

***Note from the Making and Knowing Project:***

This essay was written for “The Art Technological Source,” an 8-week graduate course at the University of Amsterdam offered by Dr. Marjolijn Bol in 2015 and 2016 to students enrolled in an MA program in either Technical Art History or Conservation and Restoration. Students worked on various recipes from BnF Ms. Fr. 640 on the following five topics: 1) tracing and painting on glass, 2) yellow dyes and their applications, 3) dragon’s blood, 4) painters’ varnishes, and 5) sieves.

This is an un-edited student paper that relies on an earlier state of the Making and Knowing Project’s transcription and translation of Ms. Fr. 640. For an updated version of the text, see:

Making and Knowing Project, Pamela H. Smith, Naomi Rosenkranz, Tianna Helena Uchacz, Tillmann Taape, Clément Godbarge, Sophie Pitman, Jenny Boulboulle, Joel Klein, Donna Bilak, Marc Smith, and Terry Catapano, eds., *Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640* (New York: Making and Knowing Project, 2020),  
<https://edition640.makingandknowing.org>. DOI: <https://doi.org/10.7916/78yt-2v41>.

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# The role of dragon's blood in falsifying and imitating red gemstones

## Introduction

This annotation is written in collaboration with 'The Making and Knowing Project: reconstructing the 16<sup>th</sup> –century workshop on BnF Ms. Fr. 640 at Colombia University New York'. The BnF Ms. Fr. 640 is a unique French manuscript dated to approximately the 1580s and consists of a large collection of recipes and techniques relating to a wide range of subjects. The topics vary from medical recipes, pigment preparation, casting techniques and much more.<sup>1</sup>

In the context of the course 'Art Technological Source Research' my fellow students Michaela Groeneveld, Elisabeth Kuiper, Marianne Nuij and I did a research into the resin called dragon's blood, as mentioned by the author of the manuscript. The author refers to the word dragon's blood on seven folios related to different kind of subjects.<sup>2</sup> As part of the course we carried out a reconstruction workshop, which was dedicated to prepare various solutions with dragon's blood according to the recipes from the manuscript. During the reconstruction workshop we encountered several difficulties, which had to be investigated further. Each one of us did additional research into these difficulties.

The main focus of this research is the role of dragon's blood in falsifying and imitating red gemstones. Some of the recipes about dragon's blood in the manuscript can be associated with these techniques. It is of interest to understand the role of dragon's blood in these techniques because it will provide relevant knowledge about the workshop concerning counterfeiting red gemstones in the 16<sup>th</sup> century. This paper presents a first investigation into the making and knowing of red gemstone imitations and falsifications with the utilization of dragon's blood.<sup>3</sup>

Since there are different species dragon's blood the first step is to define which kind of dragon's blood the author probably used. After this determination the reconstruction of preparing a dragon's blood solution will be discussed. The connection of dragon's blood with counterfeiting red gemstones will be explained in the next paragraph, followed by the research into falsifying and

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<sup>1</sup> The manuscript now resides in the Bibliothèque nationale in Paris and has been digitized.  
<[www.makingandknowing.org](http://www.makingandknowing.org)>

<sup>2</sup> Recipes against nose bleeding and for tincture (folio 038v), for lutes varnish (folio 098r) and even a recipe how to imitate dragon's blood (folio 165r) is described. The recipes relevant in this research are those describing how to prepare dragon's blood (folio 029v), how to imitate red enamel (folio 040v), the use of dragon's blood for making doublets (folio 007r) and painting dragon's blood on crystal or glass (folio 102v).

<sup>3</sup> The images of the reconstructions are placed in the appendix of this paper.

imitating red gemstones. Falsifying and imitating gems was practiced in ancient times and there are a number of different techniques doing it. However, the role of dragon's blood in falsifies red gems can be distinguished in two different manners: applying a metal foil underneath a real gem and coloring the base of a gemstone. Both techniques are described and reconstructions are made. In order to imitate red gemstones with the red resin two different kinds of techniques can be identified: making doublets and coloring transparent minerals. An attempt is made to reconstruct some of these aspects of imitating red gems. The results of the research will be discussed in the conclusion.

In order to find out what the author might have meant to describe in his recipes, it is of great concern to use additional sources. First of all is it of interest to support the information given in the manuscript with sources from the ancient times as Pliny the Elder (AD 23-AD 79) and the *Stockholm Papyrus* written at about 200-300 AD. Secondly the recipes from the manuscript could be compared and assist with knowledge dated from the same early modern period. A selection has been made from 16<sup>th</sup> and 17<sup>th</sup> century sources which resulted in the use of the treatise of Agricola (1546), Cellini (1568) and Kunckel (1679). For some aspects it was relevant to use sources from the 18<sup>th</sup> century.

### **Different dragon's blood species**

The first questions that rise are all related to where dragon's blood is originate. What exactly is dragon's blood and how is it produced? To find answers to these questions the book *Plant resins* of Langenheim is very convenient. According to Langenheim the resin has different plant origins occurring in varying continents. The name dragon's blood is used for the resin of two different monocots: from the *Dracaena* trees and *Daemonorops* palm.<sup>4</sup>

The *Dracaena* occur as trees and grown outdoors in tropics and subtropics. The *Dracaena* trees have immense trunks and branches and the dragon's blood can be collect from incisions of stems.<sup>5</sup> The most relevant kinds of *Dracaena* species are growing in Socotra and at the Canary Islands.<sup>6</sup> The dragon's blood which origin from the trees of the island Socotra, *Dracaena cinnabari*, is described by several ancient writers as Pliny the Elder and Dioscorides. The resin was characterized as magical and used for pharmaceutically and for coloring varnishes. The dragon's blood is exuded from the plant stem in teardrops and collected after a rainy season. The Arabs sent the resin during Roman times to Europa via Bombay or Zanzibar.<sup>7</sup> The *Dracaena draco*, which occurs at the Canary Island, is the most massive specie of the genus which can be 12 till 19 meters

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<sup>4</sup> The name dragon's blood is sometimes used for the exudate from several Latin American species of *Croton* but this resin was more used for medical purposes. Langenheim 2003: 441-444.

<sup>5</sup> Langenheim 2003: 70.

<sup>6</sup> Langenheim 2003: 70.

<sup>7</sup> Langenheim 2003: 441.

high.<sup>8</sup> During the 15<sup>th</sup> century the resin from this tree became a valued product of the early explorers.<sup>9</sup> But the resin was important to the inhabitants of the Canary Island so it never became an important product of trade.<sup>10</sup>

The second type of monocot is *Daemonorops*. This is a distinct group of climbing species of large Indomalaysian rattan group. The palm produces dragon's blood on the surface of unripe fruits. The palm species are grown in Borneo and Malaysia but the main producer of this type of dragon's blood can be found in Sumatra. According to Langenheime this kind of dragon's blood is the primary commercial source of the red resin.<sup>11</sup>

Based to this study it seems evident that the dragon's blood used by the author of the manuscript does not originate from the Canary Island because it never formed a regular article traded in Europe. It is not evident since when the dragon's blood from the palms are used, but from the literature of the resin originated from Socotra it is used since Roman times.<sup>12</sup> In order to find out if the dragon's blood comes from the trees of Socotra or from the palm species it is relevant to study the recipes. The author describes that good dragon's blood "(...) se trouve a grands lopins comme pieces de torteau (...)".<sup>13</sup> And as a note on the same page he describes the best dragon's blood comes in 'larme' which can be translated to drop or tears. Considering this information it would be likely the author used the dragon's blood originated from Socotra, which exudes from the stem in teardrops. For this reason we carried out our reconstructions with the dragon's blood from Socotra [fig. 1].<sup>14</sup>

#### Reconstruction: Preparing a solution with dragon's blood

The author reports a recipe with instructions to make a solution with dragon's blood [folio 029v], which we attempted to reconstruct during the workshop. The first problem we encountered was the solvent used by the author: the best eau-de-vie possible.<sup>15</sup> After experimenting with different kinds of eau-de-vie [fig. 2] we decided to dissolve dragon's blood in ethanol, which turned out to be a good solvent. We crushed the tears of dragon's blood in a mortar [fig. 3] and solved it in ethanol. We mixed different kind of amount ethanol and dragon's blood in order to testify the behavior and appearance.<sup>16</sup> Because the solutions we made became very coarse we decided to sieve the crushed dragon's blood powders, which resulted in a finer substance after mixed with ethanol [fig. 4]. We

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<sup>8</sup> Langenheime 2003: 70.

<sup>9</sup> Langenheime 2003: 442.

<sup>10</sup> Howes 1949: 139.

<sup>11</sup> Langenheime 2003: 72

<sup>12</sup> Langenheime 2003: 441.

<sup>13</sup> BnF Ms. Fr. 640: folio 029v.

<sup>14</sup> Bought at Kremers: <<http://shop.kremerpigments.com/en/dyes-und-vegetable-color-paints/dragons-blood-emzolo-37016:.html>>

<sup>15</sup> Marianne Nuij did a research into this topic.

<sup>16</sup> For a thin solution: 2 grams crushed, sieved dragon's blood solved into 8-milliliter ethanol. For a thick solution: 2 grams crushed, sieved dragon's blood solved into 4-milliliters ethanol.



examined the appearance of the solution applied on different kinds of metal surfaces [fig. 5].<sup>17</sup> The following step was reconstructing the recipe of imitating red enamel<sup>18</sup> [folio 040v]. According to this recipe mastic and turpentine was added to the dragon's blood solution.<sup>19</sup> We first solved mastic in turpentine, using the proportions as described in the instructions of mastic<sup>20</sup>, because this information was absent in the recipe. Unfortunately it took a long time before the mastic was solved; therefore we decided to use an already generated solution.<sup>21</sup> The recipe does not include the amount of mastic and turpentine that should be added to the dragon's blood. After experimenting different amounts, adding one milliliter turned out to give a good result. This solution turned out to be viscous comparing to the previous solutions, which were more aqueous and fluid. On the margin of the recipe of dragon's blood [folio 029v] the author reports to hold the solution by the fire because it would be easier to apply. We decided to heaten the solution au-bain-marie before applying. This resulted in a substance, which was beautiful and easy to apply [fig. 6].

### **The connection of dragon's blood with counterfeiting red gemstones**

Before explaining the association of dragon's blood with red gemstones it is relevant to understand the qualification of precious stones. What differ them from other stones? Marjolijn Bol carried out a research in art technological sources to answer that question. This study revealed that from ancient times onwards, the most important characteristic "*(...) is the fact that it has the ability to transmit the visible light, or, in other words, that it is translucent.*"<sup>22</sup> Furthermore, precious stones are rare and hard compared to other stones. An essential quality of transparent gems is the interaction of light with the surface: causing a brilliant luster on gems. The brilliance of the gem depends on different aspects: the refractive index of the stone itself and the way the stones is polished or set.<sup>23</sup>

Since the color of dragon's blood is red, transparent and according to Pliny also brilliant<sup>24</sup>, it is presumable that it is used for imitating translucent, red gems. Various translucent red gems exist, however only a few of them are described in recipes in art technological sources about falsifying and imitating with the use of dragon's blood. It appears that the resin is used for counterfeiting rubies, garnets, red beryl's, sunstones and hyacinths<sup>25</sup>.

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<sup>17</sup> Michaela Groeneveld did a research into this topic.

<sup>18</sup> Elisabeth Kuiper studied this subject.

<sup>19</sup> We used the thick solution, see footnote 14.

<sup>20</sup> Kremer pigmente: <[http://www.kremer-pigmente.com/info/en\\_international/60050e.htm](http://www.kremer-pigmente.com/info/en_international/60050e.htm)>

<sup>21</sup> 125 gram mastic solved into 250 gram turpentine.

<sup>22</sup> Bol 2014: 110.

<sup>23</sup> Bol 2015: 3.

<sup>24</sup> Pliny AD 77-AD 79: book 35:12.

<sup>25</sup> Red zircons are often called 'hyacinths' in art technological sources.

### **Falsifying red gemstones by applying foil backings**

In order to increase the luster of the gem, a foil could be applied underneath which could be colored with dragon's blood. In this manner opaque stones could be made translucent, says Pliny.<sup>26</sup> The author of the manuscript was aware of this practice because he mentioned it on several folios.<sup>27</sup> A recipe how to prepare the metal foils is missing but the author reports that once the 'foilles pour les pierreries' are made they should not be stored in any iron or metal box.<sup>28</sup> This may suggest the author was making the foils himself. On the other hand, the author describes that the silver leaf "(...) *is burnished by the makers of foil backings for gemstones or by goldsmiths (...)*"<sup>29</sup>, which implies the practice was done by specialists. These contrary statements do not clarify the use or making of foils by the author of the manuscript. But it does show some important knowledge the author had about this practice, referring to burnishing the foil. This action was also of great influence for the luster and color of the gem, according to Agricola.<sup>30</sup>

A relevant art technical source concerning the preparation of these foils is Cellini. In his treatise a whole chapter is dedicated to the practice of making foils for all sort of transparent jewels.<sup>31</sup> Cellini clearly explains how to make the foils but the most interesting part is the final step: coloring the foil. Despite of the information Cellini gives on this finally step, the use of dragon's blood is not described in this chapter. Nevertheless the application of dragon's blood on the foils is describes in another 17<sup>th</sup> century source.<sup>32</sup>

### Reconstruction: Placing a colored foil underneath a ruby

In the second reconstruction I attempted to reconstruct the technique of placing a foil, colored with dragon's blood, underneath a real ruby and examine the effect. In order to analyze the effect it was relevant to place the ruby on different supports, and comparing these with each other. I decided to apply the ruby on a white piece of paper [fig. 7] on a silver surface [fig. 8] and finally on one of the sheets we gilded with gold leaf and painted with a thin solution of dragon's blood<sup>33</sup> [fig. 9].

The result of the reconstruction is the great influence on the appearance of the color and luster of the gem caused by the support. By placing a silver or gold sheet underneath the ruby the color tend to be more intense and more translucent. The impact dragon's blood had on the gilded sheet

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<sup>26</sup> Pliny AD 77- AD 79: book 37:26.

<sup>27</sup> BnF Ms. Fr. 640: folio 037r.

<sup>28</sup> BnF Ms. Fr. 640: folio 037r.

<sup>29</sup> BnF Ms. Fr. 640: folio 040v.

<sup>30</sup> Agricola 1546: book 5, 87.

<sup>31</sup> Cellini 1568: 28-30.

<sup>32</sup> Pomet 1694: 191.

<sup>33</sup> 2 grams of dragon's blood solved in 8ml ethanol. See lab report for further details.

comparing to the uncolored silver sheet was minimal. However according to the theory it seems presumable the dragon's blood could have a great impact on the gem.<sup>34</sup>

### **Falsifying red gemstones by coloring them**

Coloring gemstones in order to intensify or change the original color was not a practice mentioned by the French author of the manuscript, but there is evidence it was done since ancient times.<sup>35</sup> Dragon's blood seems to play a role in this technique, described in detail by Cellini. According to Cellini an Indian ruby, which contained not much color, is falsified very proficient by covering the stone with dragon's blood. This resulted in a gemstone of which the "(...) colour looked so fine, and the stone seemed so cunningly set, that no one unless very careful, would have spotted it."<sup>36</sup> As stated by Cellini tinting gemstones was a cleverly trick to counterfeit stones but also forbidden.<sup>37</sup>

#### Reconstruction: Coloring a ruby with dragon's blood

In order to examine the effect of coloring gemstones, I decided to reconstruct the method Cellini described. I applied the dragon's blood substance, which was solved in ethanol and mixed with mastic and turpentine<sup>38</sup> and preheated, with a small pencil. By comparing the original ruby [fig. 7] to the colored ruby [fig. 10] a great effect is visible. The ruby turned from pink to a red color. The dragon's blood substance covered the ruby and also its facets, this could be undesirable. To prevent this side effect a thinner solution could be used but this will also effect the color change.

### **Imitating red gemstones by making doublets<sup>39</sup>**

The author mentioning the word 'doublets' in a subtitle [folio 007r], which is followed by the sentence: "*Good dragon's blood soaked in spirits produces its own mastic or glue.*"<sup>40</sup> This could indicate that he used dragon's blood as a bonding agent for doublets. But a recipe in which manner dragon's blood is applied on glass or crystal, is given by the author [folio 102v]. This recipe is a part of a technique to make a painting on glass, with a red background of dragon's blood. The relevant information for this research is the description how dragon's blood is applied: "(...) it is necessary to apply it little by little so that it is smooth and of one color (...)."<sup>41</sup>

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<sup>34</sup> This could be further researched by applying different solutions of dragon's blood. In this reconstruction only a thin solution of the resin was tested.

<sup>35</sup> Pliny mentioning tinting amber, as desired with kid-suet and alkanet. Pliny AD 77-AD 79: book 37: 12.

<sup>36</sup> Cellini 1568: 26.

<sup>37</sup> Cellini 1568: 25.

<sup>38</sup> Recipe: 2 grams crushed and sieved dragon's blood solved in 4-milliliter ethanol, added 1-milliliter mastic solved in turpentine (from the solution 125 gram mastic solved in 250 gram turpentine).

<sup>39</sup> A doublet is a stone that is composed of two parts, usually less expensive materials. Two pieces of this material are glued together to form a sort of gemstone imitation.

<sup>40</sup> BnF Ms. Fr. 640: folio 007r.

<sup>41</sup> BnF Ms. Fr. 640: folio 102v.

According to Cellini these false stones are made in Milan for poor people who do not know the difference between the real and the fake stone.<sup>42</sup> Kunckel as well described the practice of making doublets, which are made with a foil between two materials, which is coated with mastic.<sup>43</sup> A more relevant source of making doublets with the use of dragon's blood is Agricola. In his *Natura Fossilium* he described cementing two pieces of glass together with a thin layer of dragon's blood between them to imitate red gems.<sup>44</sup>

Recipes from the late 18<sup>th</sup> century describes as well the technique of doublets with the use of dragon's blood.<sup>45</sup> Important information in these recipes is dissolving the dragon's blood in mastic and turpentine. Furthermore, two sides of the crystal and the dragon's blood solution are heated before application.<sup>46</sup>

#### Reconstruction: Applying dragon's blood on crystal

In this research it was not possible to make a doublet, therefore I decided to experiment how the solution of dragon's blood would appear when applied on a crystal. I applied the solution of dragon's blood mixed with mastic and turpentine, in order to reconstruct the recipes. I also preheated the solution au-bain-marie before application [fig. 11]. For the application of the substance I tried to follow the instructions given by the author of the manuscript. Little by little and layer over layer I applied the dragon's blood, which resulted in crystal covered with a smooth, fine, translucent red color [fig. 12 and 13].

#### **Imitating red gemstones by coloring transparent minerals**

The *Stockholm Papyrus*, a manuscript with various recipes written in Greek dating from first century, contains a lot of descriptions how to imitate gemstones. Red, translucent gemstones are made by heating crystals, dip them into oil and leave it in the dye for the purpose of adsorption until the morning. Mixing dragon's blood with alkanet makes the dye for red gems, says the manuscript. By adjusting the process it is possible to make sunstones, rubies, beryl and hyacinth gems.<sup>47</sup> The author of the BnF Ms. Fr. 640 does not mentioning a recipe like this one<sup>48</sup>, and also due to the extent of this research I decided not to make a reconstruction of this recipe.

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<sup>42</sup> Cellini 1568: 27.

<sup>43</sup> Kunckel 1679: 102.

<sup>44</sup> Agricola 1546: book 6, 116.

<sup>45</sup> There are some disagreements about which gemstone is imitated with the dragon's blood, some say rubies, other garnets, or hyacinths.

<sup>46</sup> Chomel 1778: 531-523. Smith 1799: 139. Encyclopaedia Britannica 1817: 305.

<sup>47</sup> Caley 1926.

<sup>48</sup> An important remark is that the author of the manuscript describes recipes of gemstone imitations. The method is heating white stones with different kind of additions in a furnace. There are no connections with dragon's blood in this technique and I couldn't find any related recipes which contains the use of dragon's blood, so that's reason this recipes are not included in this research.

## Conclusions

According to art technological resources red, translucent gemstones were often falsified and imitated in different manners. As a result of this research dragon's blood appears to be an important ingredient in these techniques, mainly because of its brilliant, translucent color. Our reconstruction of dragon's blood resulted in a beautiful, fine solution that proves the usability to imitate and falsify red translucent gemstones. In order to achieve this solution it turned out to be important to crushed and sieved before solving it into ethanol. Besides that the solution became more viscous and smooth when mastic and turpentine where added. After preheating this mixture, the substance turned to be beautiful, translucent and easy to apply.

Although the author of the manuscript does not describe a complete recipe for falsifying or imitating red gems with dragon's blood, with the assist of ancient and early modern sources it is possible to confirm the role of the magical red resin in counterfeiting gems. Dragon's blood was used to apply on foils, which were placed underneath precious stones and also smeared on the base in order to change the color. Another important role of dragon's blood can be found in making doublets, which resulted in imitating rubies, garnets or hyacinths. It turned out to be possible to make reconstruction of the recipes or from combinations of the information, in order to investigate and clarify how the practice of counterfeiting gems was done in the early modern periods.

As a prospective conservator of metal artifacts this research into early modern sources like the BnF Ms. Fr. 640 is of great importance. Gemstones are often a part of metal artifacts from ancient times onwards, and knowledge about the making and knowing of counterfeiting precious stones is therefore remarkable relevant.

## Acknowledgements

I would like to thank Seth Low Prof. P.H. Smith for the opportunity to collaborate with the unique *Making and Knowing Project*. I'm especially indebted to my instructor dr. M.A.H. Bol for her encouragement during the course.

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## Appendix



Fig. 1: Dragon's blood from Socotra.

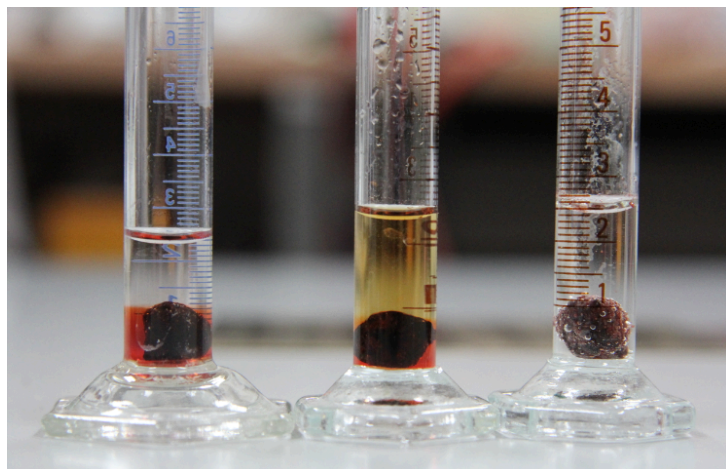


Fig. 2: From left to right: 'kirchwasser' eau-de-vie, brandy, white wine.



Fig. 3: Crushing the dragon's blood in a mortar.



Fig. 4: The sieved dragon's blood powder on the right, the coarse powder and impurities on the left.

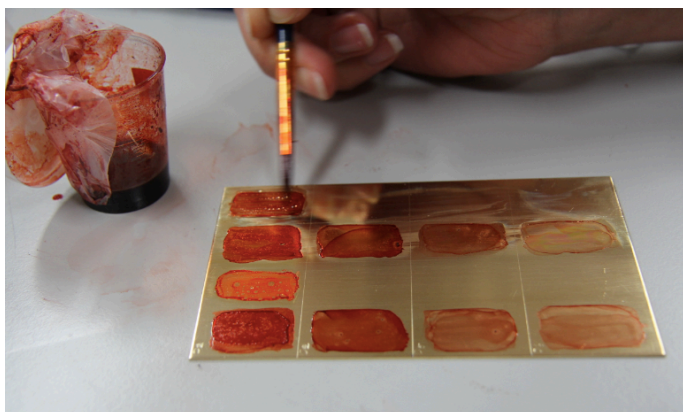


Fig. 5: Applying different solutions of dragon's blood solved in ethanol on a brass surface.

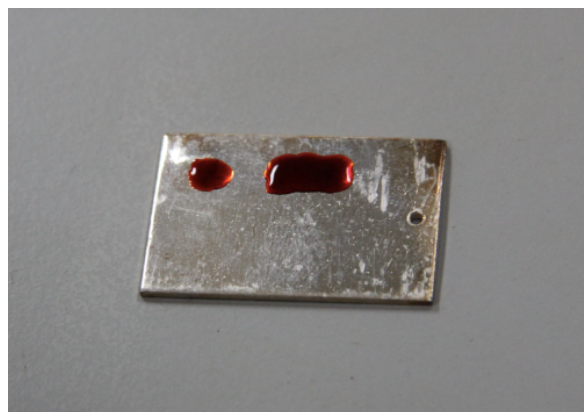


Fig. 6: Applying dragon's blood solved in ethanol and mixed with mastic and turpentine on a silver surface. Preheated before application.





Fig. 7: Ruby placed on a white sheet of paper (microscopic image with x2.5 magnification).



Fig. 8: Ruby placed on a silver surface (microscopic image with x2.5 magnification).



Fig. 9: Ruby placed on gold leaf which is colored by a thin solution of dragon's blood solved in ethanol (microscopic image with x2.5 magnification).



Fig. 10: Ruby colored with the dragon's blood substance (microscopic image with x2.5 magnification).





Fig. 11: The materials used for applying the dragon's blood au-bain-marie (hot water in the left cup) on a crystal.



Fig. 12: Swarovski crystal.



Fig. 13: Swarovski crystal colored with the dragon's blood substance.