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A GLIMPSE OF OUR PAST

The Celebrated *Ecorchés* of Honoré Fragonard, Part 2: The Details of the Technique Used by Fragonard

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It is remarkable that the famous é*corchés* of Honoré Fragonard have survived the centuries to reach us today. Studies carried out by several teams have established details of the technique used by Fragonard that help to explain their longevity. The injection of the vessels was achieved by means of a mixture of mutton tallow and pine resin diluted in essence of turpentine and essential oils. This gave Fragonard a very high success rate. Above all, he did not add pigments to his mixture while injecting the veins, and this facilitated the procedure. The vessels were painted after preservation to give them the vivid colors that we can still see today. Another detail that explains their exceptional conservation is that the varnish used by Fragonard was composed of Venice turpentine, made from larch resin and known to repel insects. Clin. Anat. 23:258–264, 2010.

Key words: écorchés; anatomical specimens; dissection; preservation

INTRODUCTION

Honoré Fragonard had proposed, in his 1792 letter to the *Assemblée Nationale*, the establishment of a national collection of anatomy to be stocked with anatomical specimens prepared with his own technique. His proposal was turned down, however, and he never divulged his technique. Instead, he dedicated himself to his work as Director of Anatomical Preparations at the *Ecole de Santé de Paris*, a position he occupied from 1795. The mystery remained complete ... until a plan for the conservation of the specimens of the *Musée Fragonard*[1] became an urgent necessity.

Although the é*corchés* had remained in a relatively good state of preservation up to 2003, they were damaged in the heat wave, which affected France that summer. The vascular injections started to melt, and drops of ''wax'' appeared on the floor of the display cases. Was this something new? Not according to those who had known the museum for several decades.

One former employee recounted how, during hot summers, the é*corchés* ''sweated wax.'' Moreover, he pointed out the mark under the great vessels of one of the thoraxes of a glass dish, which he had seen in place a long time ago, and which became progressively filled with the substance of the injections, which dripped from the aorta and the superior vena cava (Fig. 1).

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Fig. 1. View of the melting of the vascular injections in a human bust, by Honoré Fragonard (between 1766 and 1771). [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.] © C. Degueurce, musée Fragonard.

This phenomenon was thus not recent, and the injections had probably been slowly melting since their creation. A thorough examination of the *Homme à la Mandibule* showed drops of melted wax at the extremities of the mesenteric vessels. The pulmonary arteries and veins have collapsed in the thorax, and the heart is coated with wax, which has progressively flowed from the surface. Similarly, on the *Cavalier*, the internal surface of the sternum is covered with a large mass of wax, which has probably fallen from the vessels of the thorax and is slowly seeping between the pectoral muscles before dripping to the floor—giving some idea of the level of damage to this specimen.

The desire to save these unique objects, classified as *Monuments Historiques*, was behind a multidisciplinary approach aiming to discover Fragonard's method of preparation and thus to propose measures for conservation. How can one hope to preserve an object about which one lacks detailed knowledge?

RESEARCH INTO FRAGONARD'S TECHNIQUE

The opportunity to investigate Fragonard's technique came with a request for filming by the National Geographic Channel, as part of the television series "The Mummy Roadshow." The idea behind this program was to show the work of two scientists uncovering the secrets of mummies. An agreement was reached for them to conduct an investigation into the *Homme à la Mandibule*, in exchange for carrying out tests on the injection material and the varnish used in this specimen. The team concentrated on this *ecorché*, presented upright holding in his right hand a horse's mandible, evoking Samson fighting against the Philistines[2] (Fig. 2). This specimen was chosen because of its excellent technical quality and spectacular vascular injections.

The investigation was in several parts: physical, radiographic, and endoscopic. Samples of the injections and the varnish were sent to two American laboratories for analysis. The initial results were contradictory, and so samples were then sent to the *Laboratoire de Recherche des Monuments Historique* (Mme Paulette Hugon), then the *LETIAM* (*Laboratoire d'Etudes des Techniques et Instruments d'Analyse Moléculaire*) of the *Institut Universitaire de Technologie de Paris XI-Orsay* (Sung Vo Duy, Jean Bleton, and Alain Tchapla) to verify and complete the analysis.

Sung Vo Duy dedicated his third-year thesis in analytical chemistry to the study of the injected substances of the *écorchés*; the crucial data concerning the composition of the products used by Fragonard are taken from his work (Vo Duy, 2007). The second phase of his work has extended his study to the other *écorchés*, human and animal, largely revealing Frago-

[2]The Old Testament, Judges 15, verses 9–16.

nard's secrets. We report here the principal findings without entering into the methodological details.

THE CHOICE OF SUBJECTS

Fragonard probably selected his subjects for their leanness. The *Cavalier* is a young boy, around 12 years of age, mounted on a very old pony, well past ageing by examination of its dentition. The *Homme à la Mandibule*, in contrast, is very old. He has few teeth and no trace of fat remains on his body. It is unlikely that his muscles could have been so perfectly cleaned of adipose tissue had it been present in life.

THE ROUTE OF THE VASCULAR INJECTIONS

The cadavers have all undergone a thoracotomy. In the humans, this was carried out according to classic methods. The thorax of the animals was opened from both sides, revealing the heart and pulmonary vessels. None of these subjects presented with an incised aorta or vena cava that might suggest that they had been catheterized. Radiographic studies have shown that the heart was injected in both the left and right ventricles, and so the cannulae may have been positioned directly in the ventricles (Fig. 3). This is directly visible in the nilgai[3], in which the heart presents at its apex a purse-string suture made with horsehair. The product injected into the left ventricle has penetrated the aorta and spread throughout the arterial network, while that in the right ventricle has entered the pulmonary arteries.

Fig. 2. The *Homme à la Mandibule*, by Honoré Fragonard (between 1766 and 1771). © P. Forchet, musée Fragonard. Acknowledgements: P. Forchet.

Fig. 3. Thoracotomy and injection by means of a cannula inserted into the heart. © E. Bastid. Acknowledgements: E. Bastid.

THE NATURE OF THE INJECTION PRODUCT

Radiographic examination of the cadavers revealed that different products were used in the arteries and veins. For example, the radiograph of the pelvis shows a metallic density in the external iliac artery, while the neighboring vein is radiolucent. The arteries, then, unlike the veins, were injected with a product containing a metallic salt. Endoscopic

[3]Indian antelope, *Boselaphus tragocamelus*. This specimen, arrived in Alfort in 1783, is not therefore by the hand of Fragonard.

examination of the body cavities showed clearly that the interior of the arteries is stained red while the contents of the veins are simply brown, not pigmented.

The analysis of the red pigment used for the arteries showed that it was vermillion, a salt of mercury[4], which explains both the very bright color of these vessels and the presence of metal seen on the radiographs. Moreover, as Jean-Joseph Sue had recommended (see Part 1 of this article), all the vessels were repainted: the arteries in red with a mixture including vermillion, the veins in blue by means of a pigment that was found to be azurite[5]. This difference in the pigmentation of the arteries and veins is easily explained: as the veins have valves, the resistance to the injection is greater than in the arteries. The anatomist did not therefore risk making the mixture more viscous by adding pigments.

The difference in staining was sufficient to allow the arteries and veins to be easily distinguished during dissection. The vessels marked with red were repainted with a bright red color at the end of the dissection, whereas the wide, thin-walled veins were located and painted blue. The vascular system was not the only one to be injected; the penis was also distended by injection of the erectile tissues (Sue, 1765).

More surprising was the discovery of the composition of the mass of the injection. We had been expecting wax; instead, we found mainly mutton tallow mixed with pine resin and an essential oil. Only the large animals (the horse and the nilgai) showed traces of beeswax, none of the human cadavers contained it. Although this formula may be very close to that of Sue (1765), the absence of wax explains the ease of use of this technique. Mutton fat melts at a low temperature: 50% of its mass is liquid at 18°C, in contrast to beeswax of which the melting point is around 70°C. It was thus easy for Honoré Fragonard to melt the mutton fat and add to it the pine resin and an essential oil[6] to obtain a fluid mixture, easily injectable into a warm corpse. In contrast to Sue's formula (1765), Fragonard did not need to warm the corpse unduly to give his injections a much greater chance of success than with the classical method. We can now understand why Karl Rudolphi marveled at how Fragonard succeeded six times out of 10 (Rudolphi, 1805, p.33). During the cooling of the mixture, the resin thickened the tallow, which then formed into a hard mass. Fragonard also avoided the fault noticed by Alexander Monro in the case of an injection with melted tallow alone or mixed with oil of turpentine: the fragility of the vessels that break when handled (Monro, 1789, p. 681).

A similar technique reappears in the literature of the 19th century. Jacques-Nicolas Gannal published in 1838 a formula comprising:

> "Tallow, five parts,
> Burgundy resin (spruce), two parts,
> Oil of olives or nuts, two parts,
> Liquid turpentine and coloring matter dissolved in essential oil, one part" (Gannal, 1838, p. 218).

Gannal's formula was exactly repeated by Pierre Boitard[7], a great admirer of Gannal (Boitard, 1853, p. 427). The *Grand Dictionnaire du XIX^e Siècle* by Pierre Larousse listed this formula in the article on "Injections"[8] (Larousse, 1866–1877, p. 700). Fragonard had thus utilized in the 18th century a method that became the classical technique of the 19th.

DISSECTION

Once the products had been injected, Fragonard proceeded with the dissection according to the classical method. The skin was removed. If it was an animal, the cutaneous muscles were left in place. Each muscle was isolated, while preserving the nerves, arteries, and veins. Organs that were difficult to preserve, like the lungs, the intestines, and the brain, were removed.

With humans, two different treatments were used for the eyes. The first consisted of preserving the natural organ and inflating it. The second, as on the *Homme à la Mandibule*, consisted of removing the eyes of the cadaver and replacing them with artificial, porcelain eyes. The appearance was obviously very different: glazed when the natural organ was still in place, but clear, bright, and rather disturbing with the second method.

PRESERVATION

After dissection came the preservation phase. The body was probably submerged in alcohol (Fig. 4). This is attested by the presence, amongst the injected products, of fatty acid ethyl esters. Once it was saturated, the body would have been taken out of the tank and placed in the required position, probably in the drying room. We know that such a room existed above the collection room, for Fragonard mentioned it in his inventory of 1794.

[4]Mercuric sulphide.

[5]Copper carbonate.

[6]The presence of an essential oil is attested by the discovery of camphor and eucalyptol in the injections. As Pierre Boitard stipulated in his treatise (page 425), fatty and resinous substances can be "dissolved in alcohol, the fats, the wax." The essence of turpentine was the most commonly used, but its unpleasant odor made him prefer the essence of lemon or lavender (oil of aspic). Fragonard, born into a family of perfumiers of Grasse, would have known these products well.

[7]Boitard proposed the following mixture for injecting the great vessels: tallow (153 g), Burgundy resin (60 g), oil of olives or nuts (60 g), and liquid turpentine loaded with coloring matter (30 g).

[8]"For the arteries, one usually employs a mixture of tallow and of white pitch [=white Burgundy pitch], to which one adds, after having melted it and passed it through a cloth, essence of turpentine, in which one dissolves some lamp black ..."

Fig. 4. Dehydration of a dissected cadaver in a bath of alcohol. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.] © E. Bastid. Acknowledgements: E. Bastid.

POSITIONING AND DRYING

The *Homme à la Mandibule* bears to this day the marks of its positioning. How to make a dead man stand upright? The answer is visible on the écorché. The sacrum is pierced by three screw holes, and the vertebral canal is open where a metal rod was introduced. The back was rigid; the sacrum was fixed at normal height and the legs stretched downward to the floor. Fragonard probably used a frame to position the head and arms (Fig. 5). The muscles and the vessels were held in place by needles; some are still visible at the exterior of the cadaver, while the others, more deeply placed, appear clearly in radiographs. We know that they were inserted in the body before the vessels had been painted and the whole cadaver varnished, because the needles have been covered by the successive layers. As explained by Sue (1765), Fragonard had to constantly reposition the anatomical structures while they were drying. One can imagine the anatomist working on the ears and the lips of the man to give them the aggressive attitude, which is so striking today. The same type of procedure would have been adopted for the *Cavalier* and his mount.

HIGHLIGHTING THE VESSELS

In the last phase of the preparation, the arteries and veins were painted (Fig. 6). Although the work is remarkable overall, Fragonard in spite of everything left traces of paint on the anatomical structures close to the vessels. Thus, the biceps brachii of the left arm carries traces of blue paint, and again on the interior of the thorax, where the internal surface appears, through the endoscope, to be marked by traces of red and blue paint.

THE VARNISH

Once the body was ready, it was varnished with a product containing Venice turpentine, a very pure resin that takes its name from the fact that it was commonly produced from the larch of the Dolomite region, north of Venice. This leads us to the painter Jean-Honoré Fragonard (1732–1806), the cousin of

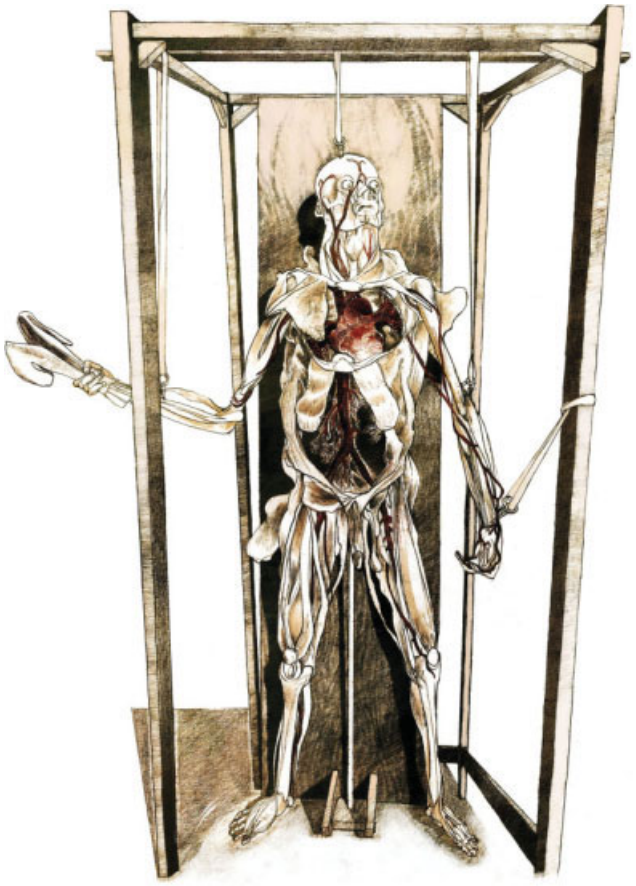

Fig. 5. Positioning of the body for drying. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.] © E. Bastid. Acknowledgements: E. Bastid.

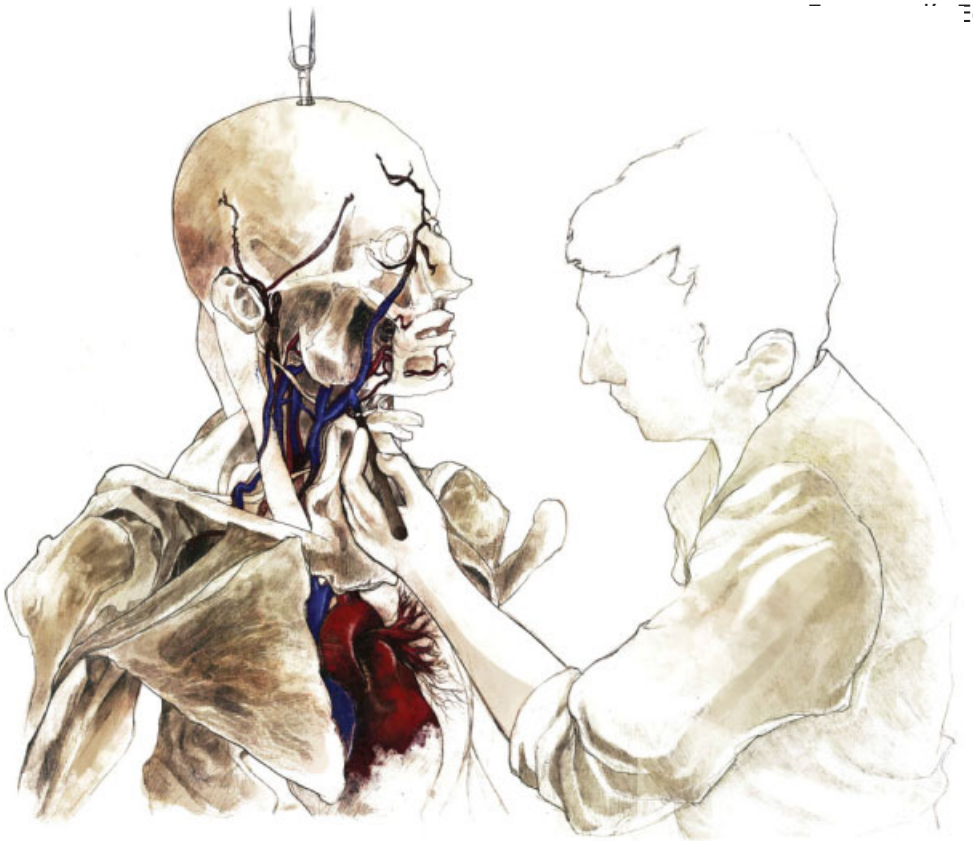

Fig. 6. Painting the vessels after drying. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.] © E. Bastid. Acknowledgements: E. Bastid.

Honoré Fragonard, for this costly product was used in the manufacture of varnishes for paintings. It has the major advantages of yellowing without blackening (the colors are still clearly visible on the *écorchés* of the museum) and its plastic properties that give it great toughness. This very expensive resin was used by Honoré Fragonard to protect his *écorchés* (Fig. 7). It undoubtedly helped in protecting these specimens from insect attack: *vers destructeurs de tout ce qu'on a pu faire jusqu'à présent* as Fragonard wrote in his letter of 1792.

In summary, this study has allowed us to grasp at least some of the details of Fragonard's method, insights which explain the laudatory remarks of Fragonard's contemporaries on his achievements and above all the longevity of his dried preparations way beyond the norm. In particular, it has enabled us to make recommendations for the conservation of the *écorchés*. The fact that the injection was made essentially of mutton tallow led us to modify the atmosphere within which they are housed. In fact, a huge project of renovation of the *Musée Fragonard* was started toward the end of 2007 and was completed in autumn 2008. Structural modifications were made to safeguard the *écorchés*. An insulating wall was built, which separates the "cabinet of curiosities,"

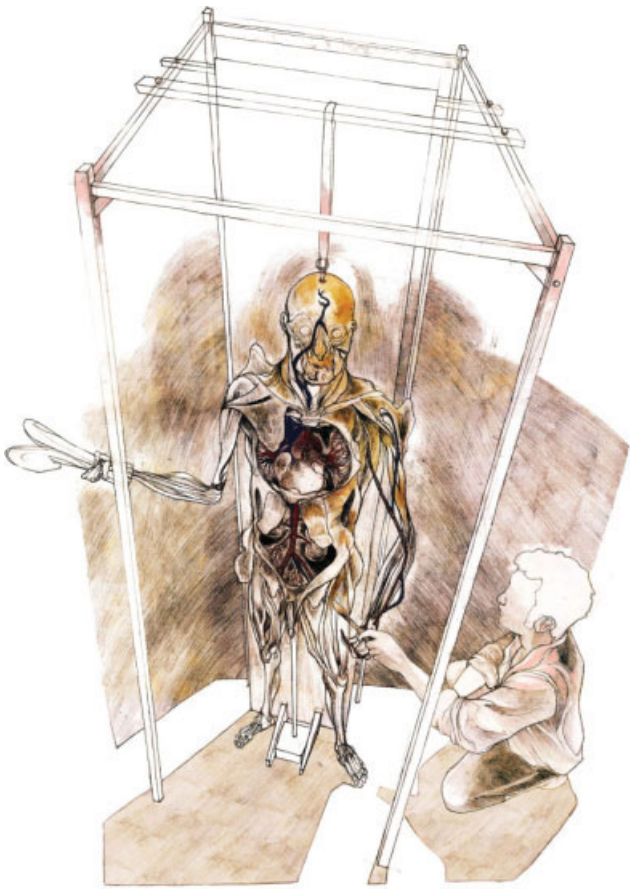

Fig. 7. Application of varnish based on Venice turpentine. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.] © E. Bastid. Acknowledgements: E. Bastid.

from the rest of the museum. The *Salle des Ecorchés* allows air-conditioning. The brief was to maintain the atmosphere at 18°C and a maximum of 50% humidity. The museum reopened its doors to the public on November 1, 2008, and the variations in temperature and humidity are monitored. We are pleased to report that the renovations have been successful, and we are confident that these irreplaceable specimens will be safeguarded for future generations.

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