

Simple Treatment Methods of Some Wooden Heritage Collectibles

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Abstract:

A large number of our wooden heritage collectibles are subjected to be lost for many reasons, such as being stored or displayed in unsuitable environments, also being treated with harmful materials that decrease their historical value. This research aims to study some examples of wooden heritage collectibles and to apply simple treatment methods. Non-specialists can be able to use these methods to preserve their heritage collectibles (private collections) without needing any specialized laboratory. The selection of these wooden collectibles is based on the variety in their uses and in their aspects of damage. The results of this research indicate that there are many types of wood used in making these wooden collectibles. In spite of the variety of the damage aspects in these wooden collectibles, but the cracks and insects' infestation damage were the most harmful and clear aspects. The type of insect that attacked the wood, and caused the largest number of tunnels were identified in this research. In The treatment processes of these wooden collectibles, we used some different cleaning methods (mechanical and chemical), warped wood reshaping, and consolidation methods. These methods and materials have been used in some previous researches that studied the conservation of wooden artifacts. The treatment processes used in this research helped in making appropriate conservation of the wooden collectibles.

Key words : *Anobium punctatum*, *Fagaceae*, Damage, Insects, Treatment, Wooden heritage.

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طرق علاج بسيطة لبعض المقتنيات الخشبية التراثية

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الملخص :

يتعرض عدد كبير من مقتنياتنا التراثية الخشبية لفقد لعدة أسباب، مثل تخزينها أو عرضها في بيئات غير مناسبة ، بالإضافة إلى علاجها بمواد ضارة تقلل من قيمتها التاريخية. يهدف هذا البحث إلى دراسة بعض الأمثلة من مقتنيات التراث الخشبي وتطبيق طرق علاج بسيطة. يمكن لغير المتخصصين أن يكونوا قادرين على استخدام هذه الأساليب للحفاظ على مقتنياتهم التراثية (المقتنيات الخاصة) دون الحاجة إلى معمل متخصص. اعتمد اختيار هذه المقتنيات الخشبية على تنوع استخداماتها ومظاهر تلفها. تشير نتائج هذا البحث إلى وجود العديد من أنواع الأخشاب المستخدمة في صنع هذه المقتنيات الخشبية. على الرغم من تنوع مظاهر التلف في هذه المقتنيات الخشبية، إلا أن الشروخ والإصابة الحشرية كانت من أكثر مظاهر التلف وضوحًا. في هذه الدراسة تم التعرف على نوع الحشرة التي هاجمت الخشب وأحدثت عدد كبير من الأنفاق. في عمليات علاج هذه المقتنيات الخشبية استخدمنا بعض طرق التنظيف المختلفة (الميكانيكية والكيميائية)، إعادة تشكيل الخشب المعوج، وطرق التقوية. هذه الأساليب والمواد استخدمت في بعض الدراسات السابقة التي تناولت دراسة ترميم القطع الأثرية الخشبية. ساعدت عمليات العلاج المستخدمة في هذه الدراسة في تحقيق الحفاظ المناسب للمقتنيات الخشبية .

الكلمات الدالة : خنفساء الأثاث - فصيلة الزان - التلف - الحشرات - العلاج - التراث الخشبي .

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Introduction:

In general, the study of the heritage collectibles selected for this research has given us a lot of information about the lives of our ancestors and the various techniques and tools used in the past. Strength, abundance, and ease of formation are some of the most important factors that led to the spread of using the wood for many purposes in ancient times and for that, we see many examples of wooden artifacts around us.

In France, heritage collectibles are found in many houses, especially those that are made of wood. Some of these collectibles are inherited from ancestors, and others come from the passion of some people to collect and preserve the heritage and historical collectibles. Some of these heritage collectibles had a great attention and for that many treatment processes and a continued observation were made to these collectibles (The museums' collectibles).

On the other hand, many heritage collectibles had been neglected as a result of many factors such as leaving them in the cellar of the house Where there is a high relative humidity which causes a great damage to the organic heritage collectibles, especially as we see in the wood which is subject to many damage aspects such as swelling and shrinking, the spread of cracks , loose joints, changing of dimensions, and decay by fungi and bacteria (Hoadley, R. B. 1998) (Anthony& Dugan, 2009).

There are other factors of neglect to these wooden heritage collectibles such as being left outside the homes in rooms that are used as stores for things that had no use, such as pieces of furniture, old clothes, carpets, and

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electrical appliances. There were no cleaning works that have been made to these rooms and so that there are a lot of insects destroying the wooden objects in these stores. The continuous inspection of these stores helps to prevent or reduce the insect damage on the wooden artifacts (Blanchette. 1998).

We study in this research some examples of wooden heritage collectibles that had multiple uses in Nice-France. The aim of this study is to identify the kind of wood, diagnose the aspects of its damage, and use simple and appropriate methods of treatment. we mean with the simple treatment methods, these methods that are possible to be used by non-specialists and that don't require a conservation laboratory. However, these processes must be done according to the scientific methods of heritage conservation.

Materials and methods:

The collectibles selected for study:

In “Nice”, a city in the south of France, people have many wooden heritage collectibles as private collections. The selection of wooden collectibles in this research is based on the diversity in their uses and in the aspects of damage that appeared on them. These collectibles varied between tools of carpentry work, in addition to other tools used in the kitchen. These tools belong to the end of the 19th century (Wooden mortar and pestle), and the beginning of the 20th century (The wooden plane and the wooden clamp).

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Carpentry tools:

1- The wooden clamp: It is a C-shaped tool, which was used to hold pieces of wood (Figure.1).

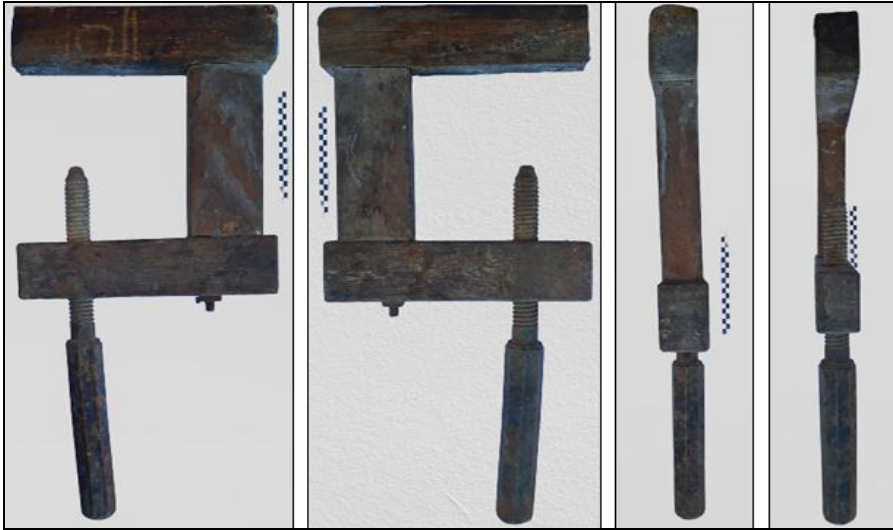


Figure.1. The wooden clamp

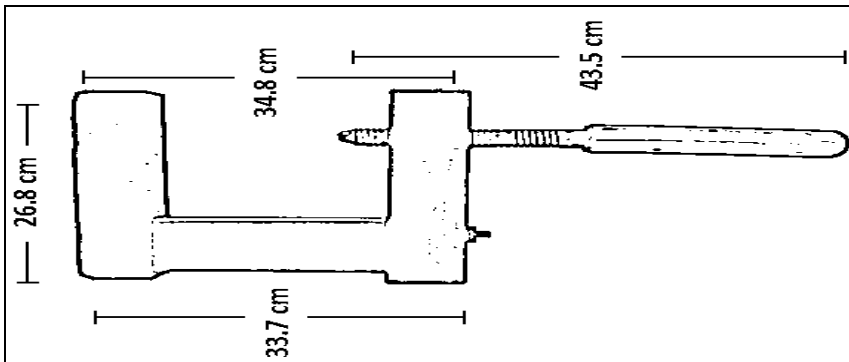


Figure.2. The dimension of the wooden clamp.

2- The wooden plane: It is one of the important carpentry tools that was used to remove the excess parts from the surface of the wood in order to obtain a flat surface suitable for the required purposes (Figure.2).

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Figure.3. The wooden plane.

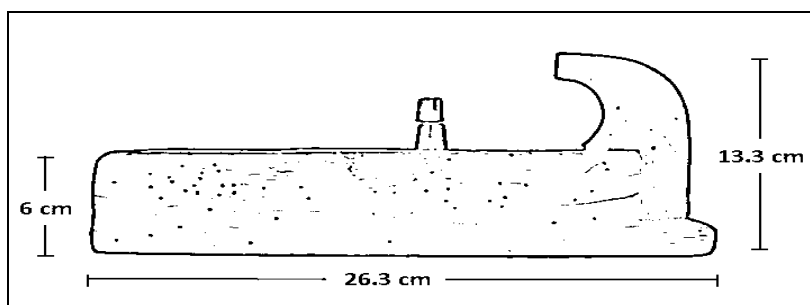


Figure.4. The dimension of the wooden plane

Kitchen tools:

1- Wooden mortar and pestle: The mortar is one of the important kitchen tools that was used in the past for grinding garlic and some types of spices (Figure.3).

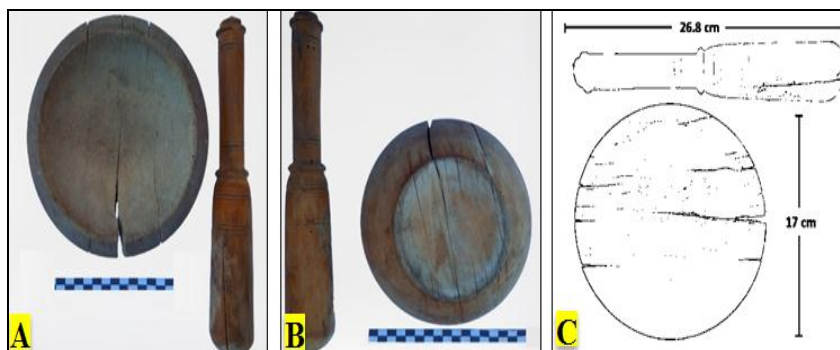


Figure.5. A&B. The wooden Mortar and Pestle, C. The dimension of the wooden mortar and Pestle.

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To make an accurate study for these collectibles, Inexpensive examination methods have been used to identify the types of wood , and to diagnose clearly the aspects of its damage.

Visual inspection: This method of examination was used to diagnose some visible aspects of damage such as: large cracks, lost parts of the wood, separated parts, rust areas, dirt layers, and areas of insect infestation (Anthony& Dugan, 2009).

Microscopic examination: This method depended on using the USB digital microscope to identify the types of wood, by examining the cross-section of this wood, diagnosing the invisible aspects of wood damage such as: micro-cracks, layers of dirt, and rust (Ali, 2019). This microscope was used to examine the exit flight holes, the ellipsoidal frass pellets, and the insect remains that were found inside the wooden heritage collectibles.

Results and discussion:

Identifying the wood types: the similarity of the outer surface of damaged wood makes the process of identifying the types of wood used in archaeological or heritage collectibles difficult. So, we have to make different sections (cross, tangential, and radial sections surface) of wood to get clear microscopic photos of the wood anatomical structure, and to identify the varied species used in earlier centuries (Timar. et al., 2013).

The types of wood were identified by examining the cross-section of these wooden samples by USB digital microscope, and they were as follows:

The wooden clamp: Three types of wood were used to make this clamp, which are (Figure.6):

Pedunculate oak (Common oak)

Quercus robur L.

Order: *Fagales*

Family: *Fagaceae*.

Genus: *Quercus*

Oak wood is a widespread tree all over Europe (Eaton, et al. 2016). *Quercus* is a genus which is including more than 500 species of trees and shrubs (Sousa, et al. 2009). In France, there are eight oak species, one of them is Pedunculate oak (*Quercus robur L.*) (Huber & Keller, 1993). Pedunculate oak is a large tree, sometimes reaches 40 m in length and 4 m in diameter, with a broad-leaved (Eaton, et al. 2016). It's also characterized by longevity and ring-porous wood (Bobiec. et al. 2011) (Denk, et al. 2017). This wood was used as a source of fuel and in the construction works (Lamas, 2015) (Eaton, et al. 2016).

Holly oak (holm oak)

Quercus ilex L.

Order: *Fagales*

Family: *Fagaceae*

Genus: *Quercus*

Holm oak (*Quercus ilex L.*), is one of the evergreen trees (Castro-Díez, et al. 1997), which is characterized by its broad leaves. It grows in the Mediterranean area such as Greece, France, and Italy (Soto, et al. 2007) (Campelo, et al. 2010). It can grow in dry environments and it can also

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grow with groundwater (Ferrio, et al. 2003). Holm oak is a diffuse-porous wood with narrow vessels (Corcuera, et al. 2004). It's one of the hardest types of wood that is difficult to be carved, because of its high density. Holm oak wood was used for many purposes, such as in making small tools (Carpentry tools), also as a source of firewood, coal production, and railway sleepers (Rigo & Caudullo, 2006).

Beech wood

Fagus sylvatica L.

Order: *Fagales*

Family: *Fagaceae*

Genus: *Fagus*

Beech (*Fagus sylvatica L.*) is one of the hardwood species widespread in Europe (Skarvelis & Mantanis. 2013). It's a big tree and its length reaches sometimes up to 50 m. It is also deciduous with elliptic leaves (Houston Durrant, et al. 2016). The beech is one of the diffuse-porous wood (Noyer, et al. 2017). It is a knot-free tree that is characterized by its strength and resistance to shock. This led to using it for many purposes such as; building boats, furniture, stairs, panels, and different tools (Lamas, 2015) (Houston Durrant, et al. 2016).

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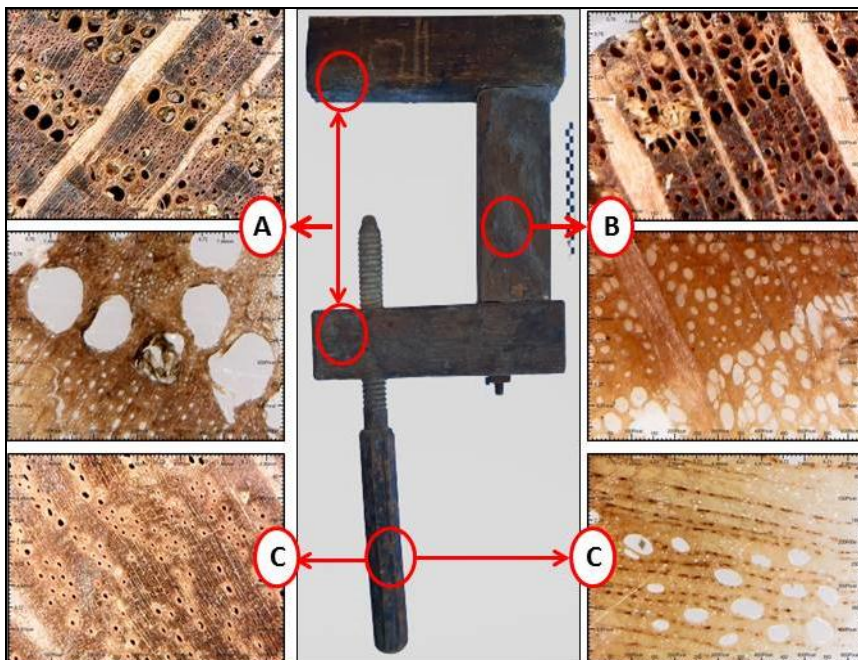


Figure.6. Cross-sections of the wood used in the wooden clamp, A. Pedunculate oak (*Quercus robur* L.), B. Beech (*Fagus sylvatica* L.), C. Holm oak (*Quercus ilex* L.).

The wooden plane: One type of wood was used to make this plane, which is:

Holly oak (holm oak) (Figure.7)

Quercus ilex L.

Order: *Fagales*

Family: *Fagaceae*

Genus: *Quercus*

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Figure.7. B&C. Cross-sections of Holm oak (*Quercus ilex L.*) used in The wooden plane (A).

The wooden mortar and pestle: One type of wood was used to make this plane, which is:

Beech wood (Figure.8)

Fagus sylvatica L.

Order: *Fagales*

Family: *Fagaceae*

Genus: *Fagus*

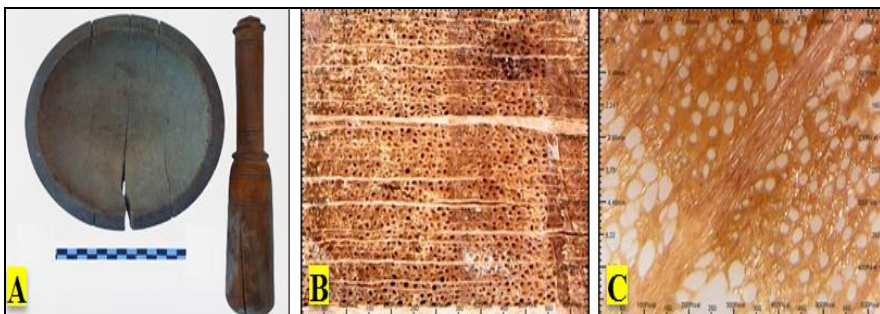


Figure.8. B&C. Cross-sections of Beech (*Fagus sylvatica L.*) used in The wooden mortar and pestle(A).

Diagnosis of the damage aspects:

The wooden heritage collectibles selected for this study have many aspects of damage, which can be clarified as follows:

Cracks:

The cracks are spread in all the wooden heritage collectibles selected for this study, but they vary in their size from one object to another. According to a previous research (Ali, 2021), the difference in the size of these cracks can be seen as an evidence of the extent of the drought of the wood. Despite of the dryness of all the wooden collectibles which caused the spread of different cracks throughout their parts, the wooden mortar is the most affected object by this factor. Several cracks (fine and wide) are spread all over this object, especially at the edges which separated from the wood, with a width from 1 to 4mm (Figures.13&14). To clean the wooden mortar, it was washed with water and left to be dry. Repeating this process led to the spread of these devastating cracks and the separation of the edges (Henriques & Azevedo, 2018) (Melin, 2019). Also, the low thickness of this mortar plays an effective role in the spread of these cracks and the separation of wood. On the body of the wooden plane spread many cracks of different sizes (1 to 3 mm) and some of these cracks extend to the edges of the wood (Figures.9&10). Also, a lot of different cracks are spread in the wooden clamp, especially in *Quercus ilex L.* and *Quercus robur L.* wood (Figure.11&12). The cracks, which are spread in the *Quercus robur L.* wood took different forms (parallel to the wood grain and perpendicular to the grain). The continuous exposure of

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these collectibles to the deterioration agents for a long time led to the spread of these harmful cracks, the severe dryness, and the weakness of the wood surface (John et al, 1993).



Figure.9. The spread of different cracks on the wooden plane.



Figure.10. The spread of micro-cracks in the wood texture (the wooden plane) USB digital microscope.

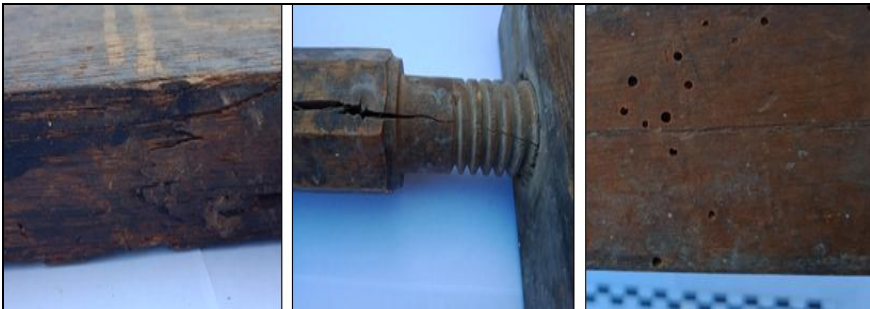


Figure.11. The spread of different cracks on the wooden clamp.

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Figure.12. The spread of micro-cracks in the wood texture (the wooden clamp) USB digital microscope.



Figure.13. Spread of the large and deep cracks on the wooden mortar and pestle.



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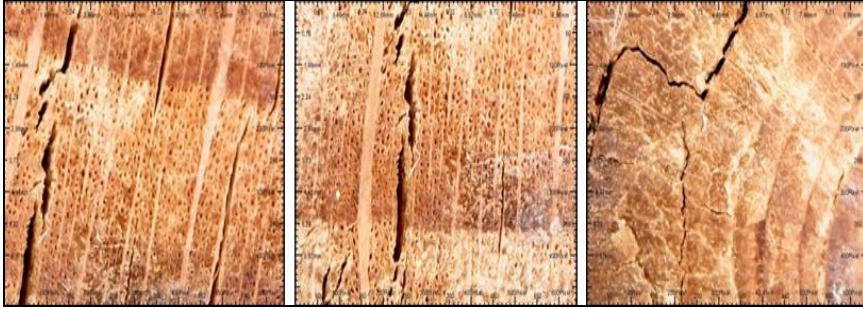


Figure.14. The spread of micro-cracks in the wood texture (the wooden mortar and pestle), USB digital microscope.

Dirt and stains:

All wooden heritage collectibles are covered with a layer of dirt and dust adhered to the surface which distorted the external surface of these woods. This aspect of deterioration is caused by the exposure of wood to high levels of humidity (Reinprecht et al, 2018). Also, there are some stains spread on the surface, such as these stains resulting from the wetness with water and which appeared on the wood surface as a result of storage or keeping them in an inappropriate environment (Figure.15).

Stains caused by animal glue which are clearly spread on both of the wooden plane and the wooden clamp. The Carpenters use the animal glue as an adhesive material to wood and that exposes the wooden tools to dirty (Figure.16).

The rust stains are spread on the wooden plane and the wooden clamp. These rust products lead to the weakening of wood, the changes of the structural properties of wood cell walls (Rodgers, 2004), and also to the corrosion of the wood surface (Cronyn 1990). These rust stains are one of the damage aspects that is

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difficult to be permanently removed from wooden objects (Williams, 2010) (Figure.17).

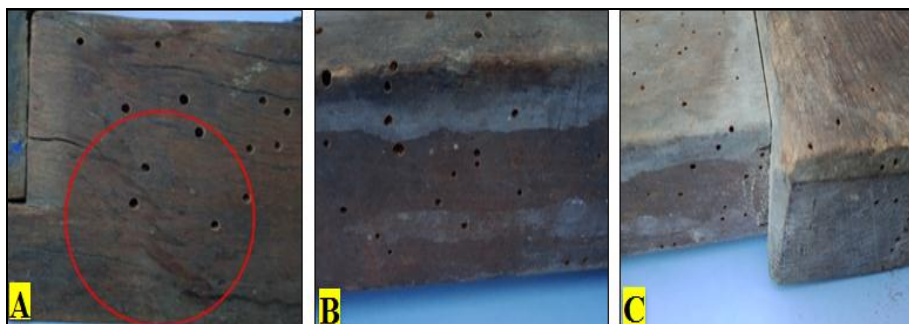


Figure.15. The wetness stains on the surface of the wood, A. the wooden plane, B&C. the wooden clamp.

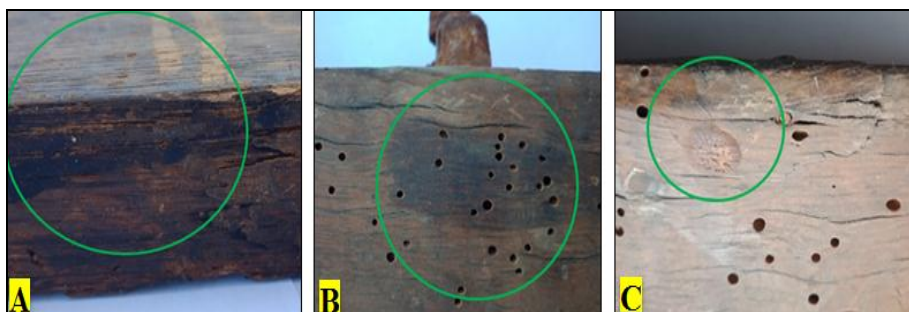


Figure.16. The animal glue stains on the surface of the wood, A. the wooden clamp, B&C. the wooden plane.

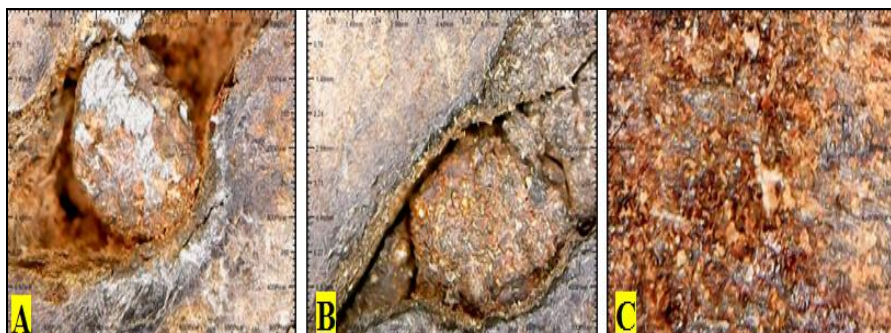


Figure.17. Spread of the rust stains on the surface and wood texture, A&B. the wooden plane, C. the wooden clamp, USB digital microscope..

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Erosion of wood edges in the wooden collectibles :

This aspect of damage depends on the use of these collectibles. All the selected wooden heritage collectibles were exposed to friction and collision with other hard materials, causing a clear erosion of wood. Also, the extensive insect damage led to the loss of some parts of these wooden tools (Figure.18).

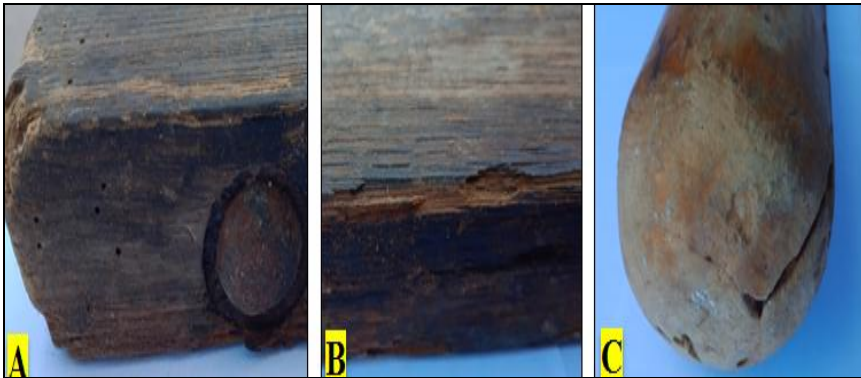


Figure.18. The erosion of wood edges, A&B. the wooden clamp, C. the wooden mortar and pestle.

The disintegration of wooden joints (loose joints):

The wooden heritage collectibles such as the plane and clamp consist of some wooden pieces attached to each other by the tongue and groove technique, and some metal nails in addition to the animal glue as an adhesive. This disintegration of the joints is due to two reasons: The first reason is caused during their uses: a Muscular strength is needed to control these joints for achieving well the work and this Muscular strength cause sometimes this process of disintegration. The second

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reason is caused by the exposure of wood to the swelling and shrinking processes, as a result of the absorption and loss of moisture from the surrounding environment (Eckelman,1998) (Figure.19).

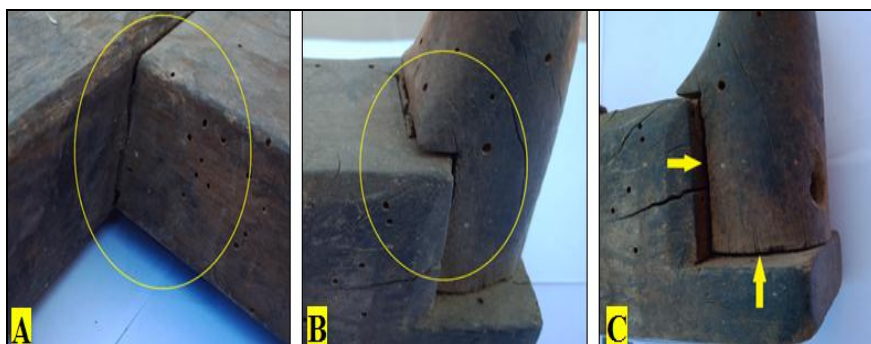


Figure.19. The disintegration of wooden joints, A. the wooden clamp, B&C. the wooden plane.

Insect infestation:

Insect infestation is one of the most important aspects of destructive damage to the wooden heritage collectibles selected for this research and this damage varies in its degrees from one wooden collectible to another.

Despite the wood hardness used in making these wooden tools, it was severely damaged. The exit holes of adult insects, which vary in their diameters between (1-4 mm), and the tunnels are spread in all parts of the affected wood. These exit holes and the tunnels were full of fecal pellets and bore dust (Figures.20-24). By examining the affected wood, there were found some frass and remains of insects and larvae inside the wood. The type of insects has been identified, and they are as follows:

1- Furniture beetles:

Scientific name: *Anobium punctatum* (De Geer).

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Taxonomy: *Coleoptera*, *Anobiidae*.

Synonym: *Anobium striatum* (OI). (Unger, et. al. 2001)

Furniture beetle (*Anobium punctatum*): It's a small insect reddish-brown to black with elongated or cylindrical shapes and from 2,5 to 5.0 mm in length. Its elytra are covered with clear rows of pits. Its white Larvae, which attack both hard and softwoods, are C-shaped and they can reach 7 mm in length. These larvae make irregular tunnels inside the infested wood, especially the wood with a moisture content between 13-30% (Toper Kaygin, et al. 2008) (Yalçın, et al, 2018), and in a temperature degree of 21-24C. This insect of Furniture beetle attacks the wooden artifacts, panel paintings, flooring, stairs, ancient wooden tools, and the wooden elements in the archaeological and historical buildings. It makes also the infected wood lose its strength and in severe cases of infection, only a thin outer layer of wood that remains. The furniture beetle is widely spread in Europe, Australia, and North America (Unger, et. al. 2001).

The remains of this insect were found in all the wooden collectibles selected for this research. The exit holes and tunnels appeared in all the directions of the damaged wood without distinguishing between the wood anatomical elements or the different directions of wood (tangential, radial, and longitudinal). "Wermuth 1990" mentioned that the furniture beetles (*Anobium punctatum*) excavate the wood disregarding its anatomical variations. This result was noticed in a previous research (ALI, 2017).

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Figure.20. Damage characteristics resulting from the furniture beetles *Anobium punctatum* (the wooden plane).



Figure.21. Damage characteristics resulting from the furniture beetles *Anobium punctatum* (the wooden plane), USB digital microscope.

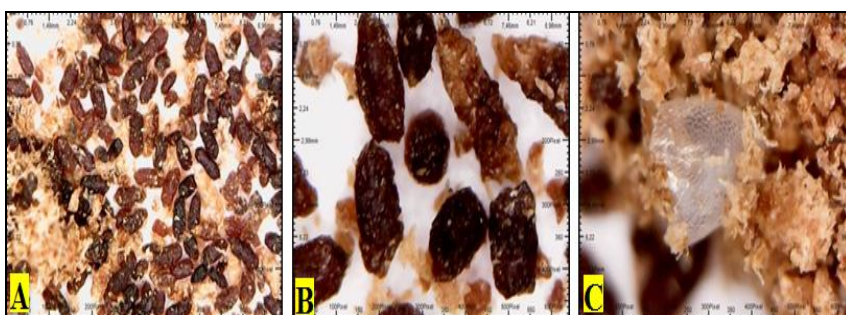


Figure.22. A&B. Light and dark brown faecal pellets found in the exit holes and tunnels, C. the remains of *Anobium punctatum* eggs, USB digital microscope, (The wooden plane).

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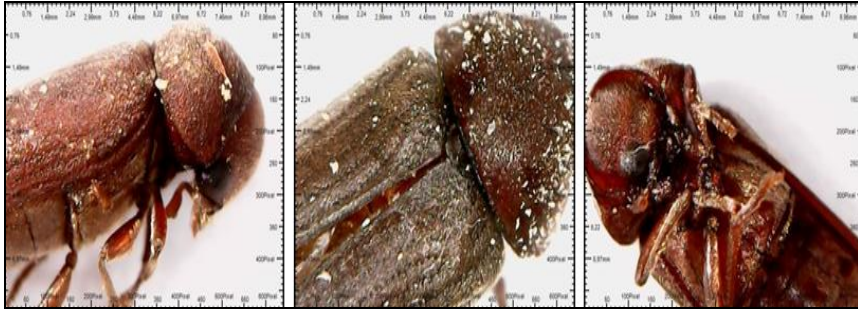


Figure.23. Furniture beetles (*Anobium punctatum*) remains that were found inside the wooden plane, USB digital microscope.



Figure.24. Damage characteristics resulting from the furniture beetles *Anobium punctatum* (the wooden clamp).



Figure.25. Damage characteristics resulting from the furniture beetles *Anobium punctatum* (the wooden clamp), USB digital microscope.

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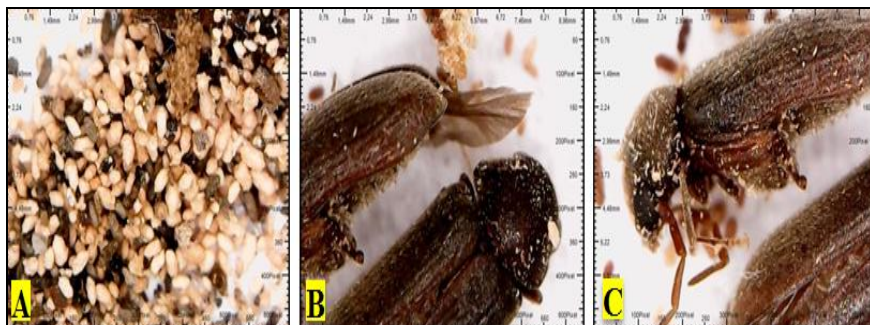


Figure.26. A. The faecal pellets found in the exit holes and tunnels, B&C. Furniture beetles (*Anobium punctatum*) remains, USB digital microscope, (the wooden clamp).



Figure.27. Damage characteristics resulting from the furniture beetles *Anobium punctatum* (the wooden mortar and pestle), B&C. USB digital microscope.



Figure.28. A. The faecal pellets found in the exit holes and tunnels, B&C. Furniture beetles (*Anobium punctatum*) remains, USB digital microscope, (the wooden mortar and pestle).

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Treatment methods:

There are many methods and materials that can be used in the treatment of damaged heritage wood. Choosing the appropriate methods and materials for treatment processes depends on the state of the damaged wood.

In general, during the stages of treatment, the archaeological artifacts in the museums are subject to the international charters of archaeological objects conservation. The basic purpose of the treatment processes is to help at preserving the human heritage for future generations, without changing its value.

On the contrary, many other deteriorated wooden heritage collectibles (private collectibles) are not subject to that international charters when they are treated, despite their historical and cultural value. In most times, they are restored by non-specialists (by the owners of these heritage collectibles) using some modern paints or using adhesive materials that are not suitable for the nature of wood. This causes some damages which destroy the artistic and historical value of these collectibles.

Remove of dirt:

The purpose of this process is to remove dirt that disfigurement the appearance of wood surfaces. This dirt differs in the nature of its components and their quantities according to the place where these wooden heritage collectibles were been displayed or stored. Some of this dirt may be removed using only mechanical cleaning methods, which depend on the disassociation of the dirt

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particles bonding using different brushes and medical scalpels.

In some cases, mechanical cleaning may not be enough to remove all the dirt layers, so chemical cleaning processes are used. In the chemical cleaning, it is used some solvents, which have a greater ability to remove the dirt and dust particles without affecting the wooden collectibles (Ali, 2020).

In this research, the mechanical cleaning method was used by using different brushes to remove the dirt and dust amounts attached to the surface. To remove the layers of animal glue attached to the wood surface, a medical scalpel was used after softening these dry layers with a mixture of warm water and ethyl alcohol (1:2). The chemical cleaning method using ethyl alcohol (Hamed, 2013) was used to remove the rest of the dirt that was difficult to be removed by mechanical cleaning methods. In spite of the density of the rust layer accumulated on the metal parts of the plane and clamp, it was a fragile and incoherent layer. These layers were been removed by a mechanical cleaning using medical scalpels, then rough and soft brushes.

The areas which were affected by the insect damage in the wooden plane and wooden clamp were cleaned by injecting them with acetone. This process was repeated several times to ensure that the acetone penetrated inside all the affected internal parts. After completing this cleaning process, the tunnels were sterilized by injecting only the internal parts using cinnamaldehyde in ethanol 2% (Axinte, et al. 2011) (Ali, 2021^{*}). These wooden heritage collectibles were left under observation inside a sealed glass box. This box was put inside the cupboard at

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a temperature of 25 C for six months to verify the cessation of insect activity.

Treatment of cracks and warps:

For the wooden mortar, these processes of treatment took a long time and that is due to the spread of large cracks extending to the edge of this mortar besides the separation of the wood edges. The treatment of cracks and warps is one of the most difficult stages in the conservation of wooden artifacts (Hoadley, R. B. 1998). The thin thickness of the wood helped to cause warping in the wood edges, which were also been separated from each other as a result of the large cracks.

These problems were been solved as follows: The wood was softened (triple within 30 days) by spraying using a mixture of ethyl alcohol and water (1:2) (El Hadidi, et al. 2020). A piece of flexible plastic and metal clamps were used in order to treat the large cracks of the wooden Mortar and the wooden plane and also to straighten gradually the warp until these collectibles regain their normal shape.

The plastic pieces were tightened and the cracks were pressured gradually to adjust the edges and reshape the warped wood.

After having a good result from the previous steps, the mortar and the plane had been consolidated with Klucel G dissolved in ethyl alcohol. This process was made in two phases. In the first phase, the collectibles were consolidated with the Klucel G (dissolved in ethyl alcohol) with concentrations of 0.5% and 1% (several times using brushes) in the presence of the flexible

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plastic piece and the metal clamps (El Hadidi, et al. 2020) (Figure.29).

The Large cracks and some missing parts from the wooden collectibles were been filled with a paste of glass microballoon and earth pigments mixed with paraloid B-72 in acetone with a concentration of 15% (Abdrabou, et al. 2015). In the second phase of the consolidation process, all the wooden heritage collectibles were been consolidated with the Klucel G (dissolved in ethyl alcohol) with a concentration of 2% (El Hadidi, et al. 2020). The interior's weak and damaged parts were been consolidated by their injecting with Klucel G (2%) through the tunnels and through the exit holes of adult insects (Figures.30-32).



Figure.29. The wooden mortar (A,B and C) and the wooden plane (D and E) during the reshaping processes with metal clamps that used to gradually pressure on the warped wood.

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Figure.30. The wooden plane after the treatment.



Figure.31. The mortar and pestle after the treatment.



Figure.32. The wooden clamp after the treatment.

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Figure.33. The wooden heritage collectibles before (A,C,D) and after the treatment processes (B,D,F).

Conclusions:

The preservation of wooden heritage collectibles for future generations is our aim. It is needed to raise the awareness of the importance of the heritage collectibles and their role in preserving the identity of peoples and the extent of their progress.

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The preservation of heritage collectibles is the responsibility of every individual in society. So, its treatment must be made using harmless methods and materials.

The renovation of wooden heritage collectibles by using some modern paints and varnishes should be avoided because it leads to the loss of Its artistic and historical value, especially these collectibles that people keep in their homes.

The simple treatment processes of wooden heritage collectibles can be used by non-specialists and also without specialized laboratories, especially in the case of the private collection that is not severely damaged and that instead of losing this heritage. But without any doubt, this treatment must be made using methods and materials that have been proven to be efficient in wood treatment. In this case, it is necessary to refer to some previous researches which study the conservation of similar cases of wooden artifacts.

There are many other methods that can be used to preserve our heritage collectibles, such as monitoring, storing, and displaying them in an appropriate environment.

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