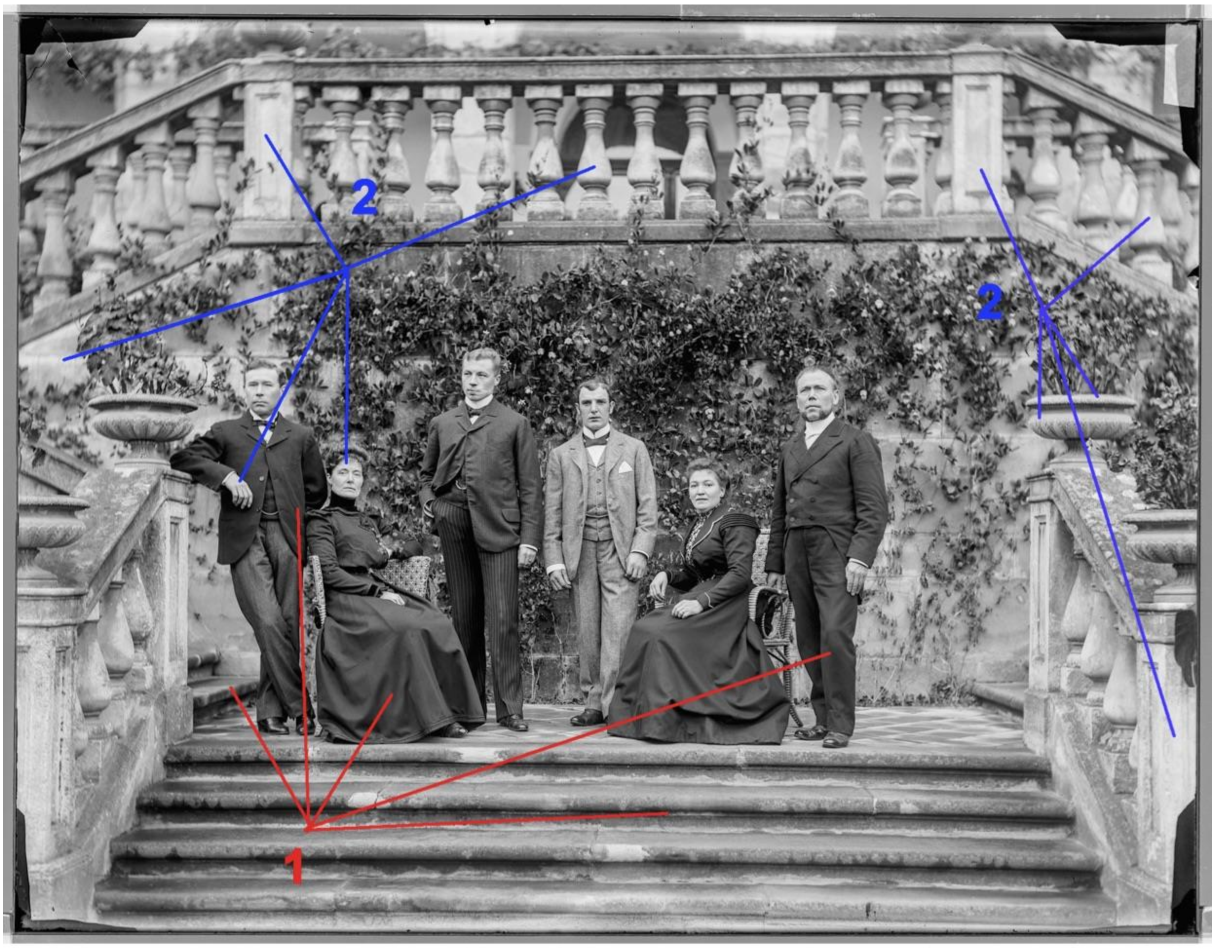


***Photo. 28.*** *A glass plate: negative developed as a RAW file. In light and dark areas on the image, details are well visible. Compare with characteristic areas marked with numbers in Photo. 27 and 28. 1-shadows; 2-lights.*
*Please note that in this case HDR was not applied and the changes in density were performed using a graphics program, globally, without covering anything. Negative from the collections of MHK. Developed by W. Pyzik.*

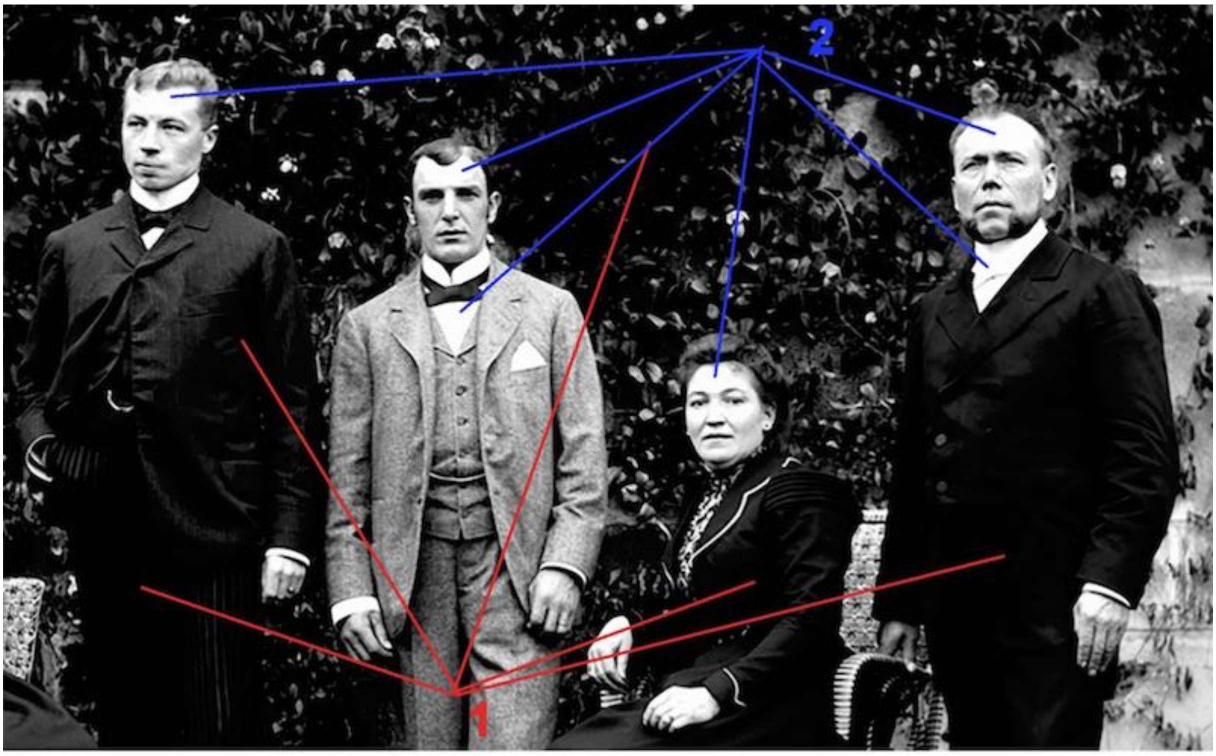


***Photo.29.*** *A glass plate: fragment of Photo. 27 magnified to present the issue in question better. Negative turned into a positive by reversal, without further development. One may see very dark and light areas without details, as compared to the areas marked with numbers in Photo. 29 i 30.*
*1-shadows; 2-lights. Negative from the collections of MHK. Developed by W. Pyzik.*

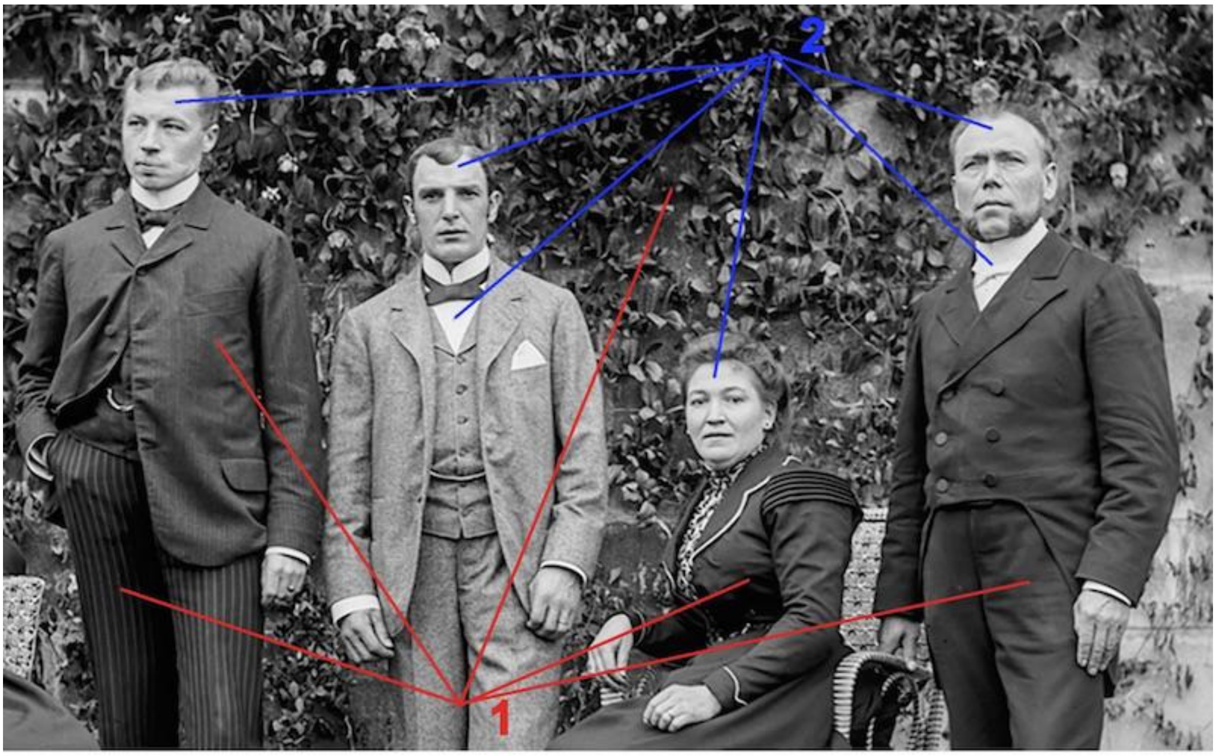

*Photo. 30. A glass plate: fragment of Photo. 27 magnified to present the issue in question better. Negative developed as a RAW file. In light and dark areas on the image, details are well visible. Compare with characteristic areas marked with numbers in. 29 i 30. 1-shadows; 2-lights. Please note that in this case HDR was not applied and the changes in density were performed using a graphics program, globally, without covering anything. Negative from the collections of MHK. Developed by W. Pyzik.*

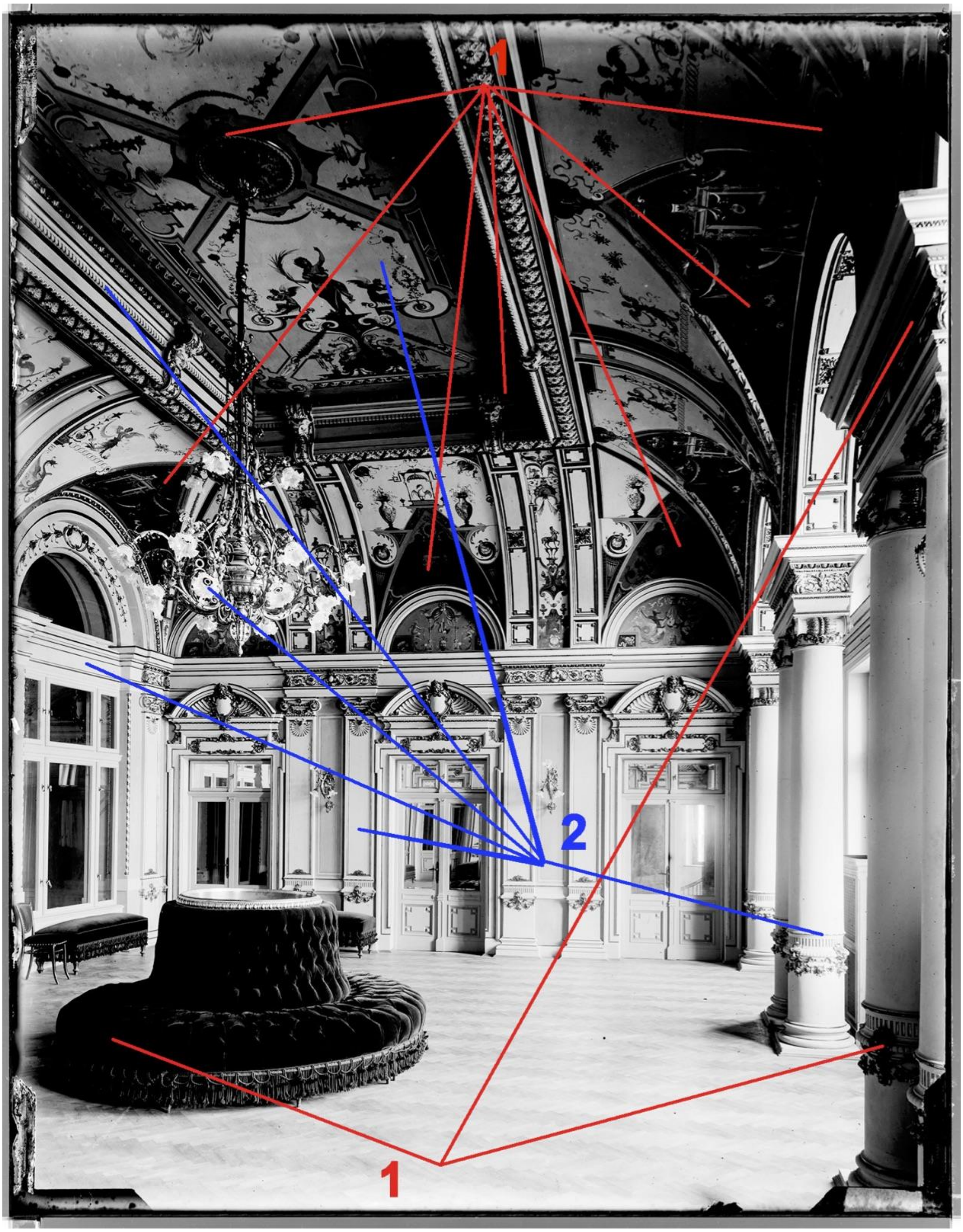


***Photo. 31.*** *Glass plate: negative turned into a positive by reversal, without further development. One may see very dark and light areas without details, as compared to the areas marked with numbers in Photo. 31 and 32. 1-shadows; 2-lights. Negative from the collections of MHK. Developed by W. Pyzik.*

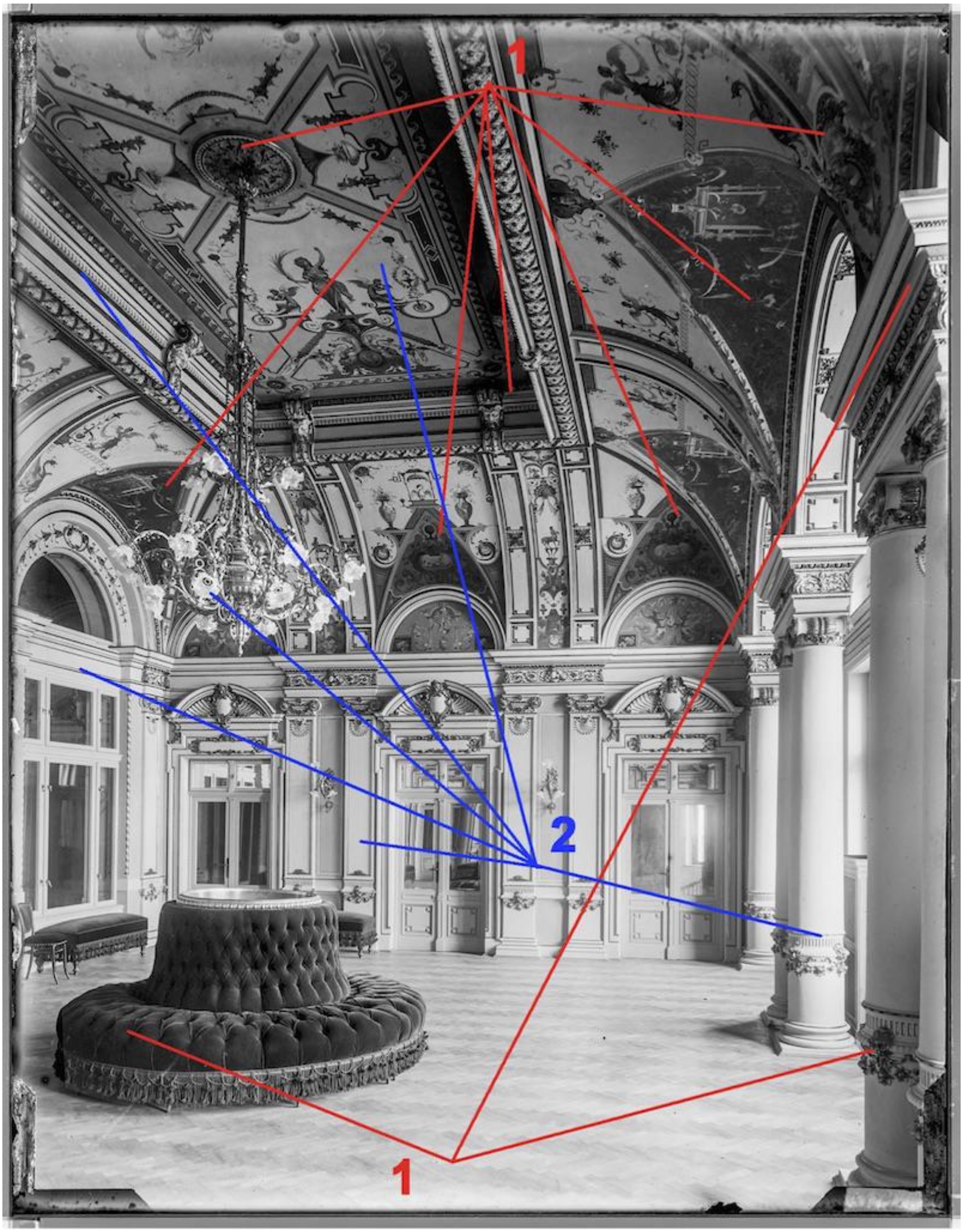


***Photo. 32.*** *A glass plate: negative developed as a RAW file. In light and dark areas on the image, details are well visible. Compare with characteristic areas marked with numbers in Photo. 31 and 32. 1 – shadows; 2 – lights.*
*Please note that in this case HDR was not applied and the changes in density were performed using a graphics program, globally, without covering anything. Negative from the collections of MHK. Developed by W. Pyzik.*

# 6. Reproduction quality and information contained in digital images

Glass plates are a specific medium. This data carrier may have a size up to 30 x 40 cm (small negatives, to compare, are 2.4 x 3.6cm large). A great amount of data may be read from such carrier when digitization is performed using digital equipment of high resolution. Quality and visibility of details however depends not only on parameters of the applied devices, skillfulness and precision of operators but also on the camera of the author of a negative, the applied optics and original lighting conditions. The oldest materials were not particularly sensitive and required a long exposure time, thus risking moved images. Also, readability of magnified images was limited to the type of plate applied. On silver plates in turn, granules may be visible, i.e. clusters of silver creating the image, leading to distortions or blurred details. This limitation did not apply to collodion plates. Below you may find sample rendering of details from a silver and collodion plate. Plate size was 23 x 27 cm.

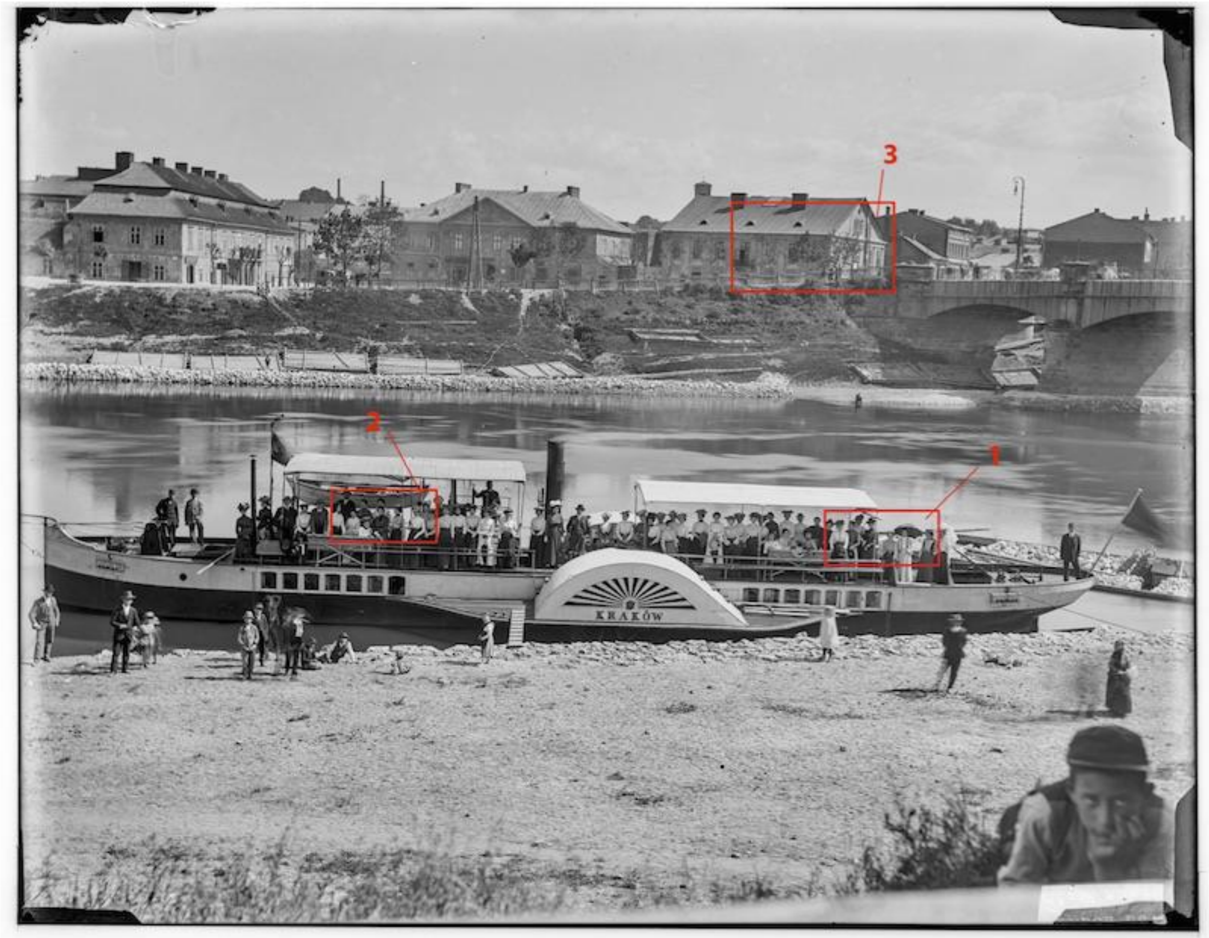


*Photo. 33. Silver-coated glass plate. Reproduction of the whole plate with parts marked in frames that were magnified (Photo. 34/1,2,3). Negative from the collections of MHK. Developed by W. Pyzik.*


1



*FFPhoto. 34/1,2,3. An enormous number of details is visible, which can be seen on a properly digitized plate, such as faces of people, clothing details or jewelry. Negative from the collections of MHK. Developed by W. Pyzik.*

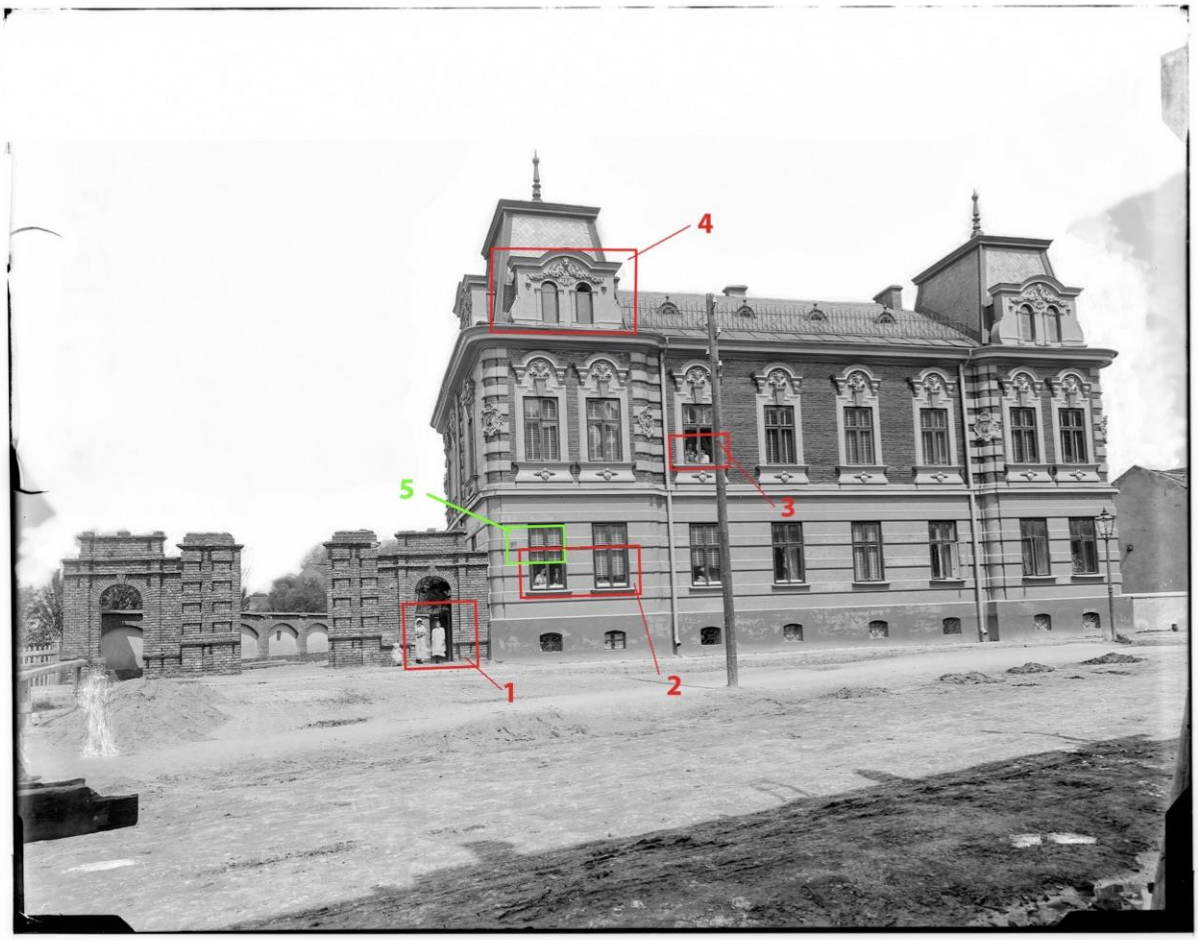


*Photo. 35. Collodion-coated glass plate. Reproduction of the whole plate with parts marked in frames that were magnified (Photo. 36/1,2,3,4,5). Negative from the collections of MHK. Developed by W. Pyzik.*

*Photo. 36/1*


1


2


*Photo. 36/1-3*


*Photo. 36/4*


*Photo. 36/1,2,3,4,5. An enormous number of details is visible, which can be seen on a properly digitized plate, such as faces of people, dates, house number. Negative from the collections of MHK. Developed by W. Pyzik.*

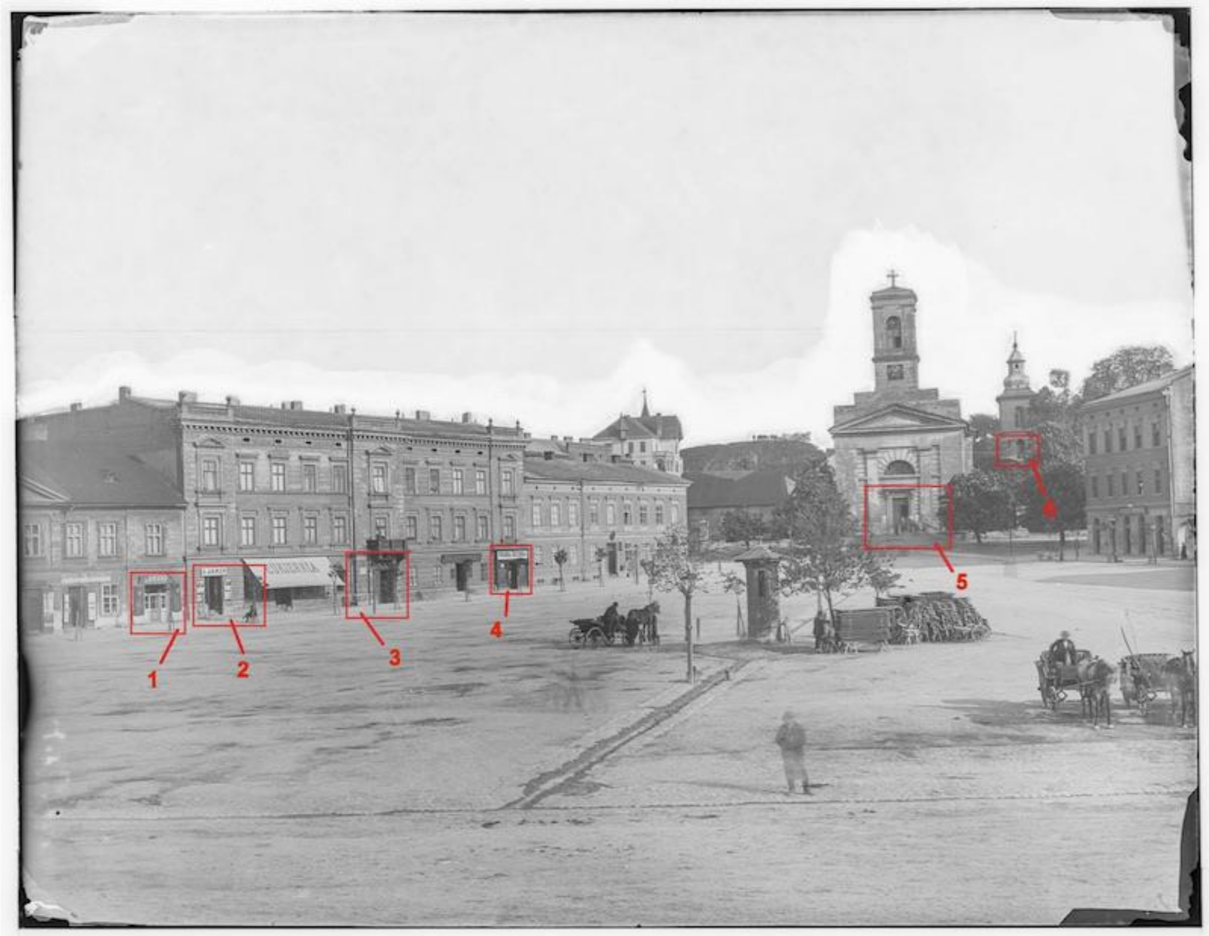


*Photo. 37. Collodion-coated glass plate. Reproduction of the whole plate with parts marked in frames that were magnified (Photo. 38/1,2,3,4,5,6). Negative from the collections of MHK. Developed by W. Pyzik.*


*Photo. 38-6*


*Photo. 38/5*


PIWIARNIA OKOCIMSKA
PIWA OKOCIMSKIEGO
MIODU HERBATY
i przekąski
WĘDLIN
4

*Photo.38/4*


*Photo. 38/3*


*Photo. 38/2*

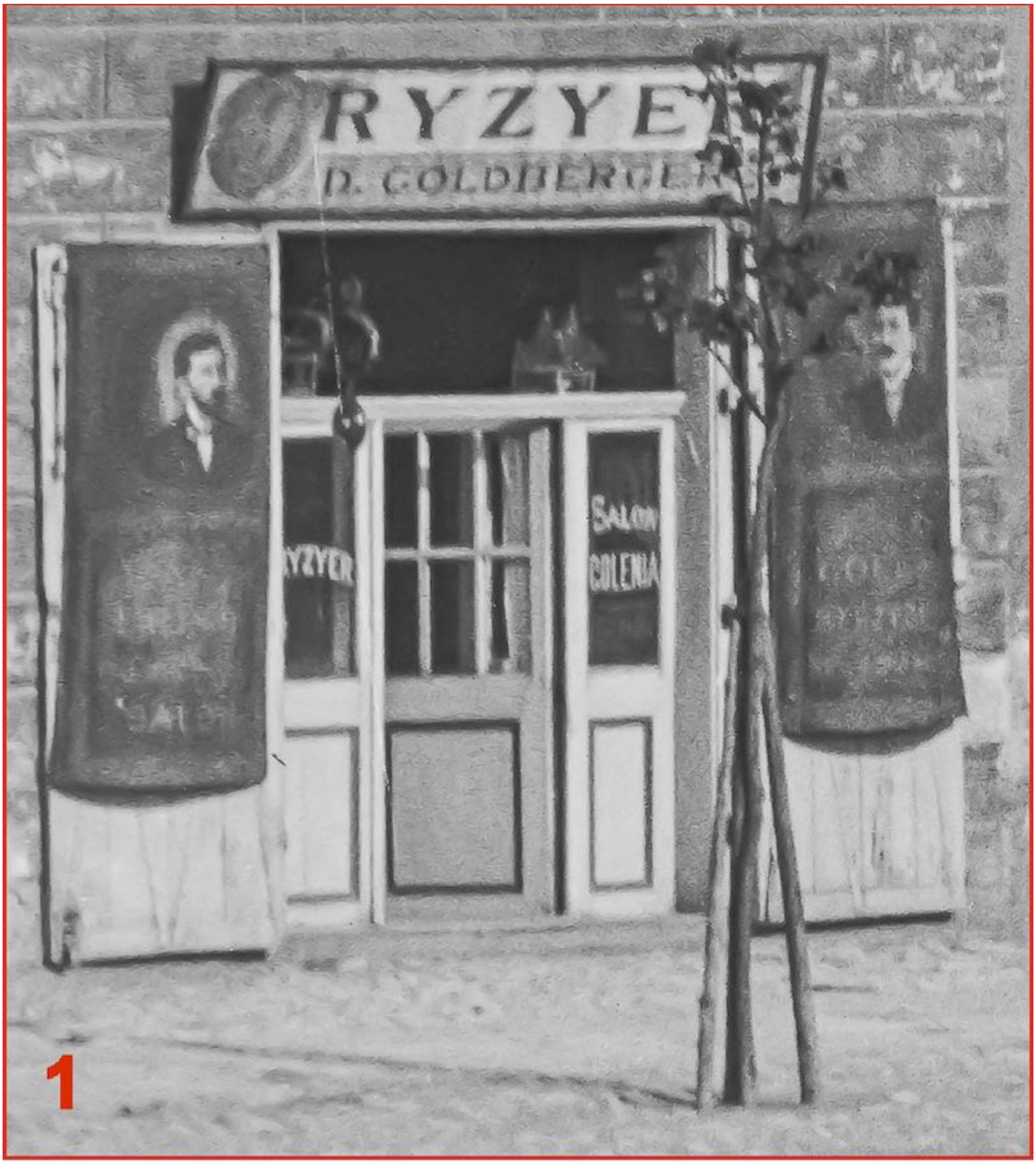


*Photo. 38/1,2,3,4,5,6. An enormous number of details is visible, which can be seen on a properly digitized plate, such as inscriptions on shop windows, signs, advertisements. Negative from the collections of MHK. Developed by W. Pyzik.*

| | Scanner | Digital camera |
|---|---|---|
| Thermal hazard | Scanning at high resolution will last up to several minutes. Fluorescent tubes or even LED lighting leads to a considerable increase in the temperature inside the scanner booth.<br>Yes | None |
| Mechanical hazard | A plate is located with emulsion facing downwards as it must be directed at the recording sensor which is in the lower part of the scanner.<br>Thus, emulsion coating may get damaged. | A plate is located with emulsion facing downwards as it must be directed at the recording sensor which is over the plate. Thus, emulsion is safe. |
| Object's exposure to light – time and intensity | One cannot limit the exposure. | Exposure may be optimized. |
| Optical density | Constant | Variable<br>Due to the option of changing light intensity |
| Optical resolution | Constant | Variable<br>An image sensor of higher resolution may be applied or photographs maybe taken of smaller areas |
| Work on RAW files | Only selected models with SilverFast Archive Suite software | Native<br>Possibility of working on high-contrast and dense negatives |
| Stitching option | No technical capacity | Yes |
| HDR option | No technical capacity | Yes |
| Exchangeable optics | No technical capacity | Yes |
| Universal character | Only for flat artefacts | Flat artefacts, flat large-size objects as well as spatial objects |

*Table 1. Summary of hazards and technical capacities of scanners and digital cameras. Developed by W. Pyzik*

## Conclusions

Wrong exposure value and shortcomings of old emulsion preparation and chemical processing techniques, time factor, improper storage conditions, sensitivity to temperature and humidity as well as carrier types make glass plates especially demanding artefacts, requiring a lot of effort to attain good quality of digital documentation.

**Main challenges of working on glass negatives:**
1. Ensuring safety of glass plates.
2. technical possibilities of digitizing difficult negatives, especially very dense, high-contrast or damaged ones.
3. Proper selection of a digital camera and optics, taking into account the size of glass plates.
4. Accurate setting of exposure conditions (quality of a copy, amount of light).
5. Covering ambient and secondary light as well as direct reflection.
6. Covering light fields outside the object, i.e. harmful light
7. Precise manual setting of focus.
8. Keeping the surface of the image sensor of the camera parallel to the negative.
9. Interpretation and development of results.

Wacław Pyzik

Graduated from the Academy of Mining and Metallurgy in Cracow, Poland. NIMOZ (National Institute for Museums and Public Collections) expert in digitization of museum holdings. Co-author and author of NIMOZ publications on the subject of digitization. Runs NIMOZ workshops and trainings devoted to digitization, color management, scanning, photography and use of graphics software.