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A Scientific Study of the Structural layer of the Mounted Silver Gelatin Prints "Black And White", Recent Scientific Methods of Examination, Analysis, and Appropriate Treatment Methods

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Abstract

Photographs are one of the most significant cultural heritage materials, which are worthy of preservation for future generation for the historical value they represent. Photographs contain important historical, social and cultural information; and therefore they are considered a very powerful documentary tool. Additionally, they represent an outstanding form of modern art.

Unfortunately, due to the lake of professionals in the field in Egypt and lack of awareness on the physical and chemical nature of photographs and how they deteriorate and what is the best methods to preserve them, photographs suffer from various forms of deterioration caused by both external and internal factors.

Mounted silver gelatin prints are common in photographic collections. However, such photographs are usually mounted on secondary supports of very poor quality, and accordingly expose the photograph to severe damage with time, depending on the surrounded environment. Which need more preservation and conservation that can't come without a good examination and analysis by the scientific instruments to achieve better conservation for the photograph.

During this research, the researchers provide an overview of the study of the structural composition of black and white photographs mounted on secondary supports, through a number of scientific devices to examine and analyze them to identify their structural layers and the changes that occurred in order to reach the best methods for preservation and conservation.

Keywords

Photographs, Conservation, Gelatin, Support, Prints.

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دراسة علمية للتركيب البنائي للصور الفوتوغرافية الجيلاتنية الأبيض والأسود المثبتة علي حوامل ثانوية وطرق الفحص والتحليل والعلاج المناسبة

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الملخص

تعد الصور الفوتوغرافية واحدة من أهم مواد التراث الثقافي ، والتي تستحق الحفاظ عليها للأجيال المستقبلية لقيمتها التاريخية والوثائقية ، حيث تحوي الصور الفوتوغرافية بين طياتها معلومات تاريخية واجتماعية وثقافية هامة ؛ فهي تعتبر أداة وثائقية قوية للغاية. بالإضافة إلى أنها تمثل شكلاً بارزًا من أشكال الفن الحديث.

ولسوء الحظ ، وبسبب ندرة المتخصصين في مجال صيانة الصور الفوتوغرافية في مصر وقلة الوعي بالطبيعة الفيزيائية والكيميائية للصور وكيفية تدهورها وما هي أفضل طرق الحفاظ عليها ، فإن الصور الفوتوغرافية تعاني من أشكال مختلفة من التلف الناجم عن كل من عوامل التلف الخارجية الداخلية.

وتعتبر الصور الفوتوغرافية جيلاتين الفضة الاكثر شيوعا في مجموعات التصوير الفوتوغرافي. وعادة ما يتم تثبيت هذه الصور على حوامل ثانوية ذات جودة رديئة للغاية ، ومع مرور الوقت تتعرض الصور الفوتوغرافية إلي أضرار جسيمة ما يجعلها تحتاج إلى مزيد من الحفظ والصيانة والذي لا يمكن أن يأتي دون فحص وتحليل جيد باستخدام الأجهزة العلمية المتخصصة.

خلال هذا البحث يقدم الباحثين نبذة عن دراسة التركيب البنائي للصور الفوتوغرافية الابيض والاسود المثبتة علي حوامل ثانوية وذلك من خلال عدد من الاجهزة العلمية لفحصها وتحليلها للتعرف علي مكوناتها والتغيرات التي طرأت عليها للوصول إلي أفضل الطرق المناسبة لحفظها وصيانتها.

الكلمات الدالة

صور، حفظ، جيلاتين، حامل، مطبوعات

1. Introduction:

1.1 Silver Gelatin Prints

Gelatin silver photography is a general term describing the most common process for making black and white photographs since the 1890s. Silver gelatin prints were made on various developing-out and printing-out papers.

Gelatin silver prints were invented by *Richard Leach Maddox* in 1871, and then improved by *Charles Harper Bennet* in 1878. (**Brost, A., and Watkins, S., 2012**). In 1873, *Peter Mawdsley* invented the first photographic paper with a gelatin emulsion, and commercially-produced gelatin silver printing papers were available by 1885.

The first experiments in making silver halide emulsions with gelatin were conducted as early as 1853 by *Marc Gaudin*. His emulsion, which he called Photogene, was based on the combination of iodide and silver and was not successful**. (Mark, 2007).**

In 1874, gelatin was commercially produced for developing-out papers. Later, in 1885, paper coating machines were invented and made commercially available. Baryta layers were added to developing-out papers in 1894. And, Kodak papers were introduced in 1894. (**Brost, A., and Watkins, S., 2012**).

Gelatin silver prints replaced albumen prints as the most popular photographic process by 1895 because they were much more stable, did not have a tendency to yellow, and were far easier to produce. This process was introduced in 1885 and is still in use today.

2. Types of silver ge1atin:

2.1 Silver Gelatin Printing-out paper

One of two major classes of photographic papers. First named in 1891 by the *Ilford* Company. Printing out paper (P.O.P) is a general term for several types of gelatin silver papers that replaced albumen papers. They were once the primary papers used for producing prints but have been rarely used since the 1920s, because they require much more light than developing-out papers. Printing out paper forms an image by the direct action of light on a photosensitive compound, such as a silver salt. **(Museum of Fine Arts Boston).**

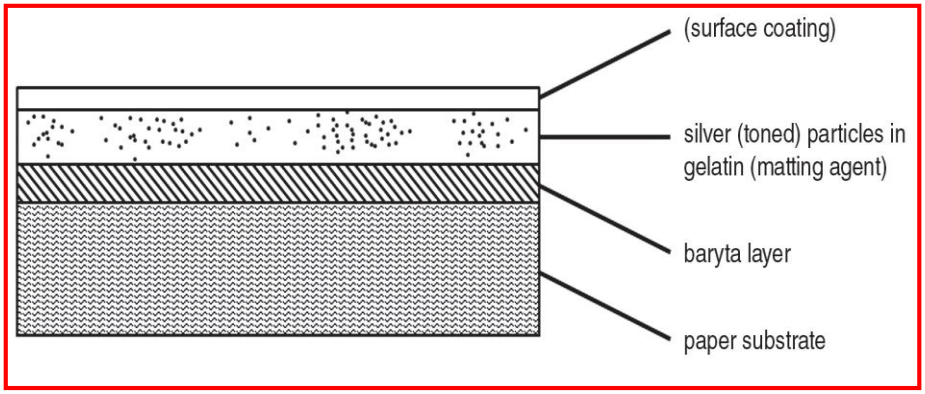
Figure (1), Package of printing out-paper (Citrate paper). Ca.1920.

After: (Lavedrine B., et al., 2009).

The papers are made by either a two-step salting process or by a one-step emulsion process. They were sometimes toned with gold before fixing. Printing out paper images were fixed in an aqueous solution containing sodium thiosulfate, but this can result in lightening of the image. Printing-out papers were sometimes left in the unfixed state, typically for studio

proofs. These unfixed prints will continue to slowly change with time. **(Museum of Fine Arts Boston).**

Figure (2). Shows cross section of a typical P.O.P silver gelatin photograph.



2.2 Silver Gelatin Developing-out- paper

The D.O.P. silver gelatin process was the most significant photographic printing process of the twentieth century. **(Dusan, and Art, 2013).** Chemical development of positive images was used as early as 1851 by *Blanquart Evart* in his commercial photographic printing film. However, development was not commonly used until the 1880s. From about 1885, papers coated with gelatin containing silver bromide became available. **(Heritage Collections Council).** Silver gelatin printing-out photographs can range in color from warm browns to cool purples because of the nature of the development of the photolytic silver strand. Pristine silver-gelatin developing-out photographs are generally monochromatic, blue-black and white in appearance. Both processes can be toned to different colors with the addition of a toning process during development, using other minerals such as selenium or gold. (**Brost, A., and Watkins**, **S., 2012**)

2.3 Difference between POP and DOP

The main difference between the P.O.P. and D.O.P. silver gelatin processes is not in the internal structure of the photographic material but in the way the silver-based image is developed. **(Dusan, and Art, 2013).** Developed images have much larger silver particles than printed-out images. In printed-out papers, the images are made up of small spherical particles of silver called photolytic silver. **(Heritage Collections Council, 1998)**

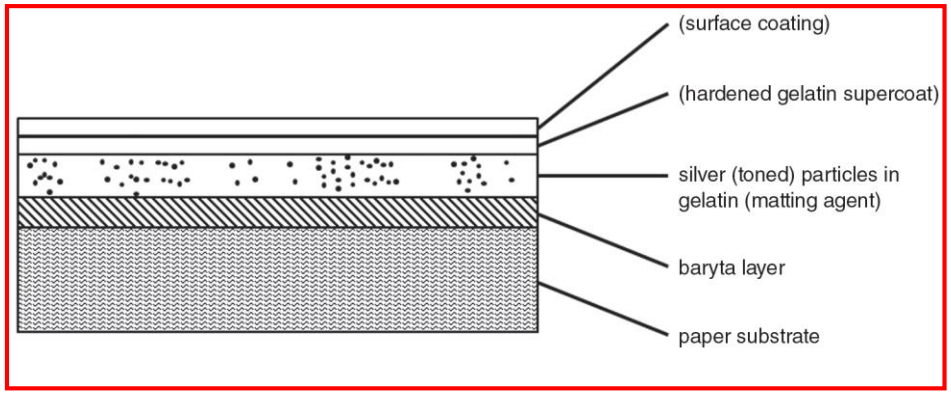


Figure (3). Shows cross section of a typical baryta-coated, fiber-based, black-and white D.O.P photograph.

3. Structural Layers of Silver Gelatin Prints

3.1 Photographic Gelatins (Binder)

A mixture of proteins prepared by hydrolyzing, via boiling, collagen obtained from skin, ligaments, and tendons. **(Museum of Fine Arts Boston).**

The use of gelatin in photographic emulsions dates back to about 1870 when *Dr. Maddox* of England replaced the collodion wet process with a gelatin emulsion which could be dried and was not required to be used immediately. **(GMIAM, 2012).**

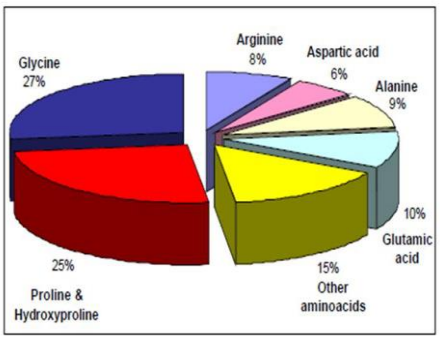


Figure (4), shows the amino acid composition of gelatin.

After, (Zandi, M., 2008)

3.2 Baryta layer

The term "baryta" was derived from barite or barytes. (**Funderburk, K**). It is a layer of barium sulfate in gelatin applied to the surface of photographic paper base to provide opacity, smoothness, and brightness. (**Fischer, M., T., 2008**). It also covers the paper fibers and prevents the emulsion coating from penetrating into the raw base. As suds, the baryta coating was applied only to the side of the paper that was to be coated with the emulsion. (**Funderburk, K**).Manufacture of baryta-coated paper did not become widespread until the mid-1880 with the advent of machine coating. Baryta was not hand applied by amateurs, so its presence indicates that the paper was commercially manufactured. (**Leyshon, W., E., 1984-2001**).Thicker baryta layers give the print a flat, uniform surface, and thin layers retain the texture of the paper.

3.3 Silver gelatin papers

Silver gelatin papers were made as halides, (chloride, bromide and Chloro-bromide) the difference was in sensitivity, color tone, and in whether they were printing-out or developing-out forms of paper. (**Ali, M., A., 2010**). the history of silver gelatin papers.

- **Bromide paper**, By Richard L. Maddox, 1871 - 1920.
- **Chloride paper**, By Eder and Pizzighelli, 1881.
- **Chloro-bromide paper**, By Dr. J. M. Eder, 1833

3.3.1 Bromide paper

A fast photographic printing paper, Bromide paper was introduced in 1871 by *Richard L. Maddox* and used until about 1920. The paper is formed using a gelatin emulsion containing silver bromide. Bromide paper gives dense black prints. **(Museum of Fine Arts Boston)**

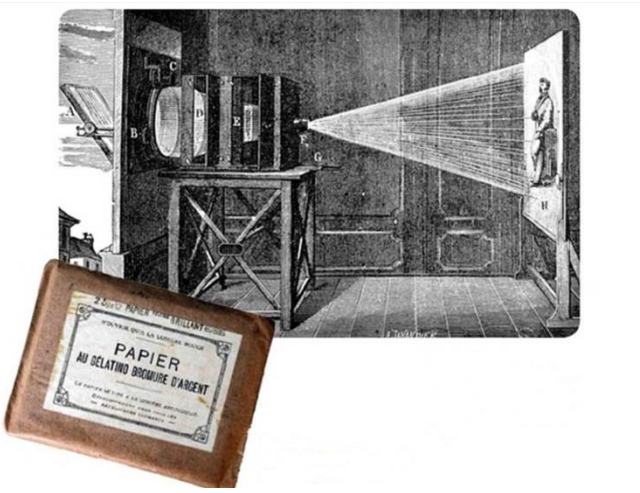


Figure (5) Package of gelatin silver bromide paper for contact printing or enlargement. Ca.1910. And Solar enlarger, engraving. ca. 1890. The first optical enlargers used sunlight as a light source to enlarge carte-de-visite-format portraits.

After: (Lavedrine, B., et al., 2009).

After more sensitive bromide papers were introduced, bromide papers became the choice for enlarging, while the slower chloride papers are generally used for contact printing. (**Leyshon, W., E., 1984-2001**), at first, the emulsion was coated directly onto the paper; after 1895, bromide developing-out papers were also coated with a layer of barium sulphate. **(Heritage Collections Council 1998)**, this paper needed to be handled in a dark room equipped with the appropriate safelight due to its relatively high sensitivity to light. (**Ali**, **M., A., 2010**). Matte-surfaced bromide paper was produced as early as 1879 by using starch in the gelatin. (**Leyshon, W., E., 1984-2001**)

3.3.2 Chloride paper

Developing-out gelatin silver chloride paper was invented by *Eder and Pizzighelli* in 1881 in Austria, and was later manufactured as "Alpha" paper. Gelatin silver chloride paper was made in both printing-out and developing-out forms. Some other trade names were: Velox "DOP chloride or chloropromide", Solio, Ronex. (**Leyshon, W., E., 1984-2001**). Early velox prints had a smooth surface, later glossy and matt surfaces were popular. (**Ali, M., A., 2010**) Figure (9)

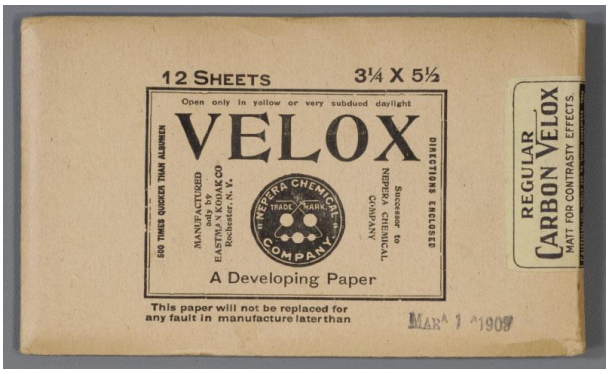


Figure (6), shows sample of VELOX paper, once of (D.O.P) papers.

Chloride paper has low sensitivity and prints slowly. It was used mainly for contact prints in which the paper was placed directly against the negative with the emulsion sides together. It was exposed with bright light, usually daylight, and then fixed with sodium thiosulfate. Silver chloride paper gives hard blue-black prints. **(Museum of Fine Arts Boston).**

3.3.3 Chloro-bromide paper "Gaslight paper":

This paper type was invented by *Dr. J. M. Eder* in 1833. It was manufactured about 1884 under the name "alpha paper" and it was also known as "Gaslight paper". (**Ali, M., A., 2010**).

Figure (7), Package and advertisment for "Gaslight" contact printing paper (Gelatin silver chloride and bromide) ca.1900.

After: (Lavedrine, B., et al., 2009).

4. History of Mounted Photographs

In 1854, Disderi came up with the idea of making small mounted photographs, where the card mount was only slightly larger than the paper print. Today we call these 'cards' or 'card mounted' photographs to distinguish them from the more variable, and enduring, 'matted' photograph. . Some photographers signed and dated the mount (or the matting) instead of the photograph. (**Chipman, A., Maloney, A., and Watkins, S., 2014**).

4.1 Secondary supports the role and significance

1- Prints are mounted on stiff cardboard, to keep them from curling.
2- The cardboard mat also provided a wide edge, that could be used for captioning or identification notes.

3- To handle the print without touching the surface of the print, which would be harmed by the natural oils and other contaminants on the hands.
4- To re-establish the physical characteristics of the support of photography, this improves the handling and storage of the prints. (**Solano, M., E., G., Morgan, S., and Watkins, S., 2009**)
5- Aesthetic of the historic photograph, valuable signature, or historic provenance can be lost through unmounting.
6- Mounting can be a physical protection for thin photographic supports that is lost when the photograph is unmounted. (**Maloney, A., et al, 2014**).
7- Signed mounts are part of the provenance of the photograph and should be kept whenever possible.
8- Commercial mounts are often manufactured of acidic wood pulp cores. Broken, cracked corners of the mount and photograph often result from handling brittle mounts. (**Chipman, A., Maloney, A., and Watkins, S., 2014**).

5. Mounting photographs

Photographs were mounted for presentation purposes—for display at home, for sale or for exhibition in competitions. Some photographic formats required mounting in order to be viewed successfully. Albumen prints are almost always found mounted to a secondary support. Many silver gelatin prints were mounted, both POP and DOP.

The hygroscopic nature of many adhesives used to mount prints, including gelatin, gum and paste, can be become deterioration factors. Gelatin was recommended for mounting as a much smaller amount was needed to create a good bond.

Adhesives were not pure, they often contained multiple additives, to adjust the working properties, viscosity, drying time and other characteristics of the resultant adhesive.

Adhesives based on or including rubber, shellac and plant resins could be expected to have discolored severely with the passage of time and to be unresponsive to aqueous resolubilization treatments. Combinations of plant and animal adhesives (such as starch and gelatin) may also prove to be less soluble now, as starch would inhibit the natural solubility of the gelatin. The Maillard reaction may also occur between protein and carbohydrate molecules, causing a brown discoloration and increasing insolubility. (**Cannon, A., 2012**).
Photographers didn't use adhesive that were prepared by themselves only, but sometimes they used commercial adhesives (**Cannon, A., 2012**).

5.1 The mounting boards

The mounting boards used in the 19th century were a constant source of potential danger for the photographic image. A typical 19th-century mount was composed of a thin top and bottom sheet of relatively good quality paper, with a center filler of poor quality pulp board. This pulp center was often loaded with lignin, the non-cellulose component of

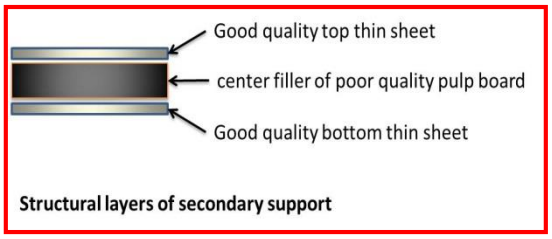


Figure (8), shows the structural layers of secondary support

wood, whose presence leads to the acidification of the entire mount and eventually of the photographic print itself.

The most common problems seen today that result from poor quality mount boards are brittleness and yellowing in the print caused by acidification of the mounting cardboard, and the brownish-red flecks and stains known as "foxing." This "foxing" may be the result of mold and fungus growth, or may also be caused by the presence of metallic salts in the mount board. Staining from decomposed mounting adhesives is also common, either initiated or compounded by the acidification of the mount board. **(Reilly,J., M.,1980)**

5.2 Adhesives

Types of adhesive according to the type of paper for example, animal glue was more likely to have been used for a thicker, stiffer photograph, and starch and gums for thinner papers. Common Adhesives mixtures were starch and gelatin, starch and dextrin, starch and gum Arabic, and rubber mixed with shellac (**Cannon, A., 2012**).

5.3 The Disadvantages of adhesive on photographs

The effects of these adhesives on the photograph itself vary. Those with a strongly acidic or alkaline nature, high moisture content, or an inclination to discolor (e.g. rubber, animal glue) may have contributed to image fading and/or discoloration of the support. Many of the adhesives may now prove intractable during conservation treatment, due to their inherent non-aqueous nature (rubber) or due to contact with various waterproofing agents, such as alum. These agents may have been added to the adhesive itself, or applied to the photograph in a wash solution, as part of the mounting process. Other components of the adhesive may have reacted with each other to bring about decreased solubility, such as the combination of starch and gelatin. (**Cannon, A., 2012**).

6. Materials and Methods

One of the silver gelatin mounted photographs from the privet collection of Mr., Francis Amin was selected, all information regarding the description and condition of the photographs were recorded. The following methods were used for investigation and analysis purposes:

6.1 Photography Documentation

A digital still camera SDPW DSC-W630 along with a Kodak gray scale and color patch were used.

6.2 Visual Inspection

A SUPEREYES PZ01 500X USB Digital Microscope was used to document and to identify the surface properties of the photographs.

6.3 PH measurements

PH strips were used to determine the changes of the pH values.

6.4 FT-IR analysis

A Nicolet 380 FT-IR Spectrometer, in the frequency range of 4000 -400 cm-1, in reflectance mode was used to determine the photograph binder and adhesives were used .The procedure was carried out in the National Institute of Standards (NIS) in Cairo, Egypt.

6.5 SEM Examinations and Analysis

This examination and analysis technique were performed using an Environmental Scanning Electron Microscope quanta-200 Emission with EDX at Antiquities research center – project sector – ministry of antiquities – Cairo – Egypt.

7. Interventive Conservation

7.1 Documentation and condition report

Title of the picture: Students and teachers group photo
Name of the photographer: unknown
Date of the picture: unknown
Number of the picture: no number
Source of the picture: private collection belonging to Dr. Frances Amin
Image process: silver gelatin D.O.P
Mount or unmounted: mounted
Housing: none
Structural layers: it consists of a three layered structure: image layer (i.e. image silver and gelatin binder), baryta layer (i.e. barium sulfate in gelatin), and primary support (i.e. paper). The photograph is mounted on a secondary support (i.e. paper and an adhesive layer).
General discretion:
It is a group photo for students and their teachers may be in the court of the school. The picture has a lot of deterioration aspects will showing in the next rows. The image black and white, mounted on a paper white cardboard, and it's signed by "CAVOUK" the name of the studio. And the picture has some of deterioration aspects as the following description.

7.2 Secondary support condition

material: paper				
Dimensions: L = 31.7 cm**,** W = 28 cm**,** T = 0.2 cm				
Deterioration aspects :				
Dust	Impeded Dirt	Loss	Cracked	Fragile/ weak
Missing parts	Abrasion	Brittle	Water Damage	
Fold	deposit			
Other Notes : the name and the address of the studio is written on the verso of the secondary support as follow: ستوديو كافوك ٥٣ شارع شبرا ت ٥٩٤٧٩ studio d art CAVOUK 53 rue choubra – le Caire tel. :59479 - There are pencil marks on the verso of secondary support and small holes.				

7.3 Primary support condition

material: paper , **paper fibers** are (invisible fibers)				
Dimensions: L = 22.5 cm , W = 16.7 cm				
Deterioration aspects :				
Fingerprints	Tearing	Mold Damage	Abraded	Water Damage
Detachment	Creased	Deposit	Dust	Yellowing
Fold lines	Missing parts	Holes		

7.4 Visual inspection

7.4.1 Examination by Digital microscope

All the images components were examined by digital microscope.

7.4.1.1 Image layer

The examination shows the surface characteristics of the images, silver grains distributions and the cracks on the image.

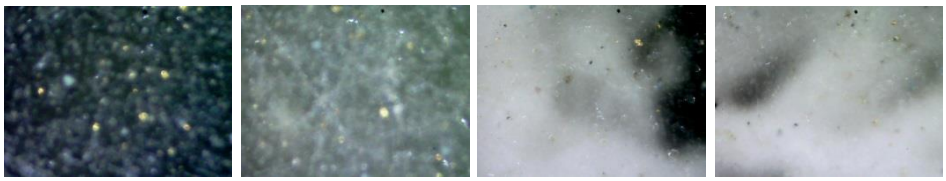


Figure (9), shows the silver grains distribution in different parts of the image.

7.4.1.2 Top, bottom and secondary support

The examination shows that the top layer in the photograph is composed of uniform fibers which means that the fibers are connecting (linked) together very well and in a good condition. Also, the bottom layer for the photograph. The secondary support is composed from different sizes of fibers and contains some impurities.

Figure (10), shows the surface characteristics of primary support and some silver grains distribution in scratched part of the image.

Figure (11), shows the paper fiber characteristics of top layer of secondary support.

Figure (12), shows the fibers characteristics of secondary support and some impurities between the fibers

7.4.

7.4.2.1 The image and primary support

The SEM examination shows the image layer, the baryta layer, and some loose paper fibers from the primary support. These fibers are cotton as revealed by their morphology. EDX reveals the presence of elements related to this layer structure such as silver (image forming material, barium and sulfur (baryta layer) and calcium related to the manufacture of the paper. Results are shown in the following figures.

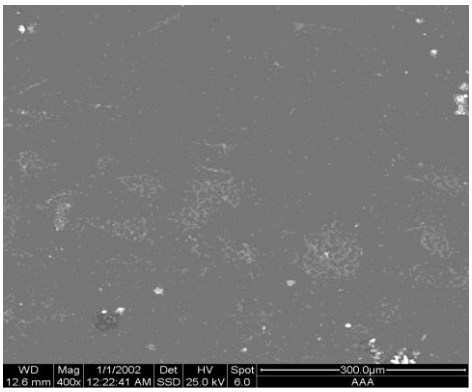


Figure (13), shows the image layer silver

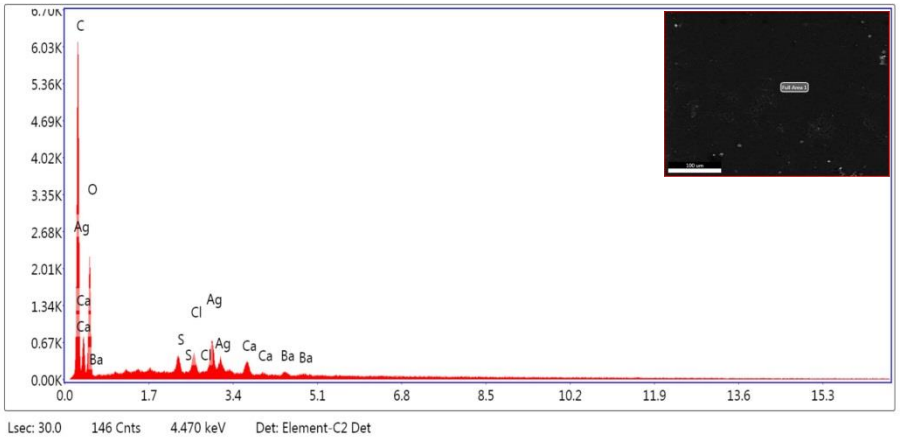


Figure (14), show the EDX pattern of the image layer chemical composition.

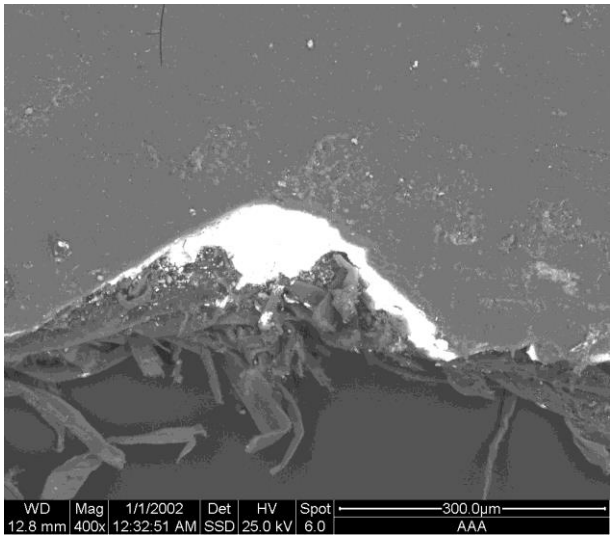


Figure (15), shows the baryta layer and the fibers of primary support.

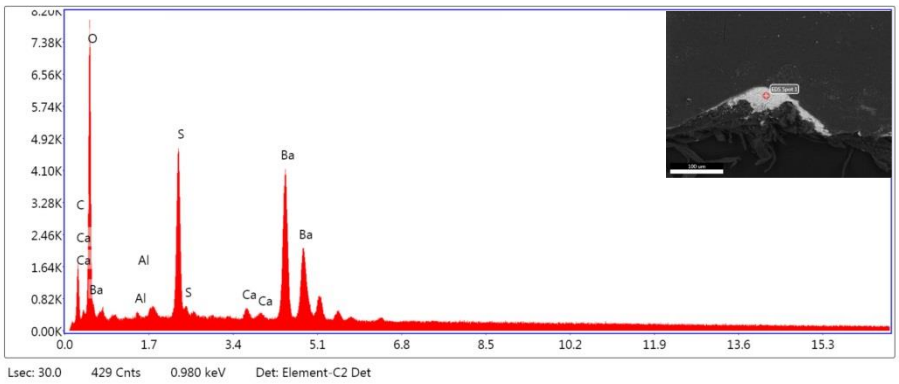


Figure (16), show the EDX pattern of the baryta layer chemical composition.

7.4.2.2 Examination the Top Layer and Secondary Support

The SEM examinations shows that the top layer is twisted fibers that are indicate the fibers is cotton. Concerning the secondary support the examination show that the fibers are wood pulp suffering from deterioration as shown in the following figure.

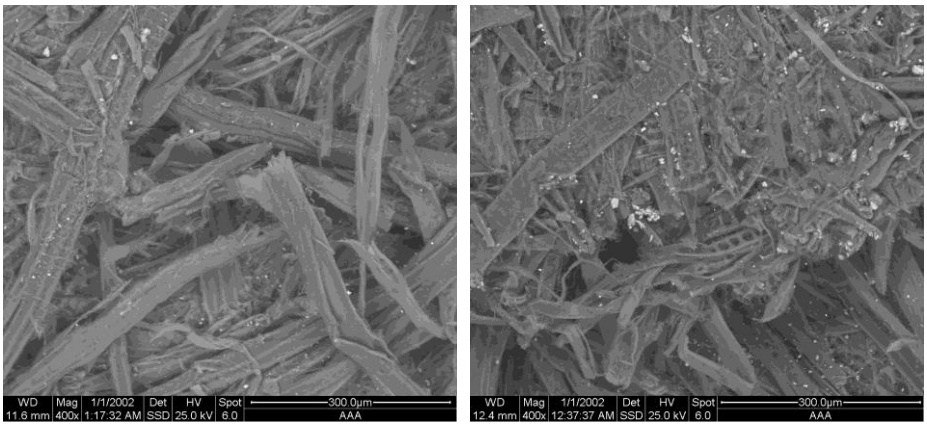


Figure (17), shows the top layer characteristics and the fibers type (left),

And the secondary support characteristics and the fibers type (right)

7.5Analysis by FTIR

All samples from each layer of the photographs had been taken to analyze by FTIR. The samples had been divided as the following table.

Table (1), shows the samples indication which taken from the case studies secondary supports.

Case study	Case studies photography Layers			
	Secondary support	Image	Adhesive	Top layer
	1.A	1.B	1.C	1.D

7.5.1Analysis of the secondary supports

All the functional of cellulose had been achieved as the following table and FTIR spectra patterns.

Table (2), shows the functional groups for the samples which taken from the case studies secondary supports.

Case study samples	Functional groups				
	OH stretching	**C-O** stretching	**C-H** stretching	**C-H** bending	**C=O** stretching
	Wave length (cm-1)				
1A	3435	1061.7	2924	886.5	1627.4

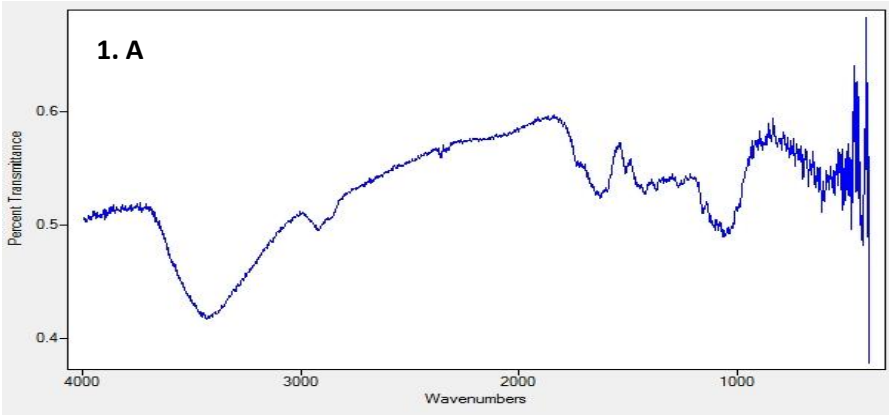


Figure (18), shows the secondary supports FTIR spectrum

7.5.2 Analysis the images layers

All the functional of the protein had been achieved as the following table and FTIR spectra patterns.

Table (3), shows the functional groups for the samples which taken from the case studies image layers.

Case study samples	Functional groups			
	C=O stretching	**N-H** Bending	**C-H** stretching	**OH** stretching
	Wave length (cm-1)			
1B	1634.6	1538.5	1455.4	3444

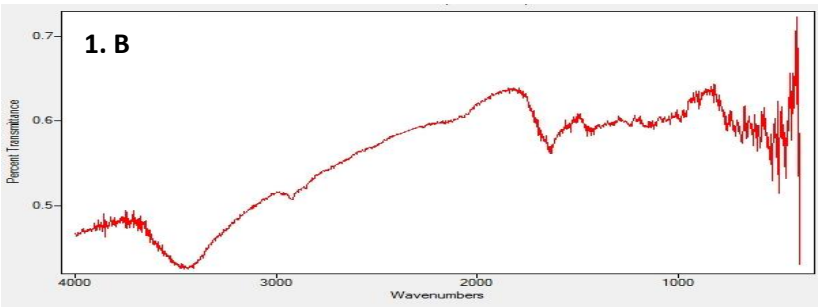


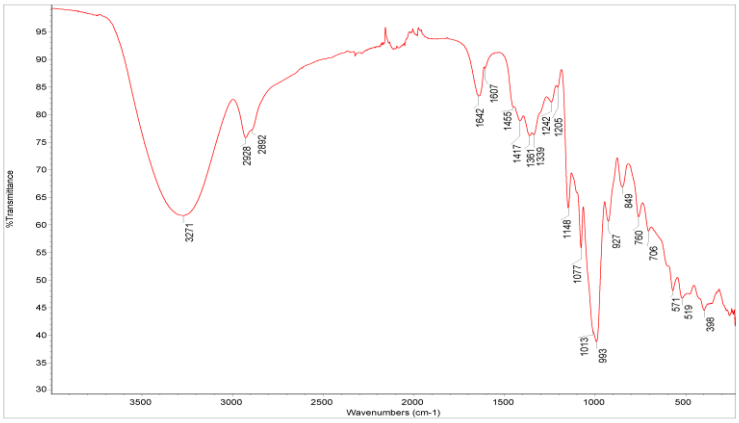
Figure (19), shows the FTIR spectrum for the sample

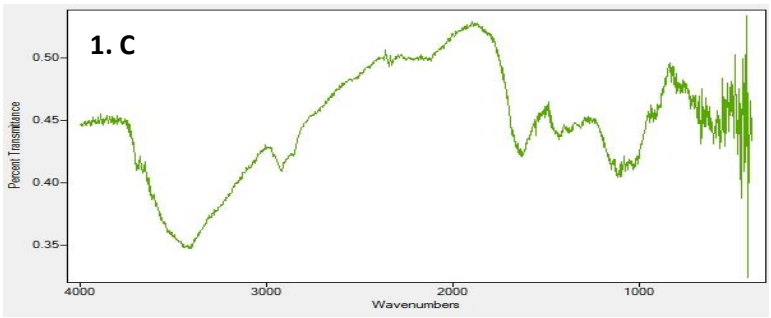
7.5.3 Analysis the adhesive

Functional groups of cellulose had been found as shown in the following table and FTIR spectra patterns.

Table (4), shows the functional groups for the samples which taken from the case studies secondary supports.

Case study samples	Functional groups				
	OH stretching	C-O stretching	C-H stretching	C-H bending	C=O stretching
	Wave length (cm-1)				
1C	3406.2	1114.6	2920.1	832.5	1634.1





Starch

Figure (20), shows the FTIR spectra for the standard sample of starch and samples 1.C

7.5.4 Analysis of the top layers secondary supports

The functional of cellulose were present as shown in the following table and FTIR spectra patterns.

Table (5), shows the functional groups for the samples which taken from the case studies top layers secondary supports.

Case study samples	Functional groups				
	OH stretching	C-O stretching	C-H stretching	C-H bending	C=O stretching
	Wave length (cm-1)				
1D	3416.4	1039.2	2921.2	906.8	1634.1

7.5.6.The secondary supports FTIR spectrum

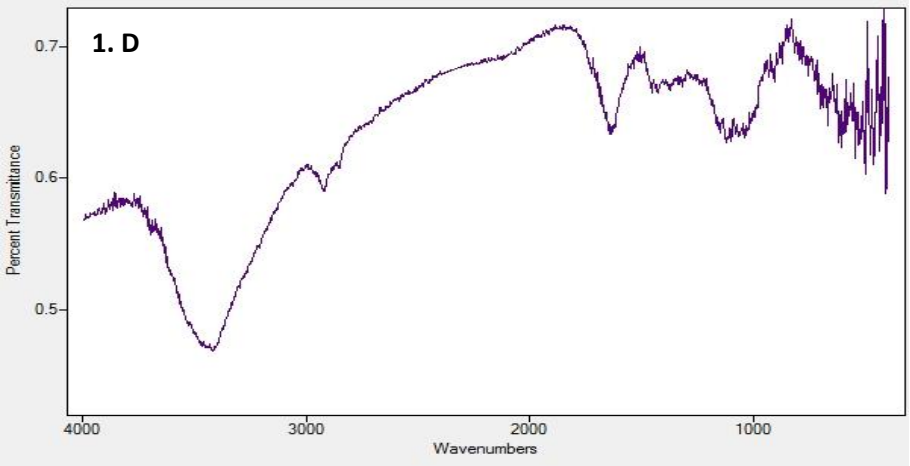


Figure (21), shows the FTIR spectrum for the sample 1.D.

8. PH measurement

The pH strips with distilled water were used to measure the approximate pH value of the secondary supports. The pH was average 4 – 5.

9.Conservation Treatments:

9.1 Mechanical Cleaning

A fine Brush (Hair goat brush), was used to remove the loose dust from the image surface, from the detached parts and secondary support, starting from the center and moving toward the edges. Concerning the pencil deterioration on the back of secondary support, the poly propylene eraser was used.

Figure (22), shows the mechanical cleaning by fine brush and removing the pencil writing and imbedded dirts by eraser

9.2 Unmounting

The spatula was used to detach the image from the acidic secondary supports, starting from the edges to the center of the image. A good adhesion in the middle of the image with the acidic secondary support was observed, so there are some residue of a good quality paper on the back of the image.

Figure (23), shows the steps of unmounting the Image from acidic secondary supports

9.3 Removing the residue from the back of the image

Distilled water was sprayed and applied by brush to wet the parts on the back of the images, and then it was removed by the scalpel.

Figure (24), shows the removing of residue of adhesive and secondary supports from the back of the images.

9.4 Facing the good quality paper

Klucel G 2% in ethyl alcohol was used to adhere the tissue paper for facing and support the top layer of secondary support, the tissue paper strips were adhered over lapping.

Figure (25), shows the facing process

9.5 Detachment and Unmounting high quality papers from the acidified secondary support

The scalpel and spatula were used to detach the top layers and the bottom layer after that the scalpel was used to reduce the secondary support, and then distilled water was applied by brush to wet the secondary support which was later removed by scalpel.

Figure (26), shows the detachment and decreasing acidic secondary support from top and bottom layers,.

Figure (27), shows the removing acidic secondary supports from the top and bottom layers.

9.6Treatment the top and bottom layer of secondary support

As previously shown, the top and bottom layers suffer from cracks, loss, detached, holes, etc… All these aspects have been treated and supported using tissue paper and CMC 3% with light box to view and determine

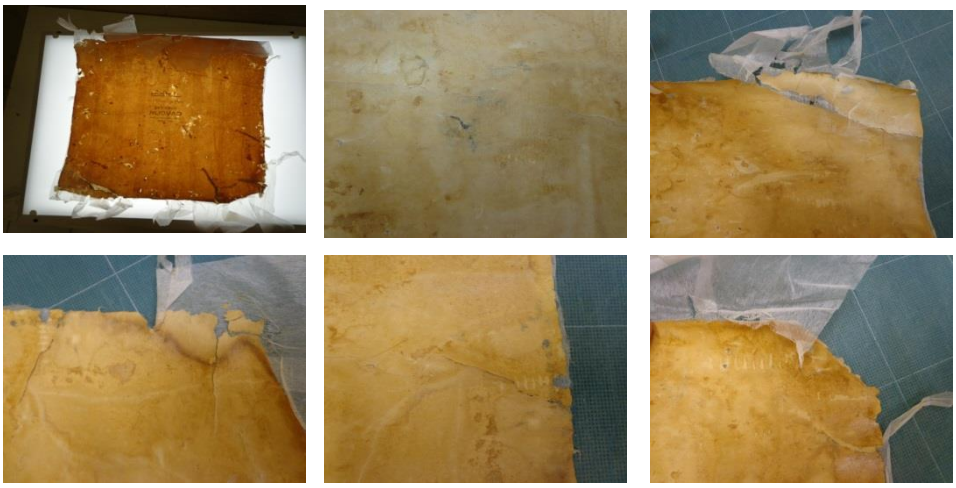


Figure (28), shows some of deterioration aspects of the bottom layer before treatments.

exactly borders of cracks and loss parts. The outlines of the losses were taken with a pencil adding 2 mm approximately. Then the resultant patches were cut by scalpel and adhered in place by brush and CMC.

Figure (29), shows the deterioration aspects on the top layer and two examples of treatments losses parts.

9.7 Image treatment process

CMC 3% and tissue paper were used to adhere the detachment and torn parts of the primary support.

Figure (30), shows the cut part in the corner of the image before treatments (left) and after treatments (right).

9.8 Unfacing process

After completing the treatments, ethyl alcohol and brush had been used, the unfacing operated in the opposite way of over lapping tissue facing strips.

Figure (31), shows unfacing top layer (up) and bottom layer (down), (before) left, (during) mid, and (after) right for the bottom layer

9.9 Smoothing paper

After treatment, all the excess parts have been removed by cutter and ruler.

9.10 Remounting process

Klucel G 4% was used in remounted the top, bottom layer and the image on the new acid free secondary support.

At the first, the top layer was adhere and compressed between two cardboard under press. Then, the bottom layer was treated in the same way. After, the image was fixed as shown in the following figures.

9.11 Final Result after treatments

The following figures show the case studies before and after treatments.

Figure (32), shows the top & bottom layers after smoothing treatment parts


Figure (33), show the remounting the top layer (left) and pressed the mounting layer (right).

Figure (34), show the top layer before and after treatments (up), and the bottom layer before and after treatments

10. Conclusion:

The study approved that the image consist of the common structural layers of the silver gelatin photographs.
The secondary support suffering from the acidity with the time.

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