The Six Techniques of Pierced Openwork Jewellery in Late Antiquity and their Evolution

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Introduction

The development of pierced openwork jewellery is a characteristic phenomenon of Late Antiquity. The distinctive feature of this type of object compared to other forms of art is the high value of the raw material – mostly gold. Consequently, the way in which this costly material was used became a central preoccupation of the goldsmith. During Late Antiquity at least six different techniques were invented to improve the way in which the gold could be economised, to simplify the manufacturing process or for aesthetic purposes. The question of the importance of each of these factors has to be dealt with here briefly before discussing the techniques. Whether techniques or aesthetics are the primary factor in the evolution of art is a debate which goes back to the end of the 19th century and is of specific concern with regards to the works of art of the 3rd century. Several general aesthetic changes that one can see on pierced jewellery are a transposition on a smaller scale of the changes which occur in monumental art. These general aesthetic changes had a great impact on the “techniques” employed on pierced jewellery, because the liberty taken with naturalistic shapes freed the figures and the vegetal ornaments used on jewellery from the formal conventions of the classical tradition, which were technically too constraining. When there was no aesthetic objection to flattening shapes or to deforming their proportions, new techniques could freely develop, naturally going in the direction of an economy of material and of time necessary for the manufacture of objects. But these technical changes would hardly have been possible without the aesthetic changes which occurred in the major arts in the 3rd century such as sculpture, painting, etc., which were the formal models used for the figures and the ornamentation on jewellery.

Two important works of the 1990s initiated research on the techniques of pierced jewellery. Ogden and Schmidt’s paper in 1990 dealt with the techniques used for piercing jewellery as well as of the method of creating hollow beaded wire. They distinguish two techniques: the first one is called ‘chisel-cut’ pierced work and consists of simply cutting out the pierced pattern with a sharp chisel in a thin sheet of gold; the second technique is based on round perforations punched into the metal, which were afterwards ‘opened out’ with a triangular-sectioned chisel. This technique uses a thicker sheet of gold and creates smaller patterns. It was successfully reproduced in experiments carried out by Ogden and Schmidt. According to them the round perforations are obtained by pressing a tapered round-section punch through the sheet. I rather think that the perforations were achieved with a small round-section punch with a convex end, according to the marks made by this tool in those places where it did not entirely perforate the sheet (see p. 7). The triangular-sectioned chisel (comparable to a graver) used by Ogden and Schmidt during their experiments to carve the metal is useful in creating the angles, but most of the time the tool marks bear witness to an ordinary chisel. The example they select for the ‘chisel-cut’ technique – the fragmentary jewel from the Fayoum, now in the British Museum – has patterns which were not just simply cut out. It corresponds to what I call the chasing-cutting technique which means that the patterns were first chased in order to give them relief before being cut out.

This technique has been explained by Niemeyer in a study which focused on the great necklace from the Assiût treasure. Niemeyer also distinguishes the two techniques described by Ogden and Schmidt, emphasising more the chasing-cutting technique which is used on the necklace. She explains that the cutting out of the patterns is brought out on a soft support by chasing all around the patterns, that is, by pressing the chisel in a repeated way against the sheet which creates strong deformations on the obverse. The cut-out piece is then pressed from the obverse in order to be removed from the sheet. She suggests that the repeated chasing of the patterns was enough to cut them practically out and to remove them easily by pressing from behind. I rather think that the work of chasing and cutting are two separate phases of the technique, the first one usually using a blunt chisel, the second a sharp chisel which is pushed in an oblique way against the inner wall of the patterns (see the drawing in Pl. 4).

These studies agreed about the existence of two different techniques, but the reasons for their development were not clear. In fact, these techniques appear only at an advanced stage of the evolution of pierced jewellery, towards the end of the 3rd or the beginning of the 4th century. Several other techniques existed before their appearance and some other techniques appeared after them. They take part in a long evolution which is different in the West and the East.

In order to study the different techniques of pierced jewellery it is necessary to have a precise terminology. As far as possible I have tried to find simple words which sum up the principle of each of the techniques in order, as for example the cutting-carving technique, in which the holes are first cut out and then carved out, or the chasing-cutting technique in which the patterns are chased before cutting them out.

There are three elements in an openwork object: the surface, the depth and the opening (Pl. 1). The surface is that part of the openwork which is in the foreground. It is usually flat and creates the patterns depicted by the openwork. The depth of the gold sheet is the part which produces an effect of...
The manufacturing process of the six techniques

In order to distinguish the techniques, their manufacturing process is illustrated by six drawings (Pls 2–7). These show a section of the sheet, the thickness of which differs according to the technique. The drawings explain the way in which the sheet is pierced, the resulting deformations, and the processing afterwards, which involves carving or chasing the sides and the angles of the openwork and flattening the burrs. These drawings will help us to understand the tool marks and the deformations which are visible on the jewels, and which we will study Afterwards.

The cutting-carving technique and the cutting technique seem to be the earliest ones. The cutting-carving technique consists in cutting out patterns which are smaller than the final result, by going around it with a sharp chisel, and then carving it until obtaining the required result (Pl. 2). First the sheet is placed on a hard support to avoid its deformation from the pressure of the chisel while cutting out the opening (Pl. 2.1). However, it should not be so hard a support as to blunt the chisel, so wood was probably used. As the chisel pierces the sheet, it drives into the wood used as support and drags along pieces of the sheet into the small gap opened by the chisel in the wood. Second, the cut-out pieces are removed (Pl. 2.2). Third, the sides and the angles of the openwork are carved out with a small sharp chisel which removes gold shavings (Pl. 2.3). Fourth, the sheet is placed upside-down in order to flatten the burrs created on the back by the process of cutting (Pl. 2.4). This is a technique which needs a relatively thick sheet of gold to have enough material to carve.

The cutting technique simplifies the process (Pl. 3). By giving up the carving phase, it allows the jewellery to be of a thinner sheet, which creates a less expensive jewel. Indeed, the thickness of the sheet of gold is only useful if it is intended to be carved; if the patterns are only cut out, this thickness can be reduced at will. The other phases of the work are the same as for the previous technique: the openings are cut out by a sharp chisel (Pl. 3.1), the cut out pieces are removed (Pl. 3.2), and the burrs which have been driven into the wood with the chisel during the cutting are flattened (Pl. 3.3).

The advantage of the cutting technique is that it uses a thin sheet of gold. The disadvantage is that it is practically impossible to give relief to the patterns by this technique: it requires a completely flat decoration. The chasing-cutting technique is a solution to this problem (Pl. 4). This is the most ingenious technique because it makes it possible to create considerable relief with a very thin sheet of gold. To create the relief, all the patterns are first chased, which means that with a blunt chisel the outline of the designs are pushed into a soft support, placed behind the sheet of gold, so that the sheet is deformed (Pl. 4.1). Second, a sharp chisel is chosen to cut out the openwork. As can be seen on Pl. 4.2, the sharp chisel is pushed into the sheet in an oblique way, by pressing it against the inner wall of the patterns which have been chased, in order to follow in the nearest way the relief. In fact, if the chisel cut the openwork in the middle of the depression created by the chasing, the result would not be satisfactory because a fold could be seen in the bottom of the openwork, instead of a uniform relief. This happens sometimes on jewels which have been executed hastily. Third, the cut out pieces can be removed if the cutting was not deep enough (Pl. 4.3). The result is a strong relief, which can be compared to that of the cutting-carving technique, but the technique is very different, the work is much faster and the thickness of the sheet is insignificant.

The perforating-cutting technique comes from the cutting-carving technique (Pl. 5). On some jewels made by the cutting-carving technique, there are already some elements – mainly the more or less circular patterns – for which the perforating-cutting technique has been used, showing the transition from one technique to the other. In the perforating-carving
technique, instead of cutting all around the patterns, a small round punch is used with which the openwork can be perforated in a single action (Pl. 5.1). It accelerates the work, because the pattern no longer needs to be cut all around. As the end of the pointed or rounded punch is convex, it does not remove any metal. As it goes through the sheet, the latter opens around the spherical end of the punch and bends on the sides. The sheet has to be placed on a hard support to avoid its deformation during the perforation process. Then the sheet is carved to give a final form to the openwork by creating a relief at the angles and on the sides of the opening (Pls 5.2, 5.3). Finally the burrs which set into the wood, dragged along with the action of the punch, are flattened (Pl. 5.4). The carving phase needs a certain thickness of sheet to have enough material to carve.

The perforating-chasing technique accelerates the work compared to the perforating-carving technique and uses a thinner sheet of gold (Pl. 6). Indeed, the sheet’s thickness is diminished by replacing the carving phase by the chasing phase. The small round punch pierces the metal, as in the previous technique (Pl. 6.1). To get the patterns, the surface of the sheet is chased near the perforations by pushing a chisel into the sheet, which is not too sharp, to avoid going through it (Pl. 6.2). In the end the burrs are planed, instead of being flattened, because in this way the chasing on the front is not damaged (Pl. 6.3). The work is simplified and above all the thickness of the sheet of gold is reduced.

The perforating-punching technique is the continuation of the previous one, but in a much simplified form (Pl. 7.1). First the patterns are perforated with a punch as in the last two techniques (Pl. 7.1). But instead of chasing each side of the patterns, a punch will be pushed into the sheet of gold, which has already the form of the pattern wanted (Pl. 7.2). This considerably accelerates the work because a single movement is sufficient to give a pattern.
Plate 4 The chasing-cutting technique

1. Chasing the patterns
2. Cutting with sharp chisel
3. Removing the cut-out piece

Plate 5 The perforating-carving technique

1. Perforation
2. Carving
3. Result
4. Flattening the burrs

Plate 6 The perforating-chasing technique

1. Perforation
2. Chasing the patterns
3. Planing the burrs

Plate 7 The perforating-punching technique

1. Perforation
2. Punching
The tool marks and the deformations created by the techniques
To decide whether a jewel belongs to one technique or another, the best method is to examine the tool marks on the front and the deformations on the back. I present here some close-up photos showing several examples of tool marks and deformations (Pls 8–23). Based on these observations, one can establish a method for recognising each technique.

Several techniques include a phase of ‘carving’. This consists of removing small pieces of material with a sharp chisel. This process can be recognised by observing the front of the jewels, where a great number of shavings coming from the carving are still stuck to the sheet, as can be seen on Pl. 8 showing two bracelets from the Hoxne treasure. The relief can be made by carving the sides of the openwork, so that the depth will have an oblique plane compared to the surface. This is what one can see on Pl. 8a where shavings created by carving the sides of the openwork are clearly visible. The carving phase is especially useful for the angles of the patterns, which are often only carved into the depth of the openwork and do not contribute to the real opening as one can see on Pl. 8b where an aggregate of shavings coming from the carving remains stuck to an angle of the openwork.

The cutting or the perforation creates deformations on the back of the gold sheet. The type of deformation on the back of an object depends not only on the sharpness of the chisel but also on the kind of support placed under the sheet during the cutting or the perforation. The deformations can be classified into two categories: the burrs, which result from those techniques using a hard support during the cutting or the perforation, and the folds which occur when a soft support is used.

The cutting-carving technique
The cutting-carving technique is among the techniques which uses a sharp chisel during the cutting and a hard support, with the result that the deformations on the back are burrs. Three examples illustrate these burrs (Pls 9 and 10) which occur on the back of jewels using the cutting-carving technique. The burrs result from the special properties of gold as a material which exhibits significant plasticity when pure enough. As the chisel or the perforator runs through it, it can easily drag a part of the sheet by a shearing effect, which will set into the wood along the depressions created by the sharp tool. The gold sheet is not deformed elsewhere because the wood supports it. This explains the abrupt transition between the burrs and the sheet because the latter was supported by the wood during the cutting, whereas the burrs could get inside the wood in the places where the sharp tool has cut into it.

The burrs created by the cutting-carving technique follow the irregular shape of the openings, as one can see on Pl. 9. Usually these burrs are flattened as can be seen on Pls 9 and 10a. Indeed, placed on the back of bracelets, rings and pendants, they are regularly in contact with the cloth or the skin of the wearer. These burrs need to be reduced as possible by flattening. The tool used for this ‘flattening’ is unknown. Maybe, as Dandridge has proposed, it was a burnisher.¹¹ This is a blunt tool which would be pushed against the burrs in order to flatten them. In rare examples the burrs were left undamaged because they were not in contact either with the
skin or the cloth of the wearer. This is what one can see on a bracelet in the Römisch-Germanisches Zentralmuseum, Mainz (Pl. 10b). This bracelet has curved sides with which the wearer’s skin was not in contact. It is a good illustration of the shape of the burrs before they are flattened. As on the flattened ones, the burrs have an irregular shape, following the course of the chisel which was used to cut out the patterns. This is the main difference between the cutting-carving technique and the perforating-carving technique, where these burrs have a round shape.

**The cutting technique**

The cutting technique creates the same kind of burrs as the cutting-carving technique, as one can see on Pl. 11. These techniques create the same burrs on the back, because both use a hard support like wood during the cutting and a sharp chisel. The only difference between the two is that in the cutting technique the carving phase is lacking, so one can see the same patterns on the back as on the front, whereas for the jewels of the cutting-carving technique the patterns are hardly recognisable on the back because it is the carving phase which gives the final shape to the patterns. This is why on the necklace illustrated in Pl. 11, the patterns can be clearly seen on the back, because in the cutting technique the cutting phase gives the final form to the patterns without the carving being necessary to complete it.

**The chasing-cutting technique**

The examples seen previously illustrate techniques which use only sharp chisels and a wooden support. The back of these jewels show burrs of the metal which have set into the wood just when the sharp tool was cutting into it. These burrs are usually flattened later on.

**Plate 12** shows some examples where a blunt chisel was also used and the support was a soft one for most of the time. These reflect the chasing-cutting technique which has very different deformations on the back to the burrs seen previously. The deformations are folds of the metal, mostly resulting from the chasing phase, when all the patterns were pressed into the soft support with a blunt chisel, but also from the cutting, because while the sharp chisel is cutting the patterns chased before, it continues to press the sheet into the soft support. Unlike the burrs of the former techniques, the folds are desired and controlled deformations. The chasing-cutting technique uses a soft support such as wax or clay. As seen on Pl. 4.1, the sheet can bend thanks to this soft support while the patterns are being chased and cut. The outcome is a progressive fold of the sheet all around the patterns (Pls 12a-d). Its shape is very different from the burrs which result from the perforation of gold by a sharp tool on wood. Here the support was less hard and there was no strain between the wooden support and the force of the sharp tool which would lead to the setting of a piece of metal into the wood where the tool has cut it. As there is no strain between the sheet and the soft support, there are no burrs of the metal either.

Various effects can be obtained by this technique according to the thickness of the gold sheet and the size of the patterns cut out, as one can see on Pls 12a-d, because the fold of the metal is in inverse proportion to the thickness of the sheet. Consequently, there are two main styles for this technique: the broken-relief style where the folds are less important and the high-relief style where the folds have more impact. In the
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broken-relief style, the patterns are relatively small compared to the thickness of the gold sheet and the fold gives only a 'false thickness' to the sheet (Pls 12a and 12b). It can be called the broken relief style because there is a break between the surface and the depth of the openwork. In the high-relief style, the patterns are relatively large compared to the thickness of the sheet and the fold becomes important, creating a relief which curves progressively (Pls 12c and 12d).

These two styles do not correspond to a distinction between the Roman and the Byzantine periods for jewels of this technique because both styles existed in both periods. The distinction between Roman and Byzantine jewels is based more on the type of chasing of the preparatory work which acquires a different function on Byzantine jewels using chasing also to draw areas on the sheet which will not be cut out afterwards. On Byzantine jewels the chasing phase creates continuous lines between the pierced and the plain parts. This is what can be seen on the de Clercq earring in the Louvre, on which some of the chased areas indicated by the red arrow in Pl. 13 have not been cut out afterwards. This shows clearly the chasing phase which preceded the cutting phase.

To get an even higher relief, repoussé work had to be used between the chasing and the cutting phases. It is a rare technique because usually the fold of the metal coming from the chasing action on the soft support is sufficient. Yet sometimes the goldsmith was led to use repoussé to emphasise...
which created a variety of forms during its long existence. Its success can be explained by its relatively low cost compared to other techniques because it requires only a thin sheet of gold and also has the ability to create a strong relief.

The perforating-carving technique

The tool used to perforate the round holes for the perforating-carving technique was a small round convex punch as illustrated in Pl. 5.1. One can obtain an idea about the shape of this tool from the marks left on the surfaces of the jewels. Indeed, there are some jewels on which the goldsmith has hesitated in placing the round perforations. Sometimes he started to perforate the sheet with his tool without breaking through because he understood meanwhile that there was not enough space for the perforation or that he was mistaken in choosing the place for the perforation. One of the objects which clearly shows hesitations of this sort is a pair of pierced spoons from the Hoxne treasure which have a chased and gilded representation of a sea god flanked by two fish or sea monsters (Pls 14–16). The places where the goldsmith started to perforate a round hole without finishing it are indicated by a red arrow on Pl. 14. Such mistakes show the goldsmith’s hesitation: he was perhaps not very experienced. On the second spoon the goldsmith seems to have gained more experience because he made only one mistake. He was trying to place a perforation in an improper spot on the scroll at the bottom on the left before realising that by placing a perforation here the scroll would no longer be a spiral (see the red arrow at the right of Pl. 14). This shows that before perforating the sheet, the goldsmith made a preliminary sketch of the places to perforate by pushing gently with the round punch without

Plate 13 Chased areas (back, front) which have not been cut afterwards on an earring from the de Clercq collection in the Louvre

the relief inside the plain parts on a detail or the whole of the openwork. The pair of earrings from the de Clercq collection also illustrates this process (Pl. 13). The repoussé was used to give more relief to the three feathers decorating the wings of the peacocks. It is obvious that during the chasing phase these feathers were drawn around by a blunt chisel. The marks of the repeated impressions caused by the action of the chisel can be clearly seen on both the front and back of the object. In this way, the break where the sheet has to bend when the patterns will be pushed was delimited precisely. Next the sheet was pushed from behind into a soft support with a blunt tool to give the feathers a high relief.

The chasing-cutting technique is the one which had the longest life, from the end of the 3rd to the 8th century and

Plate 14 Hesitations in placing the perforations on the pair of pierced spoons from the Hoxne treasure

Plate 15 The round perforations visible on the back of the pierced spoons from the Hoxne treasure
going through the sheet to have an idea about the final places for the perforations which he could readapt if he had made a mistake. The enlargements of these mistakes show the shape of the tool which was used to perforate the holes: it was obviously a small round punch with a convex end (Pl. 16).

These hesitations are not confined to the goldsmith who made the spoons from the Hoxne treasure. One finds the same kind of mistakes on bracelet no. 29 and on the armband no. 26, both from the Hoxne treasure (Pl. 17). On a bracelet in the Bibliothèque Nationale one can see the unaltered result of the perforation of holes with the small round convex punch: the sheet opened up in a way which follows the spherical shape of the punch (Pl. 18). This bracelet has the special feature of having retained the undamaged shape of the round burrs on its back. They have not been flattened because they did not chafe the skin of the wearer with which they had no direct contact. Nevertheless, on most of the jewels made by this technique the burrs have been flattened as one can see on Pls 19–20.

The perforating-carving technique is sometimes easily recognisable thanks to the round burrs seen on the back of these jewels (Pls 18, 20). However, it is sometimes more difficult to recognise this technique. Indeed, if the carving is extensive it can alter or even eliminate the round burrs from the back of these jewels. There are several kinds of round burrs
according to the extent of the carving. If the carving is minimal, the round burrs on the back will be almost unaltered (Pl. 20). On other jewels the round shape of the burrs are slightly altered because the carving has removed part of it. As the carving comes before the flattening, the shape of the burrs is not perfectly round when it comes to flattening them which gives distorted round burrs after flattening. This is what one can see for example on bracelet no. 18 from the Hoxne treasure (Pl. 19). Before being flattened, the round burrs were altered on one side (see the red arrows on Pl. 19). When they were flattened, they could not take on a shape as round as on the jewels of Pl. 20.

The perforating-chasing technique
At a more advanced stage the carving is replaced by chasing to make even smaller patterns, which leads to the perforating-chasing technique. It is quite easy to identify this by looking at the back of the jewel as one can see, for example, on a bracelet in the Louvre, or on a ring in the British Museum (Pls 21–22). In this technique the round perforations are almost intact, because, unlike carving, chasing does not remove any material. If carving does not leave any mark on the back of the sheet, chasing is easily recognisable, because the chisel thrusts into the gold and creates an undulating back of the sheet. On both the Louvre's bracelet and the British Museum's ring one can see that these deformations radiate around the round perforations because they are the starting point for the chasing. To protect the chasing, which are intentional deformations of the sheet, the burrs are planed instead of being flattened. One can easily see the marks of the planing on the back of the bracelet in the form of streaks having the same direction on all of the round burrs planed down (Pl. 21 top).

The perforating-punching technique
The perforating-punching technique is easy to recognise by simply looking at the front of the object. The patterns have exactly the same module because they take on the shape of the punch which was used to create them. On the Lambousa necklace one can see how the patterns have perfectly repetitive shapes of squares joining each other by their angles (Pl. 23). It is because the same punch was used to make them: a small triangular punch and another square-shaped one. If one looks more closely at the openwork one can see that each unit was first perforated before being punched. This is what distinguishes this technique from the simple punching technique in which the openwork character of the jewel disappears.

The table opposite summarises the different criteria needed to identify the techniques by looking at their tool marks on the front and their deformations on the back.

Conclusion
A good method by which to approach pierced jewellery is by studying the techniques involved in its manufacture. This was begun by the studies of Ogden, Schmidt, Niemeyer and Dandridge which identified two techniques. Now that six techniques have been recognised, our possibilities are multiplied. By examining all the material from a technical and stylistic point of view one may begin the task of identifying some of the workshops. If the techniques assume such an important rôle in the manufacture of pierced jewellery, it is because the primary value of these objects lay much more in their costly material as opposed to the artistic skills of the goldsmith. Special care was taken as to how the sheet of gold
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was used in order to obtain the largest jewels from the smallest amount of gold. Goldsmiths were also looking for methods to simplify their work, the pierced openwork techniques being quite time-consuming because of the quantity of small patterns needed on each jewel. This is perhaps not particular to pierced openwork jewellery. Technical simplification by craftsmen can be observed in other kinds of Late Antique art, such as sculpture and painting. It goes together with the aesthetic changes that occur in the 3rd century in art in general. These aesthetic changes did not come from an inner evolution of jewellery. The forms used on larger scale works of art were the models for goldsmiths. As long as sculpture and painting followed the realistic aesthetics of Hellenistic art, pierced jewellery could not develop because its relatively flat surface is not suited to those shapes which strive to imitate nature in a realistic way. It is only in the 3rd century that pierced jewellery could develop, when realistic conventions were abandoned in art, and any kind of shape could be adopted to decorate the flat surface of these jewels without shocking the wearers, less used to the realistic reproduction of natural forms. Once the representation of any kind of form became possible, following the aesthetic changes in Late Antiquity, the principle concern of the goldsmiths became the techniques that they employed. The difference between pierced openwork jewellery and other forms of art is that the craftsman was not only looking for methods to simplify his work: he had a special interest in diminishing the weight of the jewels in order to make less expensive objects. This is why during the long history of pierced openwork jewellery from the 3rd to the 7th century at least six different techniques were invented. Incompatible with the Hellenistic culture of the early Roman Empire, pierced jewellery was more suited to Late Antique society. Its development was ultimately made possible by the aesthetic and cultural changes of the 3rd century.

Notes

1 This paper is based on the first part of my doctoral study ‘Les bijoux ajourés percés de l’Antiquité tardive’, defended in the University of Paris IV Sorbonne under the direction of François Baratte, and the publication of which is in preparation.

2 For a general overview of the subject, see: A. Yeroulanou, Diatriita. Pierced-work gold jewellery from the 3rd to the 7th century, Benaki Museum, Athens, 1999.


6 Pete Dandridge followed the observations of Ogden and Schmidt about this technique and developed them further in a study of a fibula in the Metropolitan Museum of Art, New York: P. Dandridge, ‘Idiomatric and mainstream: The technical vocabulary of a Late Roman crossbow fibula’, Metropolitan Museum Journal 35 (2000), 71–86.

7 Ogden and Schmidt (n. 5), 5, pl. 2.

8 B. Niemeyer, ’Der Lunulaförmige Halsschmuck aus Assiût in der Berliner Antikensammlung: eine Goldschmiedetechnische

Table: The tool marks and the deformations identifying the six techniques

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<th>Burrs of variable shape</th>
<th>Folds of the sheet</th>
<th>Shavings coming from carving</th>
<th>Round burrs</th>
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9 On this more broadly and on the question of the workshops, see the future publication of my doctoral study ‘Les bijoux ajourés percés de l’Antiquité tardive’.

10 The perforating-punching technique changes rapidly into a simple punching technique by omitting the perforation which is not really necessary. The punching technique is outside the scope of this study, because the sheet is no longer pierced, but it is a continuation of the piercing techniques. It is the result of an extreme simplification of the work of the goldsmith.

11 Dandridge (n. 6), 74.

12 I would like to thank Catherine Metzger for permitting me to show this detail of a necklace in the Louvre, on which she is soon publishing a paper to appear in the *Revue du Louvre et des Musées de France*.

13 See the future publication of my doctoral study.

14 See n. 13.