

**THESES OF THE DOCTORAL DISSERTATION (PhD)**

**GOLDSMITH'S CRAFT IN LATE CLASSICAL  
AND EARLY HELLENISTIC MACEDONIA  
– DERVENI, SEDES, STAVROUPOLIS –**

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## **I. Subject and objectives of the dissertation**

The subject of the dissertation is the archaeological treatment of the golden jewels (60 items, 152 pieces) of the tombs found in 1962 at Derveni, in 1938 at Sedes, and in 1964 and 1974 in Stavroupolis, and published later; special emphasis is placed upon determining the technical characteristics and identifying goldsmiths and perhaps places of production. All of the pieces are kept at the Archaeological Museum of Thessaloniki.

The time frame is given partly by the period of the burials and partly by the production time of the jewels studied. With two exceptions the burials can be dated to the last quarter of the 4th century – early 3rd century BC, the jewels found therein may be dated slightly broader, to c. the mid 4th – early 3rd centuries BC. The tomb in Dagli street in Stavroupolis and its jewels are the earliest, they can be dated to the end of the 5th century – beginning of the 4th centuries BC. Tomb A in Sedes is the latest, it can probably be dated to the mid 3rd century BC or later and the jewels thereof could have also been produced at that period. Most of the jewels thus span a period of about 50 – 70 years.

The position of Macedonia at that period changed from peripheral to central within the Greek world as a result mainly of the social, economic and strategic reorganizing activity and expansion of Philip II (359 – 336 BC). He established the economic fundament of his reign by occupying regions rich in precious metals such as the Chalkidiki peninsula, the Pangaion, and Krenides, and by reviving their exploitation. The eastern campaign of his son, Alexander III (336 – 323 BC), had a great influence, among others, on goldsmith's craft. For example, precious stones were used in ever growing numbers in the production of jewels ever more frequently. Their reign, therefore, also brought about unprecedented richness. This is attested principally by the large number of grave goods made of precious metal in contemporary burials. At least a dozen tombs equipped with objects of similar type are known from the period up to the beginning of the 3rd century BC. Among them are the tombs of Stavroupolis, Derveni and Sedes. Golden jewels were also placed in large numbers in the tombs of both men and women. Full-sized golden wreaths, lion-headed necklaces and earrings, solid gold fingerrings, sheet-bands decorating clothes and weaponry, double pins, and bow-shaped fibulae are typical grave goods of the period. The archaeological research of the past decades have undoubtedly shown that Macedonia played a significant role in shaping the artistic koine of the hellenistic period and in renewing Greek goldsmith's craft.

The geographical frame of the dissertation is marked by the three sites. All of them are situated in Central Macedonia, around Thessaloniki. Stavroupolis and Sedes lie but a few kilometres and Derveni approximately 10-12 kilometres from the shore of the Thermaic Gulf.

One part of the jewels studied are characteristic of the period, the other part, however, contains rare, individual pieces (e.g. the 'rich style' earring with disc and boat-shaped pendant from Derveni, and the Sedes diadem). Among the objects we find jewels not only for the body, but also ones decorating clothing or weaponry, and other jewels ornamenting different objects. With one exception all of them are made of gold.

The original objective of my dissertation was to give a comprehensive characterisation of the goldsmith's craft of Macedonia in the late classical and early hellenistic period. Because the number of studiable jewels is limited and the topic is rather sizeable and diversified, and further due to length limitations, the study of the technical characteristics and the archaeological – art historical conclusions drawn from them, which may serve as a basis for further studies, give the subject of the dissertation. Further aim of the research is to attempt to determine the characteristic features firstly of the goldsmiths producing the jewels and if possible those of workshops. Despite the fact that they are published, most of these pieces have been given a short, and in several cases superficial description, and some of them have been completely forgotten (the jewels of tomb A in Sedes). A detailed documentation of the objects is also aimed at here.

The change of approach to the study of jewels that took place approximately in the 1980's – manufacturing techniques and archaeometrical examinations were put in the foreground, the identification of goldsmiths and workshops – offered new aspects in their treatment.

Dyfri Williams started the research direction of attributing jewels to goldsmiths. Through his systematic research he identified makers of jewels and precious metal objects from the Pontic region and South Italy. First, he applied art historical methods but later the examination of technical characteristics was also given a role in his research. In his opinion there are two ways to attributing jewels: the study of large tomb groups where the products of one goldsmith or workshop are likely to be found, or the study of certain characteristic types, through which one might attempt to identify the products of a master or a workshop (Williams 1988, Williams 1998).

In the dissertation the answers to the following questions will be sought:

1. How were the jewels of the tombs at Derveni, Sedes, and Stavroupolis made?
2. Wherein are their manufacturing techniques identical with those known generally from Greek jewellery?
3. Can my hypothesis be justified that it is possible to identify a goldsmith or a place of production based on technical details?
4. Were these jewels used in everyday life or were they made to be buried, that is to say the time of their production is identical with the time of their burial?
6. Were these jewels made in local workshops and of local raw material?

## II. Research methods

It is fundamental to study jewellery coming from excavations, which have context for determining characteristics of goldsmith's craft in Macedonia. The same view-point was applied to the analogies mentioned in the dissertation.

Jewellery cannot be studied using the photographs accessible in scientific publications, since the small technical details are only very rarely illustrated. Thus autopsy, the direct study of the artefacts, is an essential requirement for their research. The starting point is a thorough macroscopic and microscopic examination of the manufacturing techniques employed in each case, followed by the documentation of these details. I have made detailed technical descriptions and drawings, and I have also taken digital photographs and photographs with microscope on each piece.

An important part of the technical examination is the definition of the structural elements of the pieces. From the goldsmith's view-point these are the functional elements which are necessary to the construction of a piece of jewellery. For example, the animal's-head hoop earrings are composed of a hoop, an animal-head and a connecting element, and the necklaces are composed of a chain-part, a joining-piece and a connecting-element. The same structural elements with the same function can appear on different types of jewellery therefore these are named in the same way. For instance such is the connecting element which connects two other structural elements. Structural elements can be identified not only on whole pieces of jewellery but also on their parts, or on fragments of jewellery.

The circumstances and organisational structure of ancient Macedonian jewellery-production, i.e. the relationships between different masters and workshops, and their implications for the way the goldsmiths worked, and the workshops functioned has not yet been defined. At present, we can only try to find neutral terms in which to describe what we see: terms that do not pre-suppose any sort of hierarchy between goldsmiths, or postulate particular connections between places of production, but rather concentrate on describing the phenomena as precisely as possible. For this reason I use the "goldsmith" or "maker" instead of conventional "master", "hand" instead of "master hand", and "place of production" instead of the more usual "workshop". The latter term, of course, could refer either to a single room, or to a larger geographical area (a city or a region). The great advantage of these terms is that they both name the things we observe and form a good springboard for further research on what it all means: the reconstruction of the process of jewellery making in ancient Macedonia.

Those pieces which belonged to a pair, and which were therefore evidently products of the same goldsmith, should be studied individually. On the one hand this is motivated by the fact that the goldsmith made every single piece separately.

On the other hand this approach allows us to identify not only the mannerisms typical of a given hand, but also to define the range of variation possible within an individual craftsman's established technique. I applied this approach also in the documentation of the jewellery.

A separate and detailed technical analysis was therefore carried out on each piece. In the case of jewels which belong to the same type I also carried out comparative analysis of the pieces. This involved consideration of their whole structure, each of its structural elements, the details of each element, and how these were made and put together. The comparative technical analysis made it clear that a type in every case is made with using the same *schema*, i.e. the main structure and structural elements are identical but the additional elements can change. The making of the latter can be influenced by several factors, like the goldsmith's manual dexterity (rustic or meticulous decoration), the quantity of gold can be used for its manufacture (solid or hollow) etc. Comparative technical analysis of details of individual pieces has shown that this method will allow us to identify specific characteristics which are as it were compulsory for anyone making a given type of jewellery – that is to say: the characteristic features of the type – and to separate these features from those which are open to free variation, and which give some scope for the demonstration of individual skill. The latter can help to identify both goldsmiths and places of production. For the purposes of attribution, forms resulting from characteristic automatisms, marks left by characteristic tool-use, and particular details whose execution points to the maker's meticulousness, or which test the very limits of his physical abilities, can all facilitate the identification of particular hands. The design or construction of a structural element or of a smaller part, and application of a technical trick can, however, be a characteristic feature of individual goldsmiths and also of particular places of production (Dági 2006).

Documentation of the state of the objects also has an important role in studying jewellery. Ancient damage and repairs, traces of use or absence of those can give further information about the history, dating and function of the jewellery. Observation of modern damage and restoration is also essential to the uncovering and reconstruction of the original, that is to say the ancient state of the pieces of jewellery. In some cases the state after restoration proved to be the result of the restorer's or the archaeologist's imagination about the object, and did not restore the original state of the piece.

Today archaeometrical investigations also form an integral part of studying jewellery. The chemical composition of the raw material of the jewellery studied here has not yet been examined, and I had no possibility to make this kind of examination either. Thus I could only document the visual characteristics of the gold in case this was different from the usual yellow colour or the homogeneous material of the gold. Silver-like, most probably PGE-inclusions can be found in

the raw material of several pieces. Observation of these inclusions is important as they can give information about the provenance of the gold. Their presence in the material refers to the alluvial origin of the gold, i.e. the gold was extracted from a river (Craddock 2000). So we can reduce the number of gold deposits which might be the sources of the material of these jewellery. Later on using archaeometrical investigations it will be possible to determine the provenance of gold more precisely than now, by which we might also get closer to the identification of the place of production. Due to the research executed in the last decades we also have comparative results (see above). These indicate that jewellery found in sites of Central Macedonia were made of gold extracted from the surrounding gold deposits.

To sum up: I have blended three kinds of approaches during the examination of the objects: the approach of the archaeologist – art historian, the approach of a goldsmith and a conservator. By thorough examination of the manufacturing technique and the state of the jewellery we can reply to archaeological and art historical questions: through their help we can identify goldsmiths and perhaps places of production. These can also give information on the use and the function of the objects, and thus we can conclude to the correlation of the dating of the manufacture and the burial. Observation of the characteristics of the raw material can give a springboard to the identification of the provenance of gold, and in conclusion to the localization of the place of production.

### **III. The structure of the dissertation**

The analysis of the jewels is introduced by the exposition of the gold deposits and a summary of research history on the goldsmith's craft of Macedonia (Chapter I). In the treatment of both a significant role is given to outlining the new picture of Macedonian goldsmith's craft shaped by the archaeological, archaeometrical and archaeometallurgical research of the past decades.

The main focus of the dissertation is the analysis of the jewels (Chapter II). It includes the object catalogue ordered by type, preceded also per type by the research history of the individual pieces and followed by their comparative analysis, the conclusions drawn therefrom (determining the characteristic features of the type and the maker; characterising the maker of the given pieces; usage, function), and a summary. The chapter dealing with the conclusions drawn from these is based on that (Ch. III). This contains three sections: presenting the technical characteristics observed on the jewels, discussing the connections recognised between individual pieces (identical hand, identical place of production), and the conclusions as to dating drawn from the traces of wear detected on the jewels.

In the last chapter of the dissertation (Chapter IV), I give an overview on the question of the continuity of the goldsmith's workshops operating in Macedonia, taking the latest research results into account. The dissertation is completed by a short summary (Chapter V).

Two Appendices are an integral part of the dissertation (Chapter VI). In the first one the method of studying jewels I elaborated is presented through a case-study: applying the comparative technical analysis I was able to prove that a golden myrtle branch inventoried as a chance find in the Archaeological Museum of Thessaloniki belongs to the myrtle wreath of tomb B at Derveni (Dági 2012). In the second Appendix I discuss the long forgotten jewels of Sedes tomb A, at the same time identifying the wreath wrongly published as belonging to the tomb.

The catalogue of the group of finds (Chapter VII) serves the presentation of the context of the jewels. I present and illustrate the complete material of the tombs of Stavroupolis and Sedes, so far published in Greek only. From the material of the Derveni tombs, published in Greek but with a lengthy English summary, I mention and illustrate those grave goods only which are relevant to the comparison with the other two tomb groups.

The dissertation has a technical glossary (Chapter VIII), tables (Chapter IX), an index (Chapter X), and the list of sources for the illustrations (Chapter XI).

The maps and other illustrations as well as the picture tables belonging to the jewels are included in volume 2.

## **Gold deposits**

The ancient gold deposits of Macedonia as well as Thasos and the western part of Thrace which are closely related from the point of view of gold, have long been known from the written sources. The sources mention the Pangaion, Thasos and the gold mines of its *peraiá* around Skapte Hyle and Krenides, in Paionia the gold mines of mountain Dysoron and the river Echedoros (today Gallikos), and along the Strymon river the gold mines around Amphipolis. They are silent about the Chalkidiki peninsula.

Due to the ever more intense geological, archaeological and archaeometrical research of northern Greece in the 20th century, it has become possible to identify some of the uncertain deposits mentioned in the sources, and to draw a more precise picture of the ones long known.

Skapte Hyle was located in the Pangaion and the territory to the south for a long time. However, through the intense research from the 1970's, based on the traces of metal exploitation, the geological, archaeological and historical data, the scholars presumed the precious metal mines of the Thasos *peraiá* to be north-east – east of Kavalla, on the southern side of mountain Lekanis which extends as far as the river Nestos. This was confirmed by the systematic geological-archaeometrical research conducted since 1984 (Vavelidis et al. 1996). Between Kavalla – Philippi

and the Nestos approximately 150 prospects have been identified and the traces of mining activity in antiquity have been found in a dozen places: surface cuts, slag heaps from processing the ore, mining galleries and stoas. It was thus possible to show that already in the 5th century BC significant mining activity took place in the region. According to the Greek scholars the mine found at Mandra Kari was just one of the gold mines of Skapte Hyle mentioned by Herodot. And the mines of Krenides may probably be identified with the mines found around the towns of Zigos and Krioneri east of the Philippi.

The ancient mines were found on Thasos in accordance with the account of Herodot, on the Samothrake side of the island, around the modern town of Kinyra. Further, a gold mine has been identified also at Limenas, under the acropolis of the ancient city.

Also at the river Gallikos, some 40 km east of Thessaloniki, the traces of ancient gold exploitation have been identified. From the analysis of the bed-silt of the river and of its tributaries it has been ascertained that the gold content in the bed-silt comes from the mountains of Vertiskos and Kroussia east and north-east of them. The latter is situated next to the Dysoron mountain mentioned in the ancient sources. PGE-inclusions (platinum group elements) were also detected in the gold particules from the bed-silt. I have recognised such inclusions in several jewels from Derveni and Stavroupolis as well.

Scholars have identified the traces of ancient precious metal mining also on the Chalkidiki peninsula. Gold was mined on the north-eastern part of the peninsula, on mountain Stratonikos behind ancient Stageira (village of Olympiada today), around Metagitsi situated by the Sithonia peninsula, and further, the precious metal content of the rivers south of lakes Koroneia and Volvi was exploited in antiquity. Based on the technological characteristics of mining and the traces of metal exploitation, the activity goes back to the 6 – 5th centuries BC at Metagitsi (Vavelidis 2007; Vavelidis – Andreou 2008). On mountain Stratonikos – based on the coins of Philip II and Alexander III found in the mining galleries – systematic mining activity must have begun in the mid 4th century BC or slightly afterwards. The archaeological finds from Stageira, on the other hand, and the traces of metal exploitation detected around the city suggest that mining activity might have started at least in the 6th century BC in this region.

Much fewer traces of mining activity have been found on mountain Pangaion than what one might expect based on the antique sources. Traces of ancient exploitation have been detected around Nikisiani on the north-eastern part of the mountain, around Ofrinio on the south-western side, and around Chrisoupolis on the southern side. Along the Strymon traces of exploitation have been detected in the alluvial deposit not only around ancient Amphipolis, but also around Nigrita on the other side of the river some 30 km to the north, and further north, around Chimaros near lake Kerkinis.

The identification of the mines on mountain Dysoron is questionable. The ancient mountain Dysoron might have been identical with the modern mountain, or else, the whole ridge of hills bordering the Strymon valley from the west was referred to by that name. Based on the research of M. Vavelidis it is certain that there were gold mines in antiquity also west of lake Kerkinis, not far from Chimaros on mountain Kroussia, at the origin of the river Gallikos at Pontokerasia.

Based on systematic research (Vavelidis 2007) it has become evident that in central Macedonia, around the Thermaic Gulf, much more lesser or greater gold deposits were known and exploited in the archaic, classical and hellenistic periods than what the ancient written sources mention. This can be further confirmed by the large number of golden jewels of the cemeteries (e.g. Pydna, Aiginio, Sindos, Aghia Paraskevi) excavated in the region in the past decades. An important question, also for localising the goldsmith's workshops, is whether the provenance of the raw material used for these jewels can be determined.

M. Vavelidis and colleagues have conducted archaeometrical investigations on some of the jewels found at excavations in Sindos, Aghia Paraskevi, Akanthos, and Pydna, and the results were compared to the composition of gold examined from the gold deposits near the sites (Vavelidis – Kesisoglou – Mirtsou 1996; Vavelidis – Tsigarida – Mirtsou 1997). It was ascertained that the composition of the samples from the 6 – 5th century jewels from Sindos is similar to the composition of gold found in the alluvial deposit of the river Gallikos and its tributaries. The chemical composition of the 6 – 3rd century jewels from Akanthos, on the other hand, is similar to the gold from a river in mountain Stratonikos, some 20-25 km north of the town. The raw material of the archaic period jewels in Aghia Paraskevi is similar partly to the gold around Nigrita and partly to that from Gallikos. In some jewels PGE-inclusions were also detected.

Based purely on the chemical composition of the PGE-inclusions, however, the place of origin of the gold cannot be determined. German scholars published the method (Junk – Pernicka 2003) developed on Celtic gold coins through which it is possible to determine the provenance of the gold, by determining the osmium isotope ratio of the PGE-inclusions and gold deposits. Namely, the characteristics of the osmium isotope ratios of the gold deposits are preserved also in the gold artefacts.

### **Analysis of the jewels and conclusions drawn from that**

The thorough examination of the manufacturing techniques and condition of the objects under microscope, and a comparative technical analysis of the ones belonging to the same type have brought new results to their attribution, function, usage, manufacturing techniques, and in some cases the time of production.

### *Technique*

Manufacturing techniques of the jewellery found at Derveni, Sedes and Stavroupolis largely correspond to the techniques hitherto recognised on Greek jewellery. The pieces studied mostly consist of elements made of sheets and wires. Gold sheets were shaped by hammering into the required dimension and cut into form with a blade with a straight, sharp, wedge-shaped edge. In some cases tubes made of sheets were formed by using a kind of draw-plate. Plastic elements could be embossed in different ways: the sheets were pressed into a negative form, or were beaten into a negative form with a positive tool. Several figural elements were shaped also with the using of a negative form. Only one piece, namely the Herakles-head 'pendant' from Tomb Z of Derveni was made with using a positive form. Wires were used for making structural and also decorative elements of the jewels. Thick, plain wires are solid and were made of rectangular rods. For making thin, plain wires, besides rods, strips of sheet metal were also used. Simple and complex varieties of the loop-in-loop chain, which was the favourite chain type in antiquity, can be found in the jewellery studied here. Casting was only used for making solid gold fingerrings and bow-shaped fibulae. This technique was applied due to practical considerations since solid objects can get damaged in a lesser degree during wear than hollow ones.

Basically two kinds of decoration can be differentiated on pieces of jewellery made of sheet gold: one is formed into the surface of the sheet, the other one is applied to the surface. Chasing, punching and engraving were used to make a decoration into the sheet. The latter one was applied mainly to jewels made with casting but sometimes it appears also on pieces made of sheet gold (no. 15). Granulation and filigree are the most frequent decorative techniques used to attach to the surface of the jewellery. Granulation was not used for the decoration of large surfaces (the only exception is the pair of earrings from Tomb Z of Derveni). In most cases only one or a few granules were placed on the surface. In accordance with the goldsmith practice of this period, filigree decoration can be found more frequently on the jewels studied. I could detect the following types of filigree wires on these pieces: plain, strip-twisted, rod-twisted, spool wire, beaded wire, roop wire, and flattened spool and beaded wire.

Enamel is a polichrome decorative technique used to decorate the surface of jewellery. Only one type, the so-called filigree enamel can be found on these pieces (nos. 2., 9., 18., 18bis, 53.). It was applied solely on small surfaces. Precious stone (cornelian) decorates only the two fingerrings of Tomb Z from Derveni (nos. 43-44). Polichromy can only be proved on 7 pieces of jewellery and only small surfaces are decorated with enamel or precious stones. Thus gold dominates the jewellery from Derveni, Sedes and Stavroupolis and decoration made of gold or formed into the gold make these pieces elaborate.

The fixing of the elements of the jewels could happen in different ways. Mechanical joining methods, like wiring, the use of rings or a piece of chain were used to fix the elements together. Besides these usually soldering and in a few cases forging was applied to make a stable joining. For fastening the jewels to other objects, rings, threading or in case of mounts nails and tenons were used.

Goldsmiths could apply technical tricks or special tools to simplify the manufacture of jewellery or to achieve a more beautiful and precise forming of them. Technical tricks could be widespread or could be known by few people, or perhaps by only one goldsmith.

During the microscopic examination I have managed to identify technical details so far undocumented on ancient Greek jewellery. One of them is the so-called narrowing cut, which was probably not widely spread. On every piece where it was applied (on bow-shaped fibulae and the fragment of a gazelle's-head hoop earring from Sedes, on the pair of mounts with floral decoration and on the biconical octagonal bead from Stavroupolis), it served to solve the same problem: diminishing the width and avoiding the waving of the arched, truncated cone or hemisphere shaped sheets.

In several cases the use of preliminary sketches made the making of jewellery easier. Wreaths from Derveni and Sedes, the strap from Tomb B of Derveni and the octagonal mount from Stavroupolis show the typical thin incised lines of a preliminary sketch. On the central flower of the myrtle wreath from Tomb Δ of Derveni and on the base sheet of the Stavroupolis mount these are constructing lines, as well, since they helped to construct geometrical shapes, namely an octagon and a circle divided into eight parts. The lines incised along the longitudinal sides of the Derveni strap are added lines for cutting the arches decorating the edges of the strap. On the myrtle and olive wreaths of Derveni Tomb B and A and on that of Sedes Tomb A, the preliminary sketch was used for making elements in large quantities like the leaves.

Because of the tool-marks on some pieces from Derveni and Stavroupolis I could distinguish different kinds of cutting tools which made the cutting of sheets easier. The use of an arch-shaped blade can be identified on the strap from Tomb B and on the pair of earrings from Tomb Z of Derveni, and a tube-shaped blade was used for cutting the elements of the central flower on the myrtle wreath of Derveni Tomb Δ. According to the bibliographical data, coarse metalworkers' shears had been in use since the Hellenistic period and scissors were applied probably from the Roman period onwards in metalworking. We have no data on any kinds of saw used in goldsmith's craft or in metalworking. The tool-marks on jewellery from Stavroupolis, however, show that both kinds of cutting-tool seem to have been used: the strap found in tomb of Dagli street was presumably cut with a pair of scissors and the mounts from both tombs of Stavroupolis were probably cut with some kind of a saw.

In case of the pair of earrings with disc and boat shaped pendant from Tomb Z of Derveni the goldsmith applied a technical trick for the horizontal bending of the wide strip of sheet. For this he used a beaded wire flattened by hammering instead of a strip of sheet. The jagged edges of the flattened beaded wire made it possible to bend the strip horizontally more easily and without damage than a simple strip of sheet.

Another technical trick was used to make the lion's-head hoop earrings and necklaces from Derveni and Sedes. The edge of the animal head or the connecting element behind it was bent at right angle in order to make the soldering of the two elements easier.

On several jewels I have managed to observe ancient repairs which were executed during their manufacture. The goldsmiths who made those pieces mended the damage arisen during manufacture and corrected the details mistaken in this way. This kind of repair was executed directly after the damage thus the raw material used for it is the same as was used for the making of the jewel. The most frequent problem arose during the soldering of the elements of the jewellery, when the piece melted and wore into holes. These kinds of damages were repaired by using patches, i.e. pieces of sheet metal which were soldered onto the missing parts. This kind of repair, for example, was applied several times on the jewellery of Tomb Γ at Sedes.

The so-called *diatrita* or openwork technique is considered to be the popular decorative technique of Roman and Byzantine jewellery in the 3rd – 7th centuries AD. I could identify, however, this technique on the mount-pair found in the Oraiokastrou street tomb and on two mounts from the tomb of Dagli street of Satvroupolis.

Analysis of the technical details also gave new information on the process of jewellery making. Goldsmiths in antiquity also planned their work before making a piece of jewellery. By the help of planning they harmonized the demands of the commissioners and the technical realization of the jewels. The goldsmiths planned the elements of the jewels and also their size, and how they would make them and place them on the jewel. The details which required complicated or special technical solutions were also planned in advance because those could affect the making of the whole object. A piece of jewellery is the result of a planning process which means that the complete jewel itself can allow us to reconstruct the concept of its making. All this can be recognised on the three wholly preserved myrtle wreaths (nos. 1-3 ). Their makers planned the size of the support of the wreath, the arrangement of the branches and also the arrangement of the leaves, flowers and berries on the branches, and all the details of these elements. The making of the loop-in-loop chains (nos. 15, 22, 28) was also pre-planned because the thickness and the width of the chain influenced the size of the

other elements of the necklace, or quite the contrary, the chain was formed to fit the other elements.

### *Attribution*

Similar technical examination of the bull's-head hoop earrings in the Collection of Classical Antiquities in Budapest proved that comparative technical analysis of pieces of jewellery belonging to the same type will allow us to identify specific characteristics which are as it were compulsory for anyone making the given type, i.e. the characteristic features of the type, and to separate these features from those which are open to free variation and give some scope for the demonstration of individual skill, that is to say which can be the characteristic features of both goldsmiths and places of production.

Proceeding from this in case of the jewellery types found in the tombs at Derveni, Sedes and Stavroupolis – mainly based on my observations on these objects – I have collected and separated the technical details which can be characteristic of the given type or maker or place of production. I have listed them in the dissertation. In some cases I could define which details might be features of goldsmiths or of places of production. Generally said, forms resulting from characteristic automatisms, marks left by characteristic tool-use, and particular details whose execution points to the maker's meticulousness and elaborateness, can all serve to identify particular hands.

Special technical tricks can be typical of a maker and a place of production, as well. For example, among the technical tricks observed on the jewellery of the three tomb groups, use of preliminary sketch probably can be attributed to a place of production in a wider sense, i.e. of a region or an area, because it can be identified on wreaths from Derveni and Sedes (nos. 1, 2, 4) and also on the mount from Stavroupolis (no. 53). We can interpret the narrowing cut in the same way because it can be found on bow-shaped fibulae from Sedes (nos. 32-34), a mount and a bead of Stavroupolis (nos. 52 and 25), and also on the gazelle's-head hoop earring dated to the middle of the 3rd century BC from Tomb A of Sedes (no. 12).

I have managed to prove by the help of the comparative technical analysis that a gold myrtle branch inventoried as a chance find in the Archaeological Museum of Thessaloniki and the myrtle wreath from Tomb B of Derveni were made by the same goldsmith, and that the myrtle branch originally belonged to this wreath (Appendix 1).

In two cases I could attribute jewels of the same type to the same goldsmith. Three sheets with embossed figural decoration found in the Dagli street tomb in Stavroupolis are probably the production of the same hand based on their same manufacturing technique, the same characteristic tool-use observed on all of them and their similar measurements. Fragments of double pins found in Tomb B at Derveni can be attributed to a single goldsmith because of their uniformity of

shapes, the same making technique of their heads and the wirings of the heads which were the results of automatical movements.

In several cases I could also distinguish makers of pieces belonging to the same type. Double pins from Tomb Δ at Derveni and from the Dagli street tomb in Stavroupolis can be attributed clearly to different hands according to similarities and differences of the manufacturing technique and the design concept of the jewels. The double pin of Stavroupolis can also be attributed to a different place of production from the pins from Tomb B at Derveni. We can point out clear differences among the makers of the myrtle wreaths mainly based on the construction concept of the whole wreath and that of its elements, and on the technical details. From these we can come to the conclusion that different goldsmiths made the Stavroupolis and the two Derveni wreaths (nos. 1-3). All the three goldsmiths knew very well the schema of the manufacture of a myrtle wreath, which points to the same place of production. Comparative technical analysis of further gold myrtle wreaths from Macedonia will allow us to define whether this place of production means a workshop, a smaller region (Central Macedonia) or a larger area (Macedonia). According to the differences between the making techniques of the same elements and between the concepts, I could differentiate the two goldsmiths who made the two lion's-head hoop earrings from Derveni and Sedes. By the different technical details of the same structural elements (e.g. the hinge-plate into which the pin of the fibula is fixed), we can distinguish the two makers of the bow-shaped fibulae from Derveni and Sedes.

Based on the details of the manufacturing technique, I have also managed to attribute different types of jewellery to a single hand. I suppose that the same goldsmith made the diadem, the lion's-head hoop earring, the bow-shaped fibulae, the pendant and the necklace found in Tomb Γ at Sedes. Technical features typical of him are the uneven quality of the filigree wires used on the jewels, the unprecise joining of the elements and the cutting of sheets, the fixing method used to fasten the two halves of figural elements, and additionally he had a problem with the soldering, and he used patches to hide the damages and defects on the jewels. According to the simultaneous existence of all these features can the pieces of jewellery mentioned be attributed to the so-called 'Sedes' goldsmith. The place where he worked is so far unknown. I think we can proceed with answering this question after the examination of further jewellery from ancient Macedonia.

#### *The time of usage, burial, and production*

The gold jewellery found in tombs, especially if made of very thin sheets, often pose the question whether such pieces were made for everyday use or explicitly for the burial. This question is relevant not only for the burial rites but also for the dating of the jewellery. The presence or the lack of traces of wear, i.e.

damage, repairs, abrasions, help us to determine whether the making of the jewellery coincided or not with the time of the burial.

By usage we chiefly mean their everyday usage, but I cannot leave out their usage during the funerary ceremony either. They could well have been damaged during such occasions and even repaired. In such case, traces of wear could not have arisen, as their use in the burial rites lasted only a few days. Thus, it could happen that a newly made piece got buried in a damaged or even repaired state. In the late classical and early hellenistic Macedonian burials, and in the tomb groups examined here, it is quite common that the gold jewellery melt to a small extent, became discoloured or its surface became covered with ash. These features suggest that these pieces of jewellery were worn by the dead or decorated the burial clothes during the cremation or at least at the beginning of it. I observed such damage on 10 pieces (nos. 3, 4, 5, 6, 10, 18bis, 21, 38, 39, 49).

Almost half of the analysed artefacts (24 out of 60) were also used in everyday life. This is confirmed not only by the traces of wear and the repairs made during their use, but also by certain technical details and damage, the remains of a carrier object and fastening pieces, as well as by the traces of the fastening itself. In the case of the myrtle wreath of tomb B at Derveni (no. 1) the hardness of the sheet of the leaves points to everyday use. On the basis of the traces of abrasion and repairs, it can be said that a piece of jewellery had been made before the burial. The extent of abrasion is influenced also by the quality of the gold, the intensity and duration of the usage. There was no analysis made to determine the quality of gold of the jewellery from the three tomb groups, hence on the basis of the abrasions only, we cannot estimate how long they had been used before. This means we can but create a relative chronology at present.

On the basis of what I have hitherto said, tomb Z at Derveni is the only one, where all the pieces of jewellery had been used to some extent before the burial. The jewellery in tombs Δ and H at Derveni, and probably some necklace elements and cloth-ornaments in Tomb E were put into the tomb as new, used only during the funerary ceremony. In Tomb B both new and used pieces were placed. The undecorated, solid fingerring and the double pins were new, while the wreath, the sheet-diadem and perhaps the band, as well, were used pieces. In the case of the Tomb in Dagli street in Stavroupolis the double pins and the sheets decorated with a lion figure proved to be new, and the band with the guilloche pattern and the mounts did not show any trace of usage either. The tomb from Oraiokastrou street contained both used and new jewellery. The myrtle wreath, the sword-mount, the pair of mounts with floral decoration and the bands with guilloche pattern were also used in everyday life. The following pieces found in the tomb were made exclusively for the burial: the bead in the shape of a Heracles-knot, the pendant that presumably belonged to a breast chain, the rosette-shaped clothes-ornaments, and the biconical octagonal bead, as well. In Sedes Tomb A there were both new

and used jewellery. Used pieces were the necklace with the lion-heads, and the fragments of the gazelle's-head hoop earring. The astragalos and the tube-shaped bead, that originally must have formed a single necklace, were placed into the tomb as new. The myrtle wreath that was burnt in the funeral pyre cannot be determined whether it had been used in daily life before. Among the jewellery of Tomb Γ there is only one piece that shows traces of permanent use before the burial: the solid gold fingerring decorated with a kourotrophos scene. All the other pieces (diadem, necklace, bow-shaped fibulae, pendant, lion's-head hoop-earring) have probably been made right before the burial, for funerary purposes.

We can observe in contemporary Macedonian burials that objects made earlier (e.g. metal and ceramic vessels) were also placed into the tombs. We have such examples also in our three tomb groups as well (Tomb B at Derveni, Dagli Street Tomb in Stavroupolis). I think the used jewellery of Tomb Z at Derveni also belongs to this category. According to the repairs executed in different times, the pair of earrings with disc and boat shaped pendant must have been made earlier than the time of the burial. We do not know, during what period the repairs had been made, but it is unlikely that they would cover more than a few decades. I do not find it plausible that this pair of earrings could have been made earlier than the beginning of the production of this type, that is, around the mid-fourth century BC. A much earlier find is the scarab in the swivel ring of the tomb. The stone shows extensive traces of wear, which are greater in extent than on the ring made of gold, although the stone is far more resistant to wear. It means that the stone had been used elsewhere earlier. On the basis of its shape and the extent of the traces of wear the scarab can be dated even to the 5<sup>th</sup> century BC.

On the basis of the extent of traces of wear and the amount of scratches, the fingerring with inscription in Tomb Z must have been used for a long time before it was placed into the tomb. The inscription (KΛEITAIΔΩPON) is later than the damages, thus it is most likely that it was inscribed onto it little before the burial, and hence the ring really was a gift for the dead person.

### *Function*

The technical analyses proved about some pieces that their function had been different from what earlier scholarship had suggested (Pfrommer 1982, 142.; Themelis – Touratsoglou 1997, 89., 127; Romiopoulou 1989, 209-210.). These are the following:

- In Tomb B at Derveni the sheet diadem was probably an ornament piece on a Macedonian/Phrygian type helmet or on a Phrygian cap. The latter is more likely, as no metal helmet was found in the tomb.

-In Tomb Z the Heracles-head 'pendant', on the basis of its size, weight, the opening on its bottom, the holes on its neck and the remains of a bronze fixing wire, was made neither for a necklace, nor for an earring. It is more likely that it

was a decoration on a rod-like object. The suspension ring can determine its purpose, or even point to a secondary use (as amulet?), if it will be later confirmed that it was not soldered to it at the same time of the production.

-According to the holes that served for fastening and to its size, the band of Tomb B at Derveni is surely not a diadem. One of its ends is broken, which means the band was originally longer. Probably it was placed in the tomb folded. Perhaps originally it was an ornament for a cuirass.

### **The continuity of the goldsmith workshops in Macedonia**

The existence of ancient goldsmith workshops could only be proved beyond doubt if we found the tools necessary for the making of jewellery, raw materials, scrap and waste material, half-made or finished products. Since these are lacking, we can only attempt to suppose their existence indirectly. Most often the operation of such a workshop is suggested where a larger amount of jewellery comes to light. We can get closer to their identification by the presence of a greater amount of jewels which share a similar repertoire of decorative motifs and techniques and are similar in style. Further on gold deposits and their exploitation can also point to the functioning of goldsmith workshops.

The northern Greek territory of ancient Macedonia does not lack such indirect evidence. On the basis of the large quantity of gold jewellery, the Macedonian goldsmith workshops flourished first in the 6<sup>th</sup> century BC, while their subsequent revival was in the second half of the 4<sup>th</sup> century BC (Despini 1996, 29-30.). Both periods present an equally even picture of the jewellery finds. Today the first period is best represented not only by the cemetery of Sindos but also by the cemeteries of Aiiane, Archontiko, Nea Philadelphia, Aghia Paraskevi, Thermi, and Stavroupolis in Thessaloniki, as well as by the archaic tombs of the cemetery of Vergina. We know the jewellery of the second flourishing period from the tombs at Derveni, Sedes and Stavroupolis, discussed in my dissertation, and also from, for example, the Great Tumulus in Vergina, and from the tombs in Amphipolis, Pydna, Sevasti, Nikisiani and Nea Michaniona.

In addition to the finds themselves there are also written sources and the excavated mines that attest to several places of exploitation of precious metal in these periods in the area between the rivers Axios and Nestos.

Archaeometrical investigations link the excavated gold jewellery with the gold deposits. The composition of the gold jewellery of the 6-4<sup>th</sup> centuries from Sindos, Akanthos, and Aghia Paraskevi is similar to the composition of gold from the gold deposits in the area between the Strymon and the Axios. On the basis of this comparative analysis it is supposed that these pieces of jewellery were made by local goldsmith workshops, using gold originating from the surrounding area.

Today more and more jewellery finds point to a continuity between the two peak-periods in the 6<sup>th</sup> century BC and in the second half of the 4<sup>th</sup> century BC.

The gold jewellery found in the tombs at Pydna and Nea Philadelphia, for instance, well illustrate that the jewellery types of the 6<sup>th</sup> century survived in the 5<sup>th</sup> century as well. Some types, as the bow-shaped fibulae or the double pins survived up until the end of the 4<sup>th</sup> century. The bow shaped fibulae then were adjusted to the new taste of the times and in the second half of the 4<sup>th</sup> century were produced with an embossed Pegasos protome and lion-skin decoration. The continuity of precious metal jewellery production is also confirmed by the finds coming from 3<sup>rd</sup>-2<sup>nd</sup> century tombs, as well (Pydna, Aiginio, Veroia, Amphipolis, Akanthos, Kassandreia), where gold jewellery came to light in great quantities. These were, according to contemporary demands, decorated with an increasing number of precious stones, while executed with less and less technical skill.

The question arises: whether the continuity of the goldsmith workshops can be confirmed even before the 6<sup>th</sup> century BC, in the territory of Central Macedonia or Macedonia, and how far the continuity can be traced back in time? The first gold jewellery dates back to the late Neolithic period (ca.4500-3700) from the territory of Macedonia (Aravissos, Sitagroi, Dikili Tash). They were made locally, most likely of local gold. Very few gold jewellery came to light also from the Bronze Age settlements of Macedonia. There are a few known objects from the Late Bronze Age layers (ca. 1400-1050 BC) of Kastanas, by the Axios, and from Toumba in Thessaloniki. At this last site some stone crucibles were uncovered too, one of which contained traces of gold in its porous stone surface. This proves beyond doubt that in the Late Bronze Age, in this settlement, 1.5 km away from the Thermaic Gulf, gold was worked and even gold jewellery was produced. Recent archaeometrical investigations demonstrated that the jewellery from Kastanas is similar in its composition to the gold of the rivers Axios and Gallikos, while the composition of gold of the finds from Toumba is similar to the gold from the area near Nigrita and two other gold deposits in the northern part of the Chalkidiki peninsula (Vavelidis – Andreou 2008). The comparison of the chemical composition of gold jewellery from the Bronze Age with the composition of gold from the gold deposits in the surrounding area produced the same results as the analysis of the 6<sup>th</sup> – 4<sup>th</sup> century jewellery. This confirms the hypothesis that the jewellery in Central Macedonia was made of local gold, and most probably also in workshops near the gold deposits. The tell of Thessaloniki had been inhabited from ca. 2000 BC until 300 BC, but we do not have any evidence yet that there was a goldsmith workshop here operating also after the Bronze Age.

We hardly know any gold jewellery from the tombs of the Early Iron Age Macedonia. There are, however, several finds from this period that point to metallurgical activity (mainly working with bronze). For example, fragments of moulds and slags were excavated in Methone founded by the Eretrians around 730 BC at the western shore of the Thermaic Gulf. This suggests that at the end of the 8<sup>th</sup> – beginning of the 7<sup>th</sup> century, i.e. right after the foundation of the city, its

inhabitants dealt with metalworking and making jewellery. The settlement found at Anchialos, near the river Gallikos, was also Euboian, to which the cemetery of Sindos, rich in gold finds, belonged. At Anchialos the archaeologists found the remains of a coppersmith workshop active in the Geometric period.

Thus in the territory of ancient Macedonia there are traces of the exploitation and working of various metals from the late Neolithic period. In addition to the metal objects, tools necessary for their production were also excavated. Between the Neolithic period and the late Bronze Age, however, the making of gold jewellery seems to be only occasional, not a regular activity. The reason for this – besides the small number of our excavated finds – could be for example the limited knowledge of the gold deposits, of technology necessary for the exploitation, extraction and working of gold as well as the limited knowledge of the technology of making jewellery in that period.

The exploitation and processing of gold and the making of gold objects probably increased in the late Bronze Age. According to the results of excavations in the last decades in Northern Greece, we can presume that the Greek colonisation of the Chalkidiki peninsula and the surrounding area of the Thermaic Gulf preceded the colonisation in South Italy. The first colonisation phase in the sub-mycenean and protogeometric period, together with the second phase in the 8th – 7<sup>th</sup> centuries, were both dominated by the Euboians (Tiverios 2008, 1-17.). Based on the finds of tools from Methone dated to the end of the 8th – beginning of the 7th century, as well as on the analogies of the archaic Macedonian jewellery found in Euboia, we can suggest that the prosperity of metalworking and goldsmith's craft can be connected with the appearance of the Euboians in the territory of ancient Macedonia. The finds from the 8th century goldsmith workshop in Eretria as well as the jewellery uncovered in Lefkandi and Eretria show that by this time the Euboians already had the technological knowledge necessary for making gold jewellery. Recent research has shown that this relationship was not one-sided: the raw material of the Euboian gold jewellery dated to the Geometric period most likely originated from the Gallikos river. Hence it seems quite probable that the Euboians were attracted to the area around the Thermaic Gulf exactly because of the precious metal deposits between the rivers Nestos and Axios. And then the settlers, who moved into this region, brought with themselves the necessary knowledge and technology. This is confirmed also by the fact that the cemetery of Sindos, rich in gold jewellery, had been the cemetery of the Euboian settlement excavated at Anchialos.

#### **IV. The main results of the dissertation**

**1.** By the thorough study under microscope and the comparative technical analysis, I could prove that the diadem, earring, fibulae, pendant and necklace found in Tomb Γ at Sedes, were all made by the same goldsmith.

**2.** Using the same methods, I could identify further hands and places of production among the jewellery of the three tomb groups:

- the same goldsmith made the three sheets with embossed decoration found in the tomb of the Dagli Street in Stavroupolis;

- the fragments of the double pins found in Tomb B at Derveni can be attributed to the same hand;

- two different goldsmiths produced the double pins of Tomb Δ at Derveni and of the Dagli Street Tomb in Stavroupolis. The latter had also been made at a different place than the pins of Derveni Tomb B;

- three different goldsmiths made the three myrtle wreaths from Tombs B and Δ at Derveni, and from the Oraiokastrou street Tomb in Stavroupolis. Their place of production, however, is the same.;

- the goldsmith who made the wreath of Derveni Tomb B was the one who made the gold myrtle branch inventoried as a chance find in the Archaeological Museum of Thessaloniki. This means that the myrtle branch belongs to this wreath.

- I could distinguish the maker of the lion's-head hoop earring found in Tomb H at Derveni from the maker of the earring belonging to the same type found in Tomb Γ at Sedes;

- I could also make a difference between the maker of the bow-shaped fibulae from Tomb Z at Derveni and the maker of the fibulae belonging to the same type from Tomb Γ at Sedes;

**3.** I confirmed that it is possible to attribute jewellery on the basis of their manufacturing technique, that is to say technical details can also be characteristic features of goldsmiths and places of production.

**4.** Using technical examination under microscope, I could prove that the gold wreath known in the archaeological literature as the olive wreath of Sedes Tomb A was, in fact, excavated at Tsagezi, near Amphipolis. A myrtle wreath was found in Tomb A at Sedes. The following jewellery made also part of the finds of this tomb: lion-headed necklace, necklace made of tube-shaped beads and astragalos beads, gazelle's-head hoop earring. On the basis of this characteristic earring type the tomb can be dated to the middle of the 3rd century BC or later.

**5.** On the basis of archaeological and archaeometrical data I hypothesize that the operation of goldsmith workshops in Central Macedonia increased during the period of Greek colonisation as a result of Euboian impact. The Euboian settlers could bring with themselves the technological knowledge to this region

rich in raw materials. I also suggest that the goldsmith workshops may also be connected to the Euboian settlements founded near the precious metal deposits.

## **V. Papers and lectures related to the subject of the dissertation**

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