USING EXAMINATION AND ANALYSIS METHODS TO DETERMINE THE ASPECTS OF DETERIORATION FOR OIL PAINTINGS (THE PAINTING OF KHEDIVE ISMAIL, A CASE STUDY)

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Abstract
This research includes a historical and artistic study of an oil painting by Khedive Ismail in the Museum of the National Post Authority in Ataba Square, dated 1932 AD, and signed by the artist O. Chimchidian. The report also includes the anatomical structure of the painting; the most important pigments materials and the oil medium used in the paint layer, as well as the fillers and the binding material were used in the ground layer, in addition to the type of fibers used in the canvas. The research also deals with the most important aspects of painting damage and the factors causing it.

Keywords
X-Ray Diffraction; FTIR; Linen; Red Lead; Cross Section.

Introduction
The painting, the subject of the study, is an oil painting in the Museum of the National Post Authority in Ataba Square. It is a life-size oil picture of Khedive Ismail, with a length of 214 cm and a width of 122 cm. Fig. No. (1) shows the oil painting the subject of the study. The date recorded on it - to 1932 AD, meaning that the painting was painted after the death of Khedive Ismail, as Khedive Ismail died on March 2, 1895 AD, and Khedive Ismail is Ismail bin Ibrahim Pasha bin Muhammad Ali Pasha, born on December 31, 1830 AD, and the painting is signed in the name of the artist O. Chimchidian, the artist Oskan Chimchidian, born in 1867 AD, and lived in Armenia, and Fig. No. (2) shows the signature of the artist and the date of the painting, and the picture is painted in oil colors on a canvas easel (canvas) installed on a wooden frame (canvas crossbar), and the picture is The subject of the study is surrounded by a frame of gilded wood, size 152 x 242 cm.
As for the subject of the painting, it represents a realistic interior image of Khedive Ismail, standing in the official royal uniform, which is military clothes studded with decorations and insignia, holding his left hand sheath his sword, in addition to the red fez, and the painting depicts Khedive Ismail in the lobby or one of the palace halls, and in the background is to the left of Khedive Ismail, there is a red curtain that the artist painted elaborately, as he perfected the personal features of Khedive Ismail and Khedive Tawfiq, as appears in the painting the floor of the hall or the hall in which Khedive Ismail stands.

**Materials and Methods:**
The examination of oil images initially required a lot of aid, such as manual lenses or a single-lens microscope, and since that time many scientists and researchers have added a lot of aids that help in identifying and protecting materials, and accordingly many methods of examination and analysis have been developed. The recording and verification of the parts that may have been added later, the discovery of the technical details and the methods used by the artist is the purpose of the examination and analysis of oil images, and all of this helps guide the researcher and restorer both in his field of work, and written and illustrated documents record all A step taken by the restorer, which then protects him from any criticism that may be directed at him, and it is also impossible for the restorer to think about treating an effect without knowing the materials that make up it, estimating the degree of change in them, understanding the reasons for the occurrence of that change, and estimating the risks that those
images will be exposed to if they are not treated, and therefore any intervention must begin with the examination and analysis of these oil paintings.

The first important steps in this field are assessing the condition of the paintings and recording what has been done from the beginning of the restoration work that may have occurred previously, and recording the unexpected appearances that have been revealed, such as the existence of an under layer for oil painting that may be completely different from the surface layer, as it may. There are some changes in the composition by the artist who did this work, as happens with the artist after completing his painting, he then repeats some steps in the artwork and increases paint layers or certain frills, and it becomes clear from this the importance of the examinations and analyzes that are carried out on oil images. The following are the most important methods that were used in the examination and analysis of the components of the study painting:

**First: Methods of examination:**

**Photographic recording:**

The painting under study was photographed at this stage - the pre-restoration stage, then at the start of the restoration process with cleaning until the completion of the treatment and maintenance operations, and the painting under study was presented as an appropriate museum display. Several general snapshots were taken of the painting subject of the study, then some detailed snapshots were taken to highlight all the features and manifestations of damage and details of the painting to determine the treatment plan that will be applied to it. On it after the completion of the restoration process through all its stages, as these snapshots were taken for each part of the painting before, during and after the restoration, as these pictures are the complete record of the painting that can be used in any subsequent stages in the future. For the restoration and maintenance of this painting and bringing it to light and displaying it in a good manner that matches the value and history of such antiquities, and the Figs numbers from (3) to (10) illustrate the painting subject of study before restoration.

Fig. No. (3) shows the painting under study before restoration.
Fig. No. (4) shows the painting the subject of the study before restoration.

Fig. No. (5) shows the painting the subject of the study before restoration.

Fig. No. (6) shows the painting under study before restoration.
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Fig. No. (7) shows the painting subject to study before restoration.

Fig. No. (8) shows the painting the subject of study before restoration.
Fig. No. (9) shows the painting under study before restoration.

Fig. No. (10) shows the painting under study before restoration.
Ultraviolet Investigation:
This method depends on the penetration of the rays into the material and the extent of its penetration through the different layers, which gives the film degrees of color indicating the presence of more than one layer. Oily to indicate the presence of different layers or cracks.

The painting under study was photographed with a UV lamp to study the layers of photography and what there may be of subsurface layers or old restorations that are not visible to the naked eye. shows the plate during UV scanning.

Fig. No. (11) showing the painting the subject of the study during the UV examination.

Fig. No. (12) showing the painting the subject of the study during the UV examination.

Fig. No. (13) shows the painting the subject of the study during the UV examination.
Fig. No. (14) shows the painting the subject of the study during the UV examination.

Fig. No. (15) showing the painting the subject of the study during the UV examination.

Fig. No. (16) shows the painting the subject of the study during the UV examination.
Infrared Investigation:
It depends on the penetration power of the rays of the material and the extent of its penetration through the different layers, which gives the film degrees of color indicating the presence of more than one layer. This method is used to examine colors (due to a change in the absorption of some effective groups), as well as photographing oil paintings to indicate the presence of layers. The different layers or cracks, as well as to study the layers of photography and what there may be from the sub-surface layers, as well as identifying some aspects of damage.
within the paint layer or on the background of the painting and difficult to show under normal light, or any signatures or writings that are not clear that cannot be seen with the naked eye, as well as Whether the artist drew a sketch of the painting in pencil or not, as in the Figs numbers (20) to (27), which shows the painting under study during the infrared examination.
Fig. No. (22) shows the panel the subject of the study during the infrared examination.

Fig. No. (23) shows the panel the subject of the study during the infrared examination.
Fig. No. (24) shows the panel the subject of the study during the infrared examination.

Fig. No. (25) shows the panel the subject of the study during the infrared examination.
**Fig. No. (26)** shows the panel the subject of the study during the infrared examination.

**Fig. No. (27)** shows the panel the subject of the study during the infrared examination.
Second: Methods of Analysis:

X-ray diffraction analysis:

X-rays are electromagnetic rays with ultra-short wavelengths ranging between 10-9 - 10-15, having the same nature as light. The wavelengths of X-rays used in the study of materials range between 2.5 - 0.5 angstroms, and diffraction is used mainly in the analysis and knowledge of components Samples to identify the sample material, study the crystal structure of the samples, determine the size of the material crystals, identify ancient and modern colored materials, discover the forgery of oil paintings, and identify the components of the photographic floor.

The analysis was done for the samples of colored materials and the filler for the photographic floor with an X-ray diffraction device, in the analysis lab by X-ray diffraction at the Department of Archeology Restoration - Faculty of Archeology - Cairo University. It was found from the interpretation of the results of the samples analysis that the artist used the following colored materials:

Red color: It consists of red lead oxide Pb3O4, as in Fig. No. (28).

Green color: It consists of aquamarine green Cr2O3.2H2O, as in Fig. No. (29).

Brown color: It consists of Indian red Fe2O3, as in Fig. No. (30).

Black color: It consists of nitrite FeSiO2, as shown in Fig. No. (31).

The white filler used in the photographic ground: It consists of a mixture of white zinc ZnO and white lead PbCo3.Pb(OH)2, as shown in Fig. No. (32).

**Fig. No. (28) shows the pattern of X-ray diffraction analysis of a sample of red color.**
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Fig. No. (29) shows the pattern of X-ray diffraction analysis of a sample of green color.

Fig. No. (30) shows the pattern of X-ray diffraction analysis of a brown sample.
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Fig. No. (31) shows the pattern of X-ray diffraction analysis of a sample of black color.

Fig. No. (32) shows the pattern of X-ray diffraction analysis of a sample of white filler on the ground layer.

**Gas chromatography:**
Chromatographic analysis is one of the laboratory methods used in the purification and isolation of organic and inorganic materials as well, and its benefits are evident in isolating the components of mixtures of compounds, both separately, and it is considered a practical method for analysis, and gas chromatographic analysis uses columns in which the moving medium is a gas such as nitrogen or hydrogen, Therefore, this method is called the gas-solid method (GSC) or the gas-liquid method (GLC), and gas chromatography is used to distinguish composite materials, where the separate components can be distinguished by chromatography by comparing the curves of the extracted materials with known curves or preparing known mixtures and comparing their behavior with the
behavior of the unknown mixture In order to identify the linking mediator in the plate under study, a gas chromatograph was used at the Microanalysis Center, Faculty of Science, Cairo University, where samples of the colored substance were taken from separate areas of the plate, where the fatty substance was first extracted from the sample, and then converted into methyl esters of acids. After that, the sample was identified by gas chromatography, where standard samples of fatty acids were made After analyzing the archaeological sample in gas chromatography, it was found that the oil medium used in the painting under study is linseed oil, as in Fig. No. (33).

![Gas Chromatogram]

*Fig. No. (33) shows the pattern of gas chromatographic analysis of a color sample from the plate under study.*

**Infrared analysis:**
Infrared analysis is used to identify the type of bonding material used in the photographic floor, and it was found through the result of analyzing a sample from the photographic floor that the artist used animal glue as a bonding material to the photographic floor, as shown in Fig. No. (34).

![Infrared Spectrum]

*Fig. No. (34) shows the result of analyzing a sample from the ground layer by infrared radiation.*
Canvas:
Scanning Electron Microscope (SEM) is used for qualitative and quantitative analysis of the oxides that make up the sample. It requires only a very small part of the sample, whether in solid or powdered form. The sample is prepared first, then coated, and then placed inside the device. It can also be used to study the internal structure of the paint layer. It was also possible to provide it with an X-ray analysis unit (EDX) and it relies on the X-ray energy fluorescence process used to excite the elements in the sample. A sample of the canvas holder for the panel under study was examined with a scanning electron microscope, where it was found that the type of fibers used in the canvas holder is linen. As in Fig No. (35) and that the weaving structure of the canvas holder is of the type gentlemen 1/1, as in Fig No. (36), and the number of warp threads per centimeter is 11 threads, and the number of weft threads per centimeter is also 11.

The most important aspects of the painting deterioration and the factors causing it:
Oil pictures are considered to be antiquities that quickly deteriorate due to the fact that they contain within their components many organic materials such as canvas holders, glues, oil media, varnishes, and sometimes some organic colors, etc., in addition to inorganic materials such as pigments and white materials used on the photographic floor. And each of these materials has different physical, chemical and mechanical properties, which accelerates the deterioration of this type of antiquities.

The oil painting, the subject of the study, goes back to 1932 AD, meaning that it was around 90 years old, meaning that it was found in a climatic environment that undoubtedly differs greatly from the current environment in terms
of temperature, humidity, air pollution... etc. This change has undoubtedly affected all components of the painting, and the painting under study suffers from a number of manifestations of damage, which are as follows:

**Darkness of varnish layer:**
The painting suffers from the darkening of the varnish layer, which is the transformation to a dark opaque color, where the original layer of varnish changes to yellow in a large or small proportion, or to a dark yellowish-brown, or to greenish-brown, with the passage of time, this opacity leads to fragility and loss Transparency and clarity, which lead to cracking.

![Fig No. (37) shows the darkening of the varnish layer.](image)

**Dust and dirt:**
There are dust and dirt scattered on almost all of the surface of the painting and on the background of the wooden stand as well, and these dirt almost cover the color details in some areas, and some of these dirtiness is a natural product of physicochemical factors of damage represented by light, heat, moisture, oxygen and air pollution gases, and some of these dirt are caused by damage And human neglect represented by some of the dust covering the face and background of the painting under study.

![Fig No. (38) shows the dirt on the paint layer.](image)
Paint layer flaking:

It is a loss in some parts of one or more layers of the image, or the movement of some color crusts from their place in preparation for the fall after that, and some of these crusts we can say are the result of exposure to some physicochemical factors of damage, as it is clear that the subject of the study was exposed to direct friction with Sharp objects, whether it was in transportation from one place to another, perhaps, or the painting fell during its suspension, which led to a pitting under the painting between the feet of the Khedive.
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![Painting Image](image)

**Fig No. (41)** shows the flaking of the paint layer.

![Painting Image](image)

**Fig No. (42)** shows a dent on the paint layer.

**Damage to the frame and wooden Stretcher:**

The damage that occurred in the painting under study was not limited to the damage of the image from the front and back and its filling with some aspects of damage, but the damage extended to include the frame as well, and the first of these manifestations of damage is the loss of the layer of gilding in many places of the frame and its weakness and decay in other places, and perhaps this is due to weakness The level of the gilding process, this is in addition to other factors of damage, and the frame is full of areas that have lost the layer of putty and the layer of gilding on it, as well as some cracks, perhaps because of the weakness of the bonding material.
**Old restorations:**

This phenomenon is one of the most important phenomena that is evident in all antiquities in various museums and sites. The restorer usually finds himself - whether it is old or new - having to restore the antiquity in front of him and it is usually in a bad condition, and these restoration works may be as old as the antiquity. Therefore, in many cases, these restoration works are in need of restoration, and we cannot in any way deny the old restorer this effort, which in his time was considered an achievement and a correct and unquestionable restoration, but with the tremendous development in various Fields of knowledge at the global and local levels The modern restorer now has what was not available in the past, and then the restorer is required to have another level of quality of the restoration work and to replace these old restoration works with other modern ones whenever possible, and we also consider the restoration work that we carry out Now they are correct restoration works, although it is certain that one day in the life of this world there will come a time for these works and old restoration works, some of which may be suitable and some not suitable, need replacement in these times, God willing. It was found through the ultraviolet examination that some previous restorations occurred, represented in the re-coloring of some parts of the Khedive's face, especially in the chin area.

Fig No. (43) shows an old restoration in the chin area.
Fig No. (44) shows an old restoration at the end of the sword.

**Results and Conclusion:**

This painting was investigated using non-destructive methods. The supports of the painting is made of linen and an Alla-prima technique is used. The artists’ work is monochrome in tone. Red Lead, Viridian Green, neutronite Black are the main pigments in this painting. The oil used in these paintings is linseed oil.
References


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