FROM HANS GROSS TO LASER SCANNING – PRINCIPLES OF CRIME SCENE DOCUMENTATION NOW AND THEN

Dr. **Silke M. C. Brodbeck**,
Blutspureninstitut,
Obergasse 20, 61250 Usingen, Germany,
<info@blutspureninstitut.com>

"*You don't take a photograph,*
you make it."
Ansel Adams

Annotation

Hans Gross created with the first print of his book "Handbuch für Untersuchungsrichter, Polizeibeamte, Gendarmen, usw." a standard volume for the work at crime scenes in 1893. This book was published in several editions over a time period of decades.

Throughout the time the technology, which is used for crime scene documentation, has changed, correlated to the then actual available technology.

This article gives an overview about the changes in the technologies used at crimes scenes for documentation between 1893 and 2022. It describes the way from sketching and modelling to photography, Infrared-photography, spherical panoramic photography and laser scanning. Many modern technologies are based upon scientific principles which were described decades ago, although people think, that they are new.

This article also takes a look upon what principles for the work at crime scenes, postulated by Hans Gross, are still valid today.

Keywords*:* Hans Gross, Crime Scene Documentation, Sketching, Modelling, Spherical Panorama Photography, Laser scanning, Laser

Acknowledgements

The author wants to thank Prof. Dr. Christian Bachhiesl for the kind permission to use the photographs from the Hans Gross Museum in Graz, Austria and to Dr. Sinikka Brodbeck for proof reading.

Introduction

It is without a doubt, that Hans Gross published a standard book in 1893, which for the first time set criminalistic standards for the work at crime scenes

and many other judicial areas. The "Handbuch für Untersuchungsrichter, Polizeibeamte, Gendarmen, usw."[1] was published in several editions and translated into other languages.

Hans Gross was the first in many ways, even if this is sometimes forgotten. Methods like Liquid Latex Lifting[2] seem to be new, but taken into historical context, the first person to use elastomers at crime scenes, was Hans Gross, who used gum Arabic[3] to secure blood of walls.

This article takes the 1893 published material of Hans Gross and follows its development into today's crime scene documentation in a modern technical world. The human society in the 21st century is proud of its technical achievements. This article enlightens, which are the parallels of the historical crime scene work with todays work and which areas have to be viewed as historical.

Many principles, which Hans Gross formulated for the work at crime scenes are still as up-to-date as they were, when they were published. Precision, thoroughness and impartiality are the basis to every excellent crime scene documentation today. This is sometimes forgotten in the nowadays discussion, where bias became a modern topic again, although impartiality has always been a standard in good criminalistic work.

The use of language in investigative work

One factor, which is often underestimated by nowadays students of police sciences is, that their use of language has the same importance as their weapon. A clear and precise description of a crime scene is the foundation upon which the investigative work of the police, the prosecution and later on the court and the defense are resting. A good and precise language is the basis of crime scene investigation.

But one thing has changed during the times of Hans Gross in correlation to nowadays. Prior photography the description, the use of language, was the standard for the documentation of a crime scene. Today it is photography.

Crime scenes back then could only be drawn and in historical cases out of this time it is regular to find crime scene drawings. Often a murder case would be covered with two drawings. Only two pictures of a crime scene in a murder case with regular circumstances would be unthinkable in our optical world today.

1 Gross, H. (1893). *Handbuch für Untersuchungsrichter, Polizeibeamte, Gendarmen, usw*.

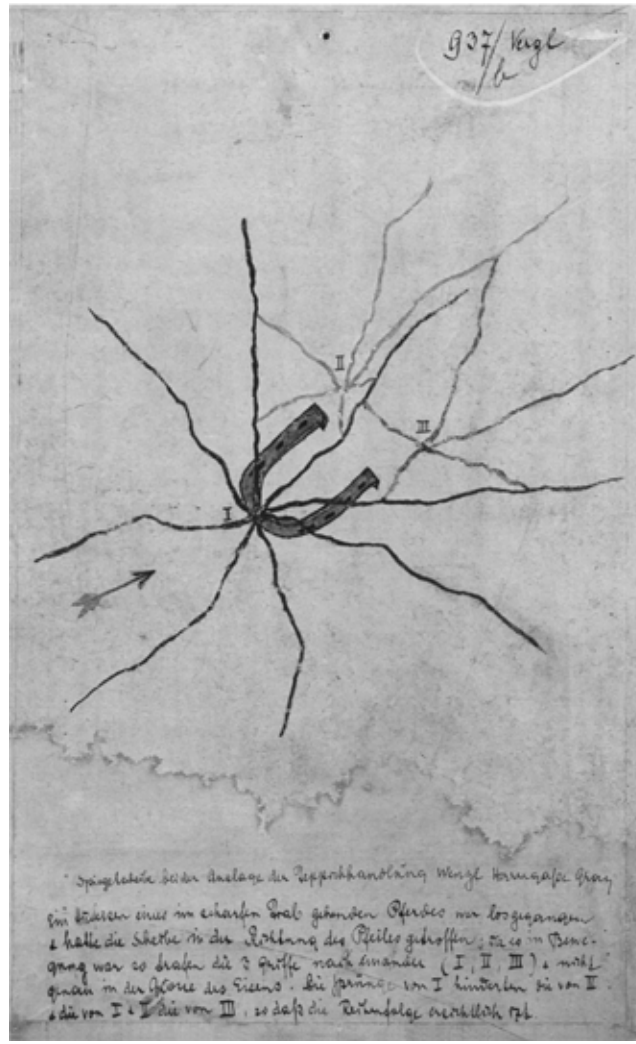
2 Brodbeck, S. (2011). The Latex Lifting Method for the Recovery of Blood, DNA and Dermal Ridge Evidence in Arson Cases. *Journal of Bloodstain Pattern Analysis*.

3 Jeserich, R. und H. (1930). *Chemie und Photographie im Dienste der Verbrechensaufklärung.*

Sketching and Modelling

In the early time of criminal scene documentation, the sketching was the most accurate tool which could be used (see picture 1).

But Hans Gross achieved more, even in a preindustrial time, when technical solutions were not existing. Hans Gross used to measure thoroughly crime scenes. For that he used a measuring tape. But also, larger territories needed



Picture 1. Description of a broken glass due to the kick of a horse. Drawing by a unknown person, text below an original handwriting by Hans Gross *(Hans Gross Kriminalmuseum der Universität Graz, Austria)*

Picture 2. Picture of Hans Gross´s crime scene kit. In the lower left corner, the measuring tape, above a little to the right the pedometer "Schrittzähler"
(Hans Gross Kriminalmuseum der Universität Graz, Austria)

to be documented and for that reason Hans Gross used a practical solution. Inside his crime scene kit there was a step counter. Whenever a distance was longer than the measuring tape, he used the step counter and multiplied the result with 80, according to a standard step length of 80 centimeter. With this mechanism he was able to document larger landscapes.

He also understood, that the three-dimensionality was sometimes important for the documentation of a scene[4]. For that he used 3-D models, which were based upon his measures and his descriptions. Although modelling was effortful, as it is also in today´s digital world. Hans Gross understood that a model is not a replacement for a crime scene visit, but a tool for visualization.

This is the paradox of a model: The closer you try to image reality, the more you understand that reality in a model cannot be reached.

4 Elek, L. (2017). Das Tatortmodell – eine Analyse anhand dreier Objekte aus dem Bestand des Hans-Gross-Kriminalmuseums der Universität Graz. *Archiv für Kriminologie,* 239, 181–192.

Especially in nowadays technical forensic marketing often the illusion is given, that modern models could become a replacement for a forensic crime scene visit. This is more an argument of marketing and not of sciences. Until today not any technical produced model is capable to depict all details of reality. A model is simply just a model and never reality.

At the time of Hans Gross the models were produced mostly out of wax, gypsum and clay. It required two steps: first a thorough measuring and then the modeling. This has remained the same chronology, even in today´s computer models. Hans Gross called his models "Tatortrelief", crime scene reliefs. He remarked that the basis of his drawings for models was derived from the military (3). Clarity and comprehensibility were already valued as important for criminal investigation.

Photography and IR-Photography

With the development of technical possibilities, the photography developed and found its way into the criminalistic world. Now it was possible to document the reality or more precisely the surface of reality with a technical procedure.

When we see today old portraits from that time, we see most of the persons looking stern. This resulted from two technical problems: First there was only one picture possible, due to the usage of photographic plates and secondly the exposure time back then was fairly long. Any movement would have destroyed the picture.

Murder scenes were in contrast to that easy, because the persons to be photographed did not move anymore. Therefore, photography found its way into criminal investigations for the use of identification and of crime scene documentation[5].

Alphonse Bertillon is reported to be the first to make a systematic approach for the photography of crime scenes, although earlier uses of photography for judicial purposes were documented in Europe.

Additional it has to be remarked that the photographic industry made a fast development in these early years. Robert W. Wood is accredited to have made the first infrared (IR) photography in the year of 1910.

Infrared photography became an important procedure in crime scene documentation, due to the fact, that bloodstains on dark surfaces often show little

5 Brodbeck, S. (2012). Introduction to Bloodstain Pattern Analysis. *SIAK-Journal – Journal for Police Science and Practice International Edition*, Vol. 2, 51–57.

to no contrast. They are sometimes hard to be seen on dark surfaces. Depending on the absorption behavior of the surface often IR-Photography produces a good contrast for the documentation in Bloodstain Pattern Analysis and is therefore still used until today. After 1910 the photographic industry became interested and with the industrial production of IR-film the method began to spread out. In the forensic field it is said that handwriting experts were the first discipline who used IR-photography, others and medicine following later. Nowadays IR-photography is still in use as a standard on dark surfaces, only the systems have become digital.

Spherical Panorama Photography

Out of the physical development in optics two additional techniques started to be used at crime scenes: Spherical Panorama Photography and Laser Scanning. Spherical Panorama Photography itself is a combination of two photographic techniques: HDRI imaging combined with a fisheye lens[6].

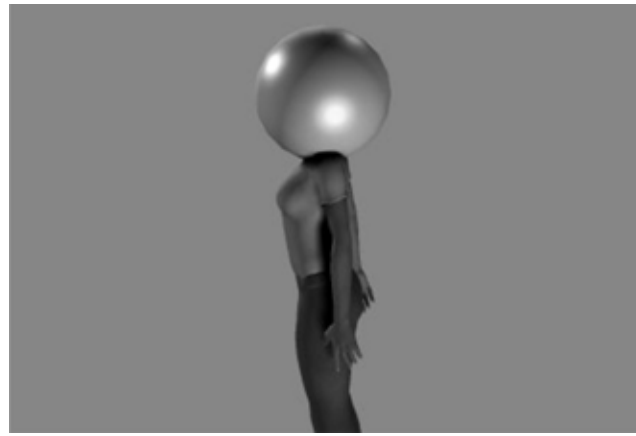
With digital photography a photographic camera can be put on a tripod and the camera is rotating on the stand at a crime scene. The camera takes several pictures in every single position, every picture with another aperture opening. Later on, all pictures from the same position will be combined to one. This is called High Dynamic Range Imaging. Due to the HDRI technique these photographs can take up to hours at crime scenes in dark areas.

These cameras use a fisheye lens, which produces a distorted image and therefore this method is primarily used for visualization of a scene. With the fisheye lens it is possible to create a spherical data set around the position of the stand. Modern systems do have to some degree capabilities of measuring, but measuring is the core competency of laser scanning. Often nowadays also both systems can be combined.

With a HDRI image it is possible to change the aperture later, when it is viewed, because in reality a HDRI-picture is a combination of several pictures with different exposures. So, in pictures of huge contrasts, where usually one part is over- or underexposed, the viewer can change the aperture at the time, when he or she is watching the data.

The fisheye lens was first described 1906 by Robert H. Wood, who would later produce the first IR-photography. A fisheye lens is an ultra-wide-angle lens, with an angle of view between 100 and 180 degrees. It produces pictures,

6 Brodbeck, S. (2008). The role of modern crime Scene documentation systems for BPA – Spheron and Laser Scanning, Abstract. *IABPA Newsletter.*



Picture 3. In a spherical, panorama photography the data is visualized like a sphere around the point of the viewer *(Blutspureninstitut, Usingen, Germany)*

which are in a computer combined to a spherical picture. This is schematized like in picture 3. The viewer is virtually standing on one point at the crime scene (where in reality the camera stood) and is able to look in a data set around, like in a sphere.

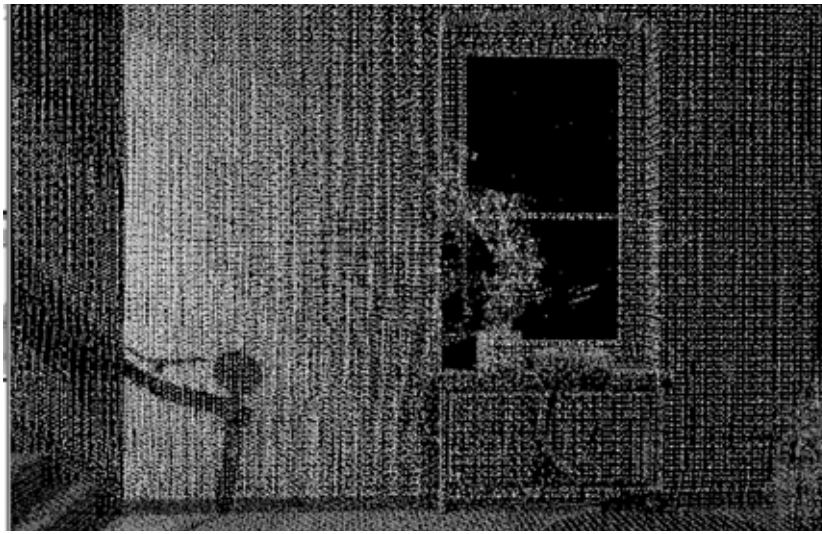
The disadvantage of this visualization method is the strong distortion in the basic data set, the short time frame covered at the scene and only the surface documented. This method does not replace photography at the crime scene.

Laser Scanning

As optical technics evolved and upon the basis of quantum physics new technologies emerged, the laser became fast a technique of modern everyday life. Nowadays nearly everybody uses laser light, e.g.in CD, DVD and Blue-ray-Players, laser printers, laser pointers, in medical surgeries, cameras and range finders and so on. It also found its way into scientific uses e. g. into spectroscopy and lidar, just to name two.

In the armory laser light is used for sighting telescopes, because it is coherent and the light is bundled. However, in the military uses of Laser often showed interesting studies like the 1K17 Szhatie study (a tank study/Russia) or later the THEL (Tactical High Energy Laser USA/Israel). But larger laser projects were often discontinued in developmental stages due to high costs.

Albert Einstein laid the principles for quantum physics for what he was rewarded in 1921 with the noble prize (he did not receive it for the relativity theory). Later in 1964 Nicolay Gennadiyevich Basov, Aleksandr Mikhailovich Prokhorov and Charles Hard Townes received the Noble prize for physics for



Picture 4. Point cloud created with Laser Scan, low number of points resulting in a low resolution *(Blutspureninstitut, Usingen, Germany)*

their basic work on Masers. Out of this highly technical field emerged the Laser, moving from microwaves to visible light, with the first Laser built in 1960[7].

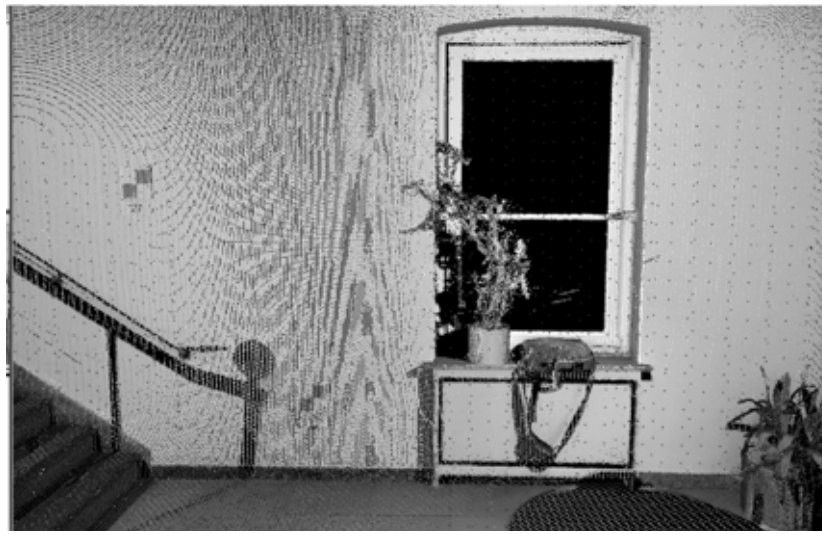
Laser stands for Light amplification of stimulated light emission radiation. The light of a laser is coherent light (the physical phases are near to parallel) and can be bundled, it can provide a high energy density and is close to monochromatic. Due to its coherence, it can be used to measure distances, which is used in laser scanning.

A laser is mounted on a tripod with the capability of rotation. It produces laser beams which are reflected on the surrounding surfaces and again registered at the base. The final product is a point cloud, in which every point stands for a distance and out of these distances a three-dimensional model of the space is created.

The more points are measured, the more detailed the picture gets and the resolution is getting higher.

Because laser light is close to monochromatic a pure laser scan does not include any color data. Nowadays laser scans produce a technical co-registration

7 Kneubühl, F. K., Sigrist, M. W. (2008). *Laser*.



Picture 5. Double registered data, one laser scan and one spherical data matched into one data set, therefore providing the point cloud and colour information. Created with a larger number of points and therefore with a higher resolution. *(Blutspureninstitut, Usingen, Germany)*

of a Laser Scan combined with a photographic camera view for providing the colour data. In earlier times two data sets, one laser scan and e.g., one spherical panoramic set were produced separately and later on matched in the computer, producing pictures, with a lower resolution.

This technique became fast interesting for crime scene work and was implemented in Germany around 2005. In 2004 the first programs to produce area calculation in Bloodstain Pattern Analysis for the use with laser scanners was published, although it has to be additional remarked, that for Bloodstain Pattern Analysis a Laser scan is not necessary. It is just a tool.

The advantages of Laser Scanning (in a modern system with a combined photographic documentation) can be described as follows:

– a fast way to produce a computer model of a space;

– making measuring afterwards possible;

– easy documenting of difficult 3-D-structures (e.g. caves, industrial buildings, fast changing places like shopping malls);

– every position and its view can be calculated and therefore imaged, even if these positions cannot be conventionally photographed.

Although it provided a step forward, Laser Scanning did not replace

photography as a standard method at crime scenes. Crimes are always dynamic motions to some degree. Even a person shot down from a large distance with a rifle is going to the ground, providing several different positions during the change of body position.

Because Laser Scanning is only the documentation of surfaces at the time of scanning, the time factor is limiting its use. A forensic technician has two advantages, which the Laser scan does not provide: The human is able to lift the surfaces, to look beneath those and is able to

photograph at several times. Often perpetrators do cover e.g., bloodstains with carpets or other pieces of furniture, when it is impossible to get them cleaned. In a good crime scene work, the crime scene can be handled over a time period and therefore can be worked layer by layer. The Laser scan only documents the outer surface at the time of scanning. The Bloodstains under a carpet will not be found, if nobody lifts the carpet. Not even with a combined laser scan and spherical panoramic image.

Conclusion

Although with the technical development of the industrial times new technologies became available, like the IR-photography, Laser scanning, Spherical panoramic imaging, the gold standard for the documentation of crime scenes has remained the photography.

But every new method has its advantage in its own specialty: IR-photography is excellent for the documentation of bloodstains upon dark surfaces with a low contrast. Laser scanning is excellent for the documentation of three-dimensional complex surroundings or surroundings, which undergo a fast change (e.g., shopping centers). Laser scanning includes measuring of distances and is able to visualize complex three-dimensional structures (e.g. roofs) or views of positions, which cannot be photographed conventionally.

But still, the illusion that the use of a modern technology, makes a crime scene visit of an expert pointless has not become true.

Until today a good documentation of a crime scene lays the profound basis for a good criminal investigation. Hans Gross described the principles in the "Handbuch für Untersuchungsrichter, Polizeibeamte, Gendarmen, usw." later changed to „Handbuch für Untersuchungsrichter als System der Kriminalistik". Although the techniques used at crime scenes have developed over the time and have become modern, the principles of precision and thoroughness have remained the same.

In the digital world a photography is only one moment, which can be

produced by anybody nowadays in masses. The unlimited resources of digital photography and the lack of the need to take care about the resources have produced a mass of data, but not necessarily of good data. The task of modern crime scene work therefore remains the same. In the modern world it is not resource managing in the focus of the work, but quality production of the optical data at crime scenes.

Until today it remains necessary for every person photographing at crime scenes to think "What do I want to show?" before taking the pictures at a crime scene. The keys to good crime scene documentation are thoroughness and precision. This will remain always from Hans Gross.

"Die Lage eines Gegenstandes, einen Zoll rechts oder links,
auf der Vorderseite oder Rückseite,
ein bisschen Staub auf einer Sache,
ein verwischbarer Spritzer –
alles kann höchsten Wert erlangen."

„The position of an object, one inch left or right,
on the front or on the back,
a little dust on one thing,
a smudgeable spatter –
everything can be of the highest value."

Hans Gross, 1893, Page 65

NUO HANS GROSS IKI LAZERINIO SKENAVIMO – NUSIKALTIMO VIETOS FIKSAVIMO PRINCIPAI DABAR IR TADA

Silke M. C. Brodbeck

Santrauka

Hansas Grossas pirmuoju savo knygos „Handbuch für Untersuchungsrichter, Polizeibeamte, Gendarmen, usw.“ 1893 metų leidiniu sukūrė standartinį rinkinį rekomendacijų darbui nusikaltimų vietose. Bėgant laikui ši knyga buvo išleista keliais leidimais.

Vystantis technologijoms keitėsi bei tobulėjo ir naudojamos nusikaltimo vietos fiksavimui.

Šiame straipsnyje apžvelgiama nusikaltimų vietų fiksavimui naudojamų technologijų kaita nuo 1893 iki 2022 metų. Jame aprašoma jų raida nuo eskizų ir modeliavimo iki fotografijos, infraraudonųjų spindulių fotografijos, sferinės panoraminės fotografijos ir lazerinio skenavimo. Daugelis šiuolaikinių technologijų yra pagrįstos moksliniais principais, aprašytais prieš dešimtmečius, nors žmonės mano, kad jie yra nauji.

Šiame straipsnyje taip pat apžvelgiama, kokie Hanso Groso postuluojami darbo nusikaltimų vietose principai galioja ir šiandien.

Raktiniai žodžiai: Hansas Grossas, nusikaltimo vietos fiksavimas, eskizų kūrimas, modeliavimas, sferinė panorama, lazerinis skenavimas, lazeris.