HISTORY

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Symmetry and Topology of Decorative Ornaments on a Silver Jug of the Seuso-Treasures

Abstract

Decorative ornaments of the jug from the Seuso-Treasures exhibits examples of ethnomathematics of the Late Roman Ages in Pannonia.

Introduction

The Seuso-Treasures is originating from Kőszárhegy village, Transdanubia Region, Hungary, created in the Late Roman Ages. The treasury consists of several silver vessels (dishes, jugs, pots, bowls) once probably deposited in the villa of a noble Roman aristocrat, living in a Roman Age settlement in the vicinity of the recent Szabadbattyán, Transdanubia, Hungary. This collection exhibits beautiful ornamental and figural adornments on the vessels and ornamental geometry may prove the rich set of ethnomathematical knowledge of the craftsmen of that age.

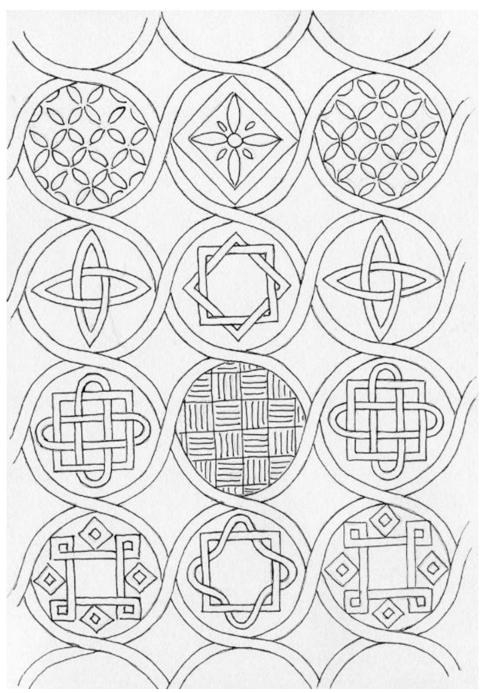


Fig. 1. Detailed outstretched drawing of a section of the surface of ornamental adornations on the famous jug of the Souso-Treasures which we call jug of ethnomathematics in Pannonia during the Roman ages. Symmetry of the background woven tendril ssystem on the jug is p4, however, in the cells p4g and p4m patterns were also placed. Various knots are also visible.

In the book of Éva Hajdú: A Seuso-kincs (The Seuso Treasury) there are excellent photographs of the vessels on which the geometry of ornamentation can be studied. There is a jug on page 18, which is covered by geometric figures placed in a woven p4 structure, which forms a framework and cell system (Fig. 1.) In the cells formed by the woven tendrills there are several simple but interesting knot types and several plane symmetry patterns.

In my earlier books, *Symmetry and Structure Building* (1990) and *Eurasian Ethnomathematics* (2011), chapters are devoted to the plane symmetry patterns and simple ornamental knots. Here we use them as background knowledge for the analysis of the patterns and knot in Roman Age Pannonian ethnomathematics.

Analysis of the plane symmetry patterns

There are 3 different types of plane symmetry patterns on the surface studied. Both of them have rotational symmetry points with 4 fold rotations but the mirror symmetry is gradually appearing in the three cases.

p4 is the symmetry of the woven frame (Fig. 2.).

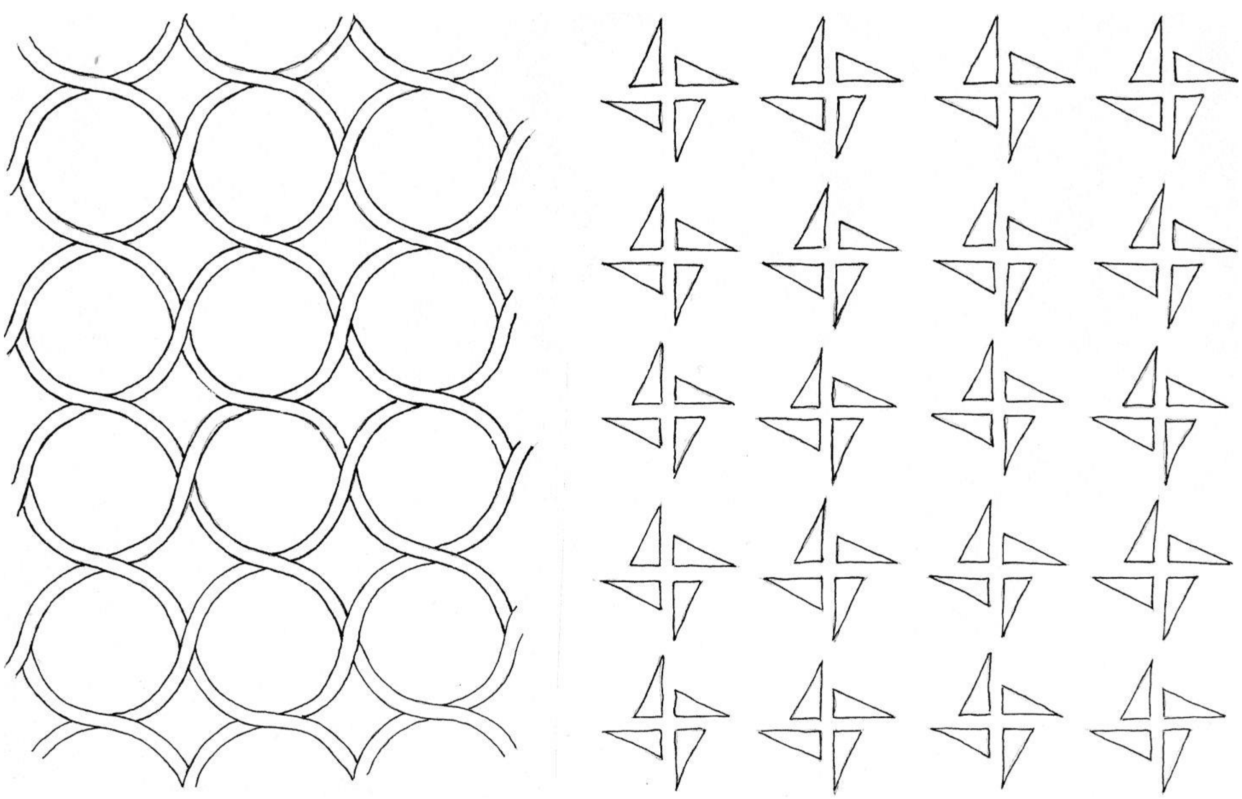


Fig. 2. Structure of the woven frame on the Seuso ornamental jug. Symmetry of the pattern can be shown by the skeletal pattern built from triangles. This plane symmetry pattern has no mirror symmetry at all.

If we make a matrix of the position in the 3X4 cell pattern of Fig. 1. we can give name to the patterns in the cell positions.

1.1	**1.2**	**1.3**
2.1	**2.2**	**2.3**
3.1	**3.2**	**3.3**
4.1	**4.2**	**4.3**

The corresponding patterns in the cells can also be given as a summary of the following analyses.

p4m	**D4**	**p4m**
C4	**C8**	**C4**
C4	**p4g**	**C4**
C4	**C4 (~C8)**	**C4**

Fig. 3. Structure of the woven frame in the 3rd row of the Seuso ornamental jug: p4g. In the centre the skeleton of this pattern can be seen. On the right the classical weaving structure pattern is shown.

The classical weaving technology produces the textile pattern with p4g plane symmetry type (Fig. 3.). Substituting the sections of the visible thread with S (instead of I), we can receive a plane symmetry pattern without mirror symmetry: a p4 type one (Fig. 2. and Fig. 4.). So the relation of the tendril frame pattern on the jug (Fig. 2.) can be deduced from a simple woven textile pattern (Fig. 3.) by reducing its symmetry, by violating its mirror symmetry.

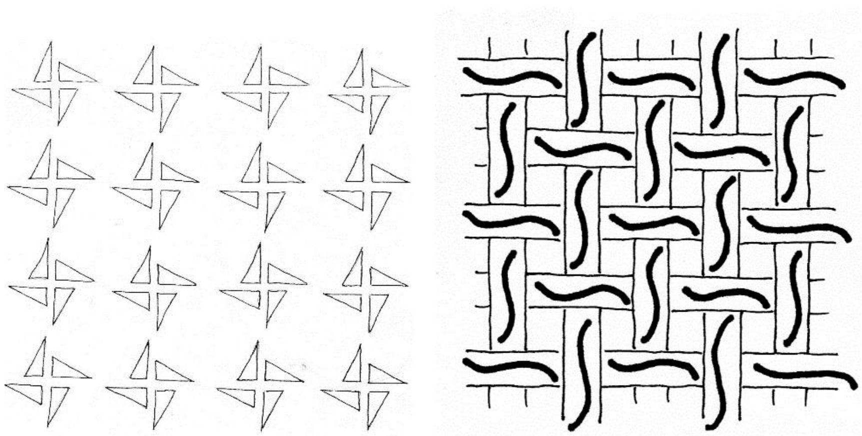


Fig. 4. Structure of the woven frame of the Seuso ornamental jug: p4, and the way it can be transformed from p4g woven structure by the superposition of S pattern on the visible threads, therefore p4g has mirror symmetry lines (Fig. 3.), but p4 has no such lines, only rotational centers (Fig. 4.).

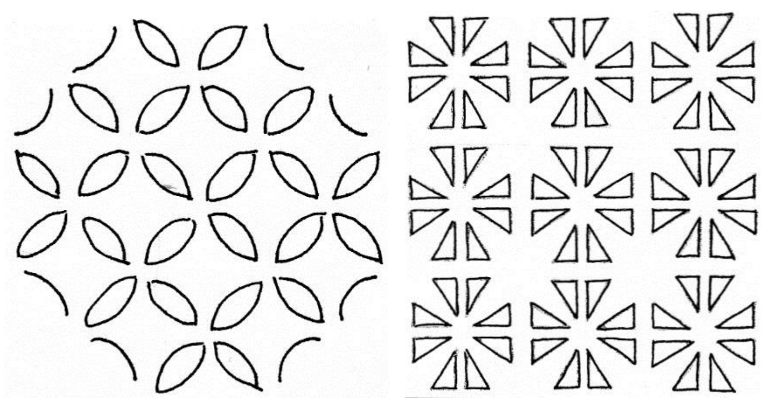


Fig. 5. On the Seuso ornamental jug p4m patterns have the highest symmetry. The figure on left can be found in the upper row on the jug. The skeleton of this pattern is the most „crowded" by symmetry elements, because it has mirror axes not only at 90 degrees rotations, but at 45 degrees rotations, too.

As a summary the unknown goldsmith master was a craftsman with a sophisticated knowledge about the plane symmetry patterns with 4-fold rotations. All the 3 different types of plane symmetry patterns which contain 4-hold rotations are represented on the surface of the Seuso jug we are studying.

Analysis of the knots

Of the 12 fields represented in Fig. 1. (and the table about the positions) there are 9 spaces filled with knots or knot-like objects. All of them contain fourfold rotational symmetry. However, most of them are variants of simple knots. Simple knots can be characterized by the number of threads which weave the knot and the number of the rotational symmetry steps. For simple knots the number of threads is defined by a method: how much threads are cut (crossed) by the radius vector starting from the centre of the knot. (The centre of the knot is the center of a circle surrounding the knot).

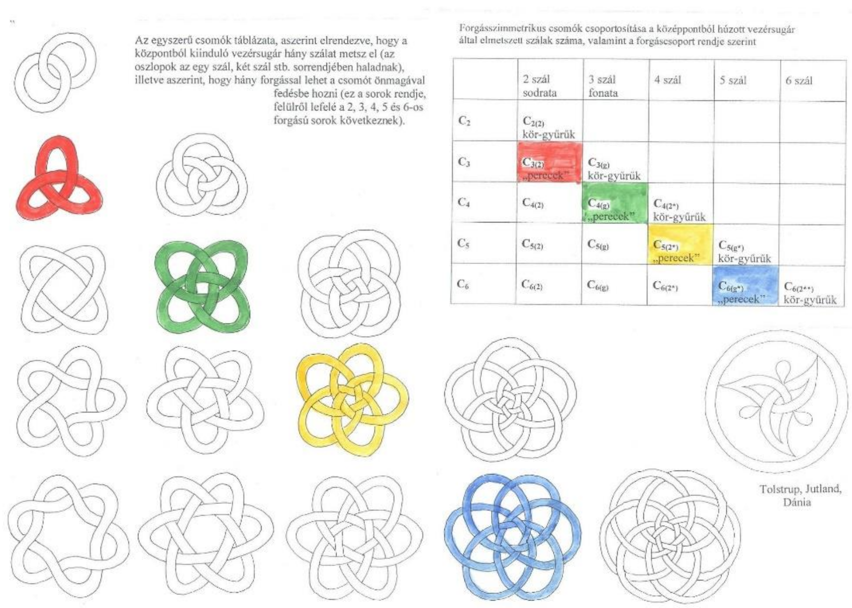


Fig. 6. The systematics of the simple knots according to their rotational symmetry (rows) and the number of threads cut by the radius vector (columns) of the knot. (page 12, Bérczi, 2011)

Fig. 6. shows the beginning of a table of systematic representatiuon of the simple knots. The number of rotational symmetries may increase with the number of threads crossed by the radius vector. In the case of simple knots all the threads surrounding the center are equivalents. The number of „returns" may result in going to pieces of the thread, because while we rotate around the center we follow a universal rule of up and down tunnel in weaving the knots. All knotted lots are represented by their straightened version, too.

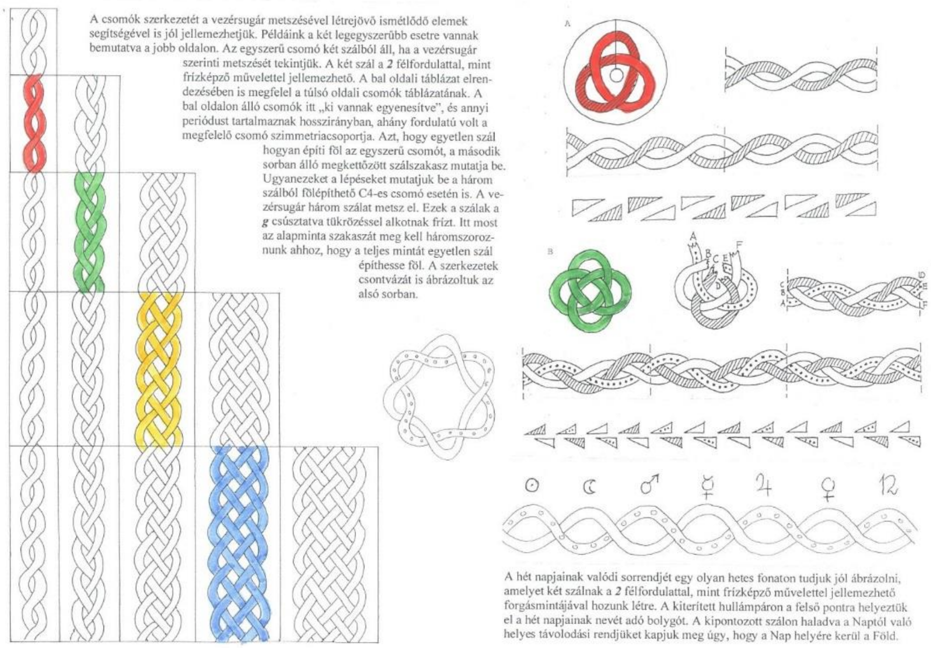
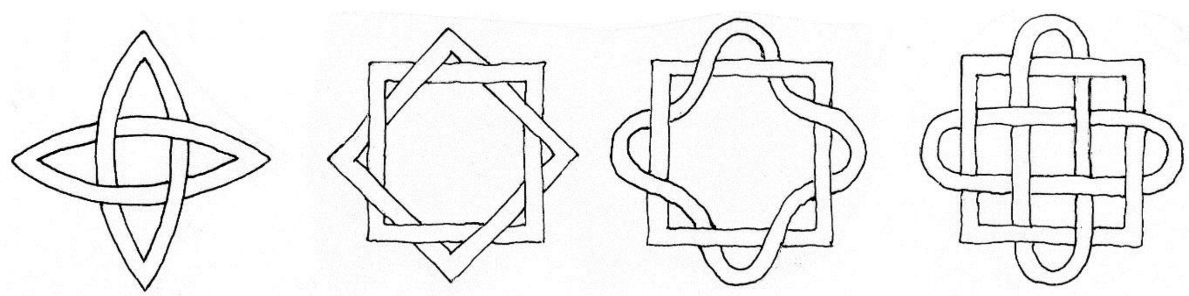


Fig. 7. The systematics of the simple knots according to their rotational symmetry (rows) and the number of threads cut by the radius vector (columns) of the knot. (page 11, Bérczi, 2011). Here the knots are straightened (left part) and some of them are divided to threads, too.



C4 C8 C4 C4

Fig. 8. The simple knots of the Seuso ornamental jug. All of them have C4 rotational symmetry, but one, the knot second from left has C8 rotational symmetry. The 3 knots from left have 2 threads woven one above the other, while the knot on he right edge has 3 threads. Topologically the two knots in the middle are equivalents.

Of the knots of Fig. 8. the one at the right edge is worth for analysis. In this knot the weaving results in breaking the knot into 3 subrings, which has no equivalent role in the knot. It will be shown, when we transform it from the rotational representation into the straightened one by circulating around the structure with the radius vector.

The equivalent topology of the three knots of Fig. 8. is easy to see in Fig. 9. The straightened version of the right side knot at bottom shows the alternation of the twisted two threads, one sinusoid and one rectangular.

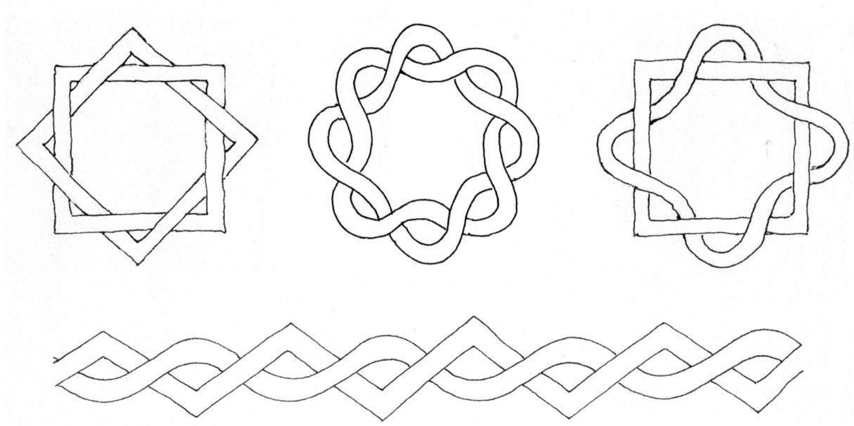


Fig. 9. The simple knots of the Seuso ornamental jug with C8 and C4 rotational symmetry (left and right side) and the corresponding C8 simple knot of the table, first column from left in Fig. 6. (if continued at bottom over 6-fol rotations). The two threads are alternating in the twisted system of the knot, only the shape of the threads changes (there are sinusoid and rectangular threads).

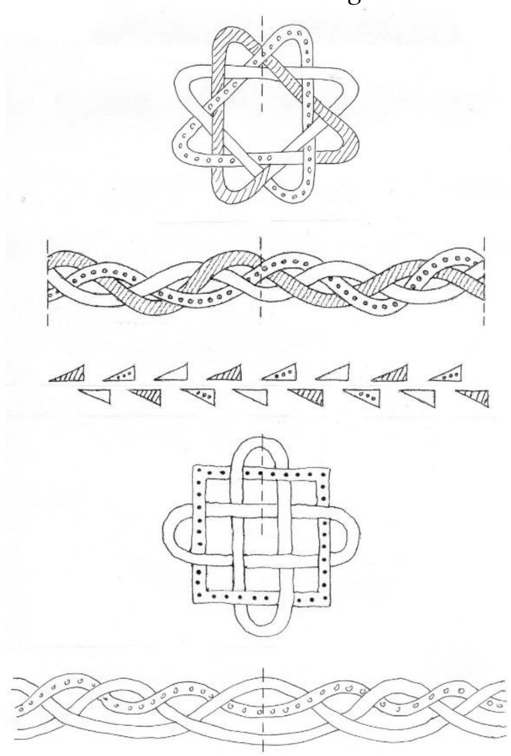


Fig. 10. Transformation of knots with 3 threads from the rotational representation (knot figure) into the straightened one (divided to threads along a line) by the crossing radius vector circulating one circle around the center of the structure.

Fig. 10. analyses the only 3 thread knot on the Sueso ornamental jug. For comparison the simple knot with C8 structure woven from 3 equivalent threads is shown. Its straightened pattern with threads exhibits the equivalence of all 3 alternating threads. They are twisted with each other by *g* (glide reflection) type frieze pattern along the line. Our Seuso knot has not this characteristics.

At the bottom figure the Seuso knot is analysed. Its straightened pattern with threads exhibits the non-equivalence of the 3 alternating threads. There is one thread (dotted) which is always running in the upper region and does not sink to the bottom. (This characteristics can be observed visually in the knot by the fact that the dotted line – the ring - stays in the outer portion of the two other rings.) The other two (empty) threads are equivalent. This non-equivalence is also visible on the knot represeantation.

Summary

The Seuso jug with geometric ornamentation has knots mainly with C4 rotational group symmetry (2.1, 2.3, 3.1, 3.3, 4.1, 4.3). There is one with C8 (2.2) and one with D4 (1.2) dihedral group symmetry. The plane symmetry patterns with 4-fold rotational symmetry are all represented: p4m (1.1, 1.3), p4g (2.2), and p4 (the frame net of the jug). This rich set of 4-fold symmetry variants proves that the goldsmith master of the jug had excellent ornamental mathematical knowledge. Ornamental art may always be a storehouse for examples for the ethnomathematical representations. The Seuso jug preserved a brilliant heritage from the master of Pannonia, from the Roman Age, in this sense, too. Therefore this jug of the Seuso Treasury gives a possibility to enjoy beauties of geometry and reveal ethnomathematics of the Roman Age.

References:

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