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The Secret Geometry of the Girona Tapestry **Curt J. Wittlin**

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THE SECRET GEOMETRY OF THE GIRONA TAPESTRY

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One of the grand monuments of medieval Catalan civilization is the majestic embroidery known as "Tapestry of the Creation", exhibited in the Cathedral of Girona, its home for close to eight centuries. Stitched on linen with colored wool shortly after 1100, it is relatively well preserved, except for its right border and its lower part. While we can easily calculate the original width to have been about 4.80 meters, its length, and the content of the missing bottom, are subject to speculation.

In this paper we will first describe the preserved pictorial elements of the tapestry and reflect upon the complete program. Then, after some information on the use of geometry by medieval artists, we will attempt to reconstruct the original dimensions of the work by analyzing the lines and curves used in determining its outlines, linking the upper and the lower sections.

A. DESCRIPTION OF THE TAPESTRY.

PRESERVED AND MISSING PARTS

The main program of the Girona embroidery is the illustration of the opening pages of the Bible by depicting various scenes of the creation story in the wide ring around the central figure of Christ the Pantocrator and by using the borders to expand on *Genesis*, 1: 14, "Let there be lights ... for signs and for seasons and for days and years", and represent in 34 squares (?) the months, the seasons, the days (?) and the Year.

The first sentence of the Vulgate is quoted on the outer circle,

beginning at the extreme left: IN PRINCIPIO CREAVIT DEUS CELUM ET TERRAM, "In the beginning God created the heavens and the earth" (see fig. 1 at point 1). This sentence continues on the circle with ET MARE ET OMNIA QUA IN EIS SUNT, "and the seas, and everything which they contain", which summarizes rather than quotes the Bible. The remainder of the circle is inscribed with *Genesis*, 1: 31, ET VIDIT DEUS CUNCTA QUE FECERAT ET ERANT VALDE BONA, "and God saw everything that he had made, and it was very good".

The angel on the left (2), standing over a black abyss, represents the "darkness upon the face of the deep", TENEBRE ERANT SUPER FACIEM ABISSI. To the right, the haloed dove in a circle on a background of waves symbolizes the Spirit of God over the face of the waters, SPIRITUS DEI FEREBATUR SUPER AQUAS (3). The biblical words which follow this line, that is, DIXIT QUOQUE DEUS: FIAT LUX, ET FACTA EST LUX, "and God said: let there be light, and there was light", are inscribed on the inner circle, also beginning at left (4). The angel symmetrically opposed to the angel of darkness bears the inscription LUX (5).

The creation story continues on the left side with the green circle on a background of waves (6). The inscription quotes *Genesis*, 1: 6, FECIT DEUS FIRMAMENTUM IN MEDIO AQUARUM, "God made the firmament in the midst of the waters". Symmetrically on the right we see how God separated the waters from the waters, UBI DIVIDAT DEUS AQUAS AB AQUIS, the FIRMAMENTUM now forming a wedge between the waves (7). Inside this sphere we find two small circles intitled SOL and LUNA, Sun and Moon, the "two great lights" God created "to rule the day and the night", as stated later on in *Genesis*, 1: 16.

The lower quarter of the ring (8) contains in its bottom half the Seas, MARE, full of all kinds of creatures, including one of the "great sea monsters", CETE GRANDIA, mentioned in *Genesis*,

1: 21. Above the waters fly the "birds of the aire", VOLATILIA CELI, all looking towards Adam, just as do "the beasts of the earth", among them a unicorn, in the compartment to the right. The artist ingeniously combined here in one scene how God created all these animals and how, later on, Adam looked them over to find a mate.

Bordering the sky and the sea on both sides we see the earth (9), covered with white flowers, the "green plants" of *Genesis*, 1: 11, 29 and 30. The "fruit tree" mentioned in *Genesis*, 1: 11 is clearly labelled as LIGNUM POMIFERUM (10). It is shown twice, once with lush, dark leaves, and once with its same three branches denuded. This illustrates the beginning of the medieval legend of the wood of the Holy Cross, which then continues in the rectangle which forms the lower part of the tapestry. The tree of Paradise was thought to have died after Eve ate its forbidden fruit. But its seeds were carried away by the rivers of Paradise, were found by Lot as three saplings, and planted by Abraham in Lebanon. King David used the grown tree in his Temple, and finally it served as Christ's Cross.¹ Forgotten for over three centuries, Saint Helen then went to Jerusalem to search for it, since her son Constantine had been told in a vision: "In this sign you shall be victorious." King Cosroe later took the Cross to Persia, but Emperor Heraclius restored it to Jerusalem. There the crusaders admired the True Cross, and, if not actual splinters of it, they could take home its legend.

To return to the story of creation, *Genesis*, 2: 20 relates how "Adam could not find a partner for himself" among the animals, ADAMUS NON INVENIEBATUR SIMILEM SIBI (11). "So the

¹ See W. Meyer, *Die Geschichte des Kreuzholzes vor Christus*, "Abhandlungen der Bayerischen Akademie der Wissenschaften", XVI.2 (1882), summarized in H. Bächtold-Stäubli, *Handwörterbuch des deutschen Aberglaubens*, vol. 5, Berlin, 1932, 487 ss.

Lord God put Adam into a trance and took one of his ribs", INMISIT DOMINUS SOPOREM IN ADAMO ET TULIT UNAM DE COSTIBUS EIUS (12).

The four corners left between the circle and the border squares are filled with clouds and the four winds, CEPHIRUS, SEPTENTRION, SUBSOLANUS and AUSTER, blowing two trumpets each into the eight directions of the wind rose.

The medallion in the top left square shows the river GEON, sitting under the tree of Paradise. Since this is only the second of four rivers mentioned in *Genesis*, 2: 10-14, we can safely assume that Pishon, Tigris and Euphrates once formed the other three corners of the tapestry.

Most (or all) other squares forming the frame represent divisions of time. The Year, ANNUS, is personified in a circle at the very top and centre. He is flanked by the four seasons, indicated by traditional activities, in addition to the Latin labels ESTAS, AUTUMNUS, HIEMS and VER.

Between the seasons and the rivers of Paradise there is a square on each side which bears no inscription and is difficult to identify. The man on the left swings a jawbone in an aggressive gesture; the one on the right holds a stick in one hand and a small animal in the other. This could well be Cain attacking his brother Abel, sacrificing a lamb. Some art historians, however, see in these figures ancient warriors like Hercules, Samson or David.² In our critical reconstruction of the tapestry we are left with two squares on the bottom border, opposite these two on top, which are not

² Space does not permit referring to the many descriptions of the tapestry, and to point out discrepancies. The undisputed authority on the tapestry, Dr. Pere de Palol, is about to publish a monograph which will summarize previous research. His many articles on the subject are quoted in a special number of the *Revista de Girona* from 1981, dedicated to the *Tapís de la Creació de la Catedral de Girona*, 149-247.

needed to complete the cycles of the months and days (if days there were). They could be filled with representations of Adam and Eve, or else of two additional legendary strongmen. However, it would be difficult to see these in connection with the overall program of divisions of time.

Comparisons of the Girona embroidery with other medieval representations of chronometrical cycles may lead us to more satisfying conjectures. For instance, an ink drawing in the Martyrologium from the abbey of Zwiefalten preserved in the Württembergische Landesbibliothek in Stuttgart³ (see fig. 2) shows in the centre of two concentric circles the old man ANNUS, holding the sun and the (half-) moon in his hands, flanked a second time by the sun and the (full) moon, but these now labeled DIES and NOX, day and night. The inner ring holds the twelve signs of the zodiac (a-m), the outer the allegorical activities of the corresponding months (1-12). The corners between the circle and the surrounding rectangle hold the four seasons (A-D). Added in a strange way to the outside of the rectangles are four figures, all making the same gesture of raised empty palms. The two personifications on top are labeled AURORA, dawn, and PRUINA, pre-sunrise frost. In dress and position of arms they remind us of the two unexplained figures in the Girona tapestry. Did the artist reinterpret misunderstood representations of the four parts of the day in his sources? Or was what the Girona figures carry in their hands added during restoration of the tapestry?

The drawing from Zwiefalten could also show another traditional representation which was reinterpreted in the Girona tapestry. Each of its twelve fields with the zodiac and months shows on its outside border a face blowing air: the twelve winds (see field 4

³ Reproduced in S. Sebastián López, *Mensaje del arte medieval*, Córdoba, 1978, 32.

in fig. 2; other are reduced here to half-circles). Attached to the outside of the great circle of the Girona tapestry we find eleven triangles, but symmetry shows that there should be twelve – the one at lower right has been omitted. These are usually explained as mountains or clouds, drawn in the “celtic” or “arabic” style. It seems simpler to see here an echo of blowing faces seen in profile, as in the drawing from Zwiefalten. The Girona artist might have wanted to avoid showing both traditions of windroses, the Roman one with eight and the Greek one with twelve winds. The faces became simple ornaments, used to fill empty spaces.

The squares along the sides of our tapestry depict the twelve months, shown as men engaged in recurring rural activities typical for each period, like ploughing in April and threshing in September.

Interrupting the series of months in an unsymmetrical way, we find two squares containing a white medallion. The one on the left is inscribed *DIES SOLIS*, and art historians were quick in identifying it as Sunday. Its counterpart on the right, preserving only the word *DIES*, represents, according to them, Monday. The other five days are to be imagined along the bottom border.

This reconstruction not fully convincing: the series of the seven days would be broken up without apparent reason. There would be no square left at bottom centre for a medallion contrasting with *ANNUS*. It is unsatisfactory to imagine five contiguous squares containing medallions all nearly identical to the one of *DIES SOLIS*.

The classical image of the *DIES SOLIS*, similar to the *ANNUS*, is closer to the concept of “day” than to that of “Sunday”. The chariot at right, drawn by only two horses,⁴ is carrying the moon, symbol of the Night. This hypothesis presupposes that in

⁴ Or oxen, according to J.M. de Aguilar in his contribution to a three part write-up in “Arte religioso actual”, 65-66, from 1964, dedicated to *El tapiz de la*

medieval Latin an expression like *dies lunae* could have meant “night”, and requires us to find space along the missing bottom border for all of the seven days, or else find other subjects for four or five of those squares.

There remains to be described the heavily damaged rectangle in the lower part of tapestry, which must have been always an integral part of it.⁵ The labels on the fragment show clearly that the top row depicts one well-known chapter of the legend of the Holy Cross. On the left, SANCTA ELENA, that is Helen, mother of Constantine, leaves Byzantium for IERUSALEM, being introduced there by Jews (IUDEI) to a certain IUDAS (a). Forced to find the true cross, Judas prays (CUM ORASSET IUDAS, b) until waves of a sweet odor (FUMUS, c) come out of the ground. IUDAS then digs there and finds three crosses. He eliminates the two crosses of the thieves which could not heal the paralytic person shown at extreme right (d).

Intruding into the middle of this strip we see parts of a large cross. At the point marked with an asterisk on figure 1, one can still make out the very top of a Byzantine crown. Is this crown sitting on the head of Emperor Constantine, who is carrying the

creación de la catedral de Girona. J.M. Taberner, in his contribution to that journal, also interprets the two medallions as Day and Night.

⁵ Lluís Batlle i Prats, *El brodat de la Creació i el brodat de la invenció de la santa creu*, in the above mentioned special issue of the *Revista de Girona*, 211-224, defends the hypothesis that the bottom strip of fabric is actually a fragment of a different embroidery, the one referred to in documents from 1538 and 1685 as *la istòria del emperador Constantí*, added to the Creation-tapestry during a restauration attempt in 1884. J. Marquès i Casanovas, *El tapís de la creació en el seu context*, *ibid.*, 217-224, pertinently points out that the F in FIAT written in the upper and FUMUS written in the lower part of the tapestry show the same peculiarity of looking like E. Josep Calzada i Oliveras, *El mosaic de la sinagoga de Beth-Alfa i el Tapís de la Creació*, *ibid.*, 173-205, describes another work of art combining a compartmentalized ring with a wide rectangle with a biblical story, in proportions very similar to our tapestry.

cross while riding into battle, as an inventory from 1369 supposedly mentioned?⁶ It is indeed very tempting to assume that the artist also depicted in the rectangle the legend of Constantine's vision of a cross bearing the inscription *In hoc signo vinces*, but we can only speculate if he also showed his victory, his conversion by Pope Silvestre and his famous "donation".

What seems obvious is that, whatever chapter of the legend of the Cross was shown below the story of how Saint Helen had it rediscovered, must have been presented in much larger size, in proportion to that of the Cross. This second scene could therefore have filled the complete lower three-quarters of the rectangle. Or else, we could imagine a tripartition of the rectangle, with the bottom part showing, again using the scale of the top strip, Cosroe taking the Cross to Persia and/or Heraclius returning it to Jerusalem.

B. GEOMETRIC CONSTRUCTIONS IN MEDIEVAL ART

Searching for medieval representations of the legend of the Holy Cross, we found a drawing which not only helps in establishing a list of possible scenes, but also suggests ways to determine the original dimensions of the Girona tapestry. A page in a French missal preserved in the Pierpont Morgan collection in New York,⁷ shows in its upper part Constantine's vision and in the lower part, on a larger scale, Heraclius returning the cross to Jerusalem (see fig. 3).

This page reminds us of the structure of the Girona tapestry: a wide border, interrupted by four circles, framing two fields of

⁶ J. Marquès i Casanova, *op. cit.*, 221, alluding without further details to a typewritten copy of the document from 1369.

⁷ MS 641, fol. 155, from ca 1060, reproduced in the *New Catholic Encyclopedia*, vol. IV, 1967, 476, fig. 3. Details are omitted in our figure 2.

uneven size. The lower scene in the drawing fills a square we *include* the upper dividing band. The diagonal of this square is equal to the width of the frame and to the height of both scenes together if we *exclude* the band which forms the base line of the bottom rectangle. The arms of the large cross follow precisely the mid-line of the drawing, while the axis of the cross coincides with a line linking the left sides of the top and bottom circles.

There is no doubt that medieval artists made use of geometry, not just as practical help in enlarging small scale cartoons to full size works, but because of the guiding principle that they should learn from God "the Geometer"⁸ whom Solomon praised for having arranged all things "by measure and number and weight" (*Wisdom*, 11: 20). The contrast between the ease with which "divine" proportions can be drawn with diagonals (especially of pentagons) and the conceptual difficulties presented by the underlying infinite numbers, may explain the widespread fascination for the secrets of geometry in Antiquity and the Middle Ages.⁹ While it may be impossible today to ascertain why a medieval artist used specific lines and circles – why, for instance, in the Morgan missal, it is not the centre of the cross which is in the exact centre of the drawing but the edge of its right arm – trying to find the lines and curves used in constructing the Girona tapestry could be a safer method for determining its original outlines than deductions based on its presumed overall artistic program.¹⁰

⁸ See F. Ohly, "Deus Geometra", in N. Kamp, *Tradition als historische Kraft*, Berlin, 1982, 1-42.

⁹ For an excellent introduction to this topic, and a wealth of well-analyzed examples, see Charles Bouleau, *The Painter's Secret Geometry*, New York, 1963. French original published in Paris, 1963.

¹⁰ Palol's theory that the original tapestry contained in its lower half a second large circle, showing scenes of the Apocalypse, is explained, with a drawing, by Calzada, *op. cit.*, 203. The tapestry would have been ten meters long, with 48 squares along its borders!

Two geometric constructions determine the dimensions of our tapestry: rebated diagonals of squares and rectangles and the divine proportion, the "golden section" established by a progression of rebatted diagonals. Both procedures are widespread in medieval art, and there are several examples where the datum lines are still very much visible even in the finished painting.

The "Expulsion from Paradise" painted by the Limbourg brothers in the *Très Riches Heures* of the Duke of Berry has been so often reproduced that we can limit ourselves in figure 4 to a schematic representation of its geometric scaffolding.¹¹ The walls of Paradise form a perfect circle, with a fountain in the centre. Pinnacles over the fountain reach up to lines found by rotating the diagonal of the imaginary square containing the circle. This diagonal, rotated in the other direction, determines exactly how much space the artist added in front of the gates of Paradise.

An even more famous painting of interest here is Roger van der Weyden's "Descent from the Cross", preserved in the Prado in Madrid,¹² the proportions of which we show in figure 5. The diagonal of a square was rebatted to construct a rectangle, the diagonal of which determines the width of the painting and the dimensions of the square on top of it. The sides of this square mark the precise

¹¹ For a reproduction and analysis see Bouleau, *op. cit.*, 65, whom we follow here. Other reproductions in Marcel Thomas, *The Golden Age. Manuscript Painting at the Time of Jean, Duke of Berry*, New York, 1979, plate 27 (Bibliography, 34) and in the *Encyclopedia of World Art*, vol. IX, fig. 139. In Giotto's "Feast of Herod" and "Assumption of Saint John", the datum lines of "Root Two" progressions determine clearly the location of the walls and columns of the depicted buildings. See reproductions in Brian Thomas, *Geometry in Pictorial Composition*, Newcastle upon Tyne, 1971, 74-75.

¹² Reproduced and analyzed in Bouleau, *op. cit.*, 67 s. Other reproductions are listed in I. and K. Monro, *Index to Reproductions of European Paintings*, New York, 1956, 654.

golden section of the overall width, and can be calculated as

$$\frac{AC}{BC} = \frac{BC}{AB}$$

that is $\frac{1+\sqrt{5}}{2\sqrt{5}}$, or 1.681..., designated by the Greek letter φ .

C. THE CONSTRUCTION OF THE GIRONA TAPESTRY

Three bands of linen of normal size, sewn together, determined the width of the tapestry. The artist first drew the inner circle and, doubling its radius, the outer one. The diagonals of an imaginary square around the large circle separate different scenes of the creation story, and, rotated from the corners determine the sides of the tapestry, *including* the two outside fringes. Dividing the top of the square (which measures *three* times the diameter of the centre or of the ring) into *five* equal parts was not difficult, nor was adding two more squares on the side. However, the diagonal of the square is slightly longer than seven-fifths of its side, and this, we believe, precisely by the width of the decorative fringe. That this is so is clearly shown by the artist in the square around the medallion of ANNUS, which includes the fringes on both its sides but excludes them on top and bottom. The medallions of GEON and DIES SOLIS are of exactly the same size, but all four fringes are on the outside of the square. We now see that the original tapestry can never have been an exact square, since its width measures nine squares plus *two* fringes, but its minimum height nine squares plus *ten* fringes.

The diagonals through the large circle also make it possible to find the lines which, together with lines dividing the squares on the top border, determine the centres of the three small circles in

the creation-ring, all of the same size as the medallions along the border. The lines BD and BE establish the compartment holding the dove of the Holy Spirit; they meet at very close to 45°, a result which might have intrigued our artist.

The rebatment of the diagonal AC leads to point F. The datum line to point G completes the "Root Two" rectangle and may have served as base line for the drawings in the "Story of Constantine" section, leaving some space above the bottom squares, used, perhaps, for an inscription. The rebatment of the diagonal AG determines the length of the tapestry at point H in a much more artistic way than simply adding up nine squares and all the fringes. This diagonal leads us to points at the sides of the tapestry where its height, excluding the top border, is divided by the golden section, that is,

$$\frac{IK}{K\phi} = \frac{K\phi}{\phi I}$$

The distance I to ϕ subtracted from the very top of the tapestry takes us to ϕ' , the centre line through the circle, which can be visualized as the arms of an all-encompassing cross, impression reinforced by the band of waves forming its right arm.

The artist not only was aware of the "divine" proportion at ϕ , he even wanted to attract the viewer's attention to that imaginary line by placing the two medallions of the Day and the Night off-centre, dividing unsymmetrically the two series of six months. Even more important, the right arm of the large cross below the circle coincides precisely with the vertical midline and this golden section. The centre of the cross lies on the line descending from the left side of the ANNUS square. Its top extends to the line common to the square and the rectangle and points exactly at the roots of the lush Tree of Paradise; its bottom, perhaps, coincides with

the intersection of two rotated diagonals. Several other lines coincide with the axes of the cross, for instance the one connecting the upper golden section at the right edge to the lower golden section at centre (φ' to φ).

The location, inclination and the measures of this cross were certainly not left to chance. We will never know all the secrets of the Girona tapestry, but we hope to have uncovered at least this one: that the artist, in depicting the story of the Invention of the Holy Cross, has "hidden" this cross at a location where several mysterious lines converge, lines originating in the Creation part of the tapestry. The viewer too has to rediscover the Cross, and learn that the story of man's salvation, through all those months, seasons and years, leads from the Tree of Good and Evil to Christ's Passion and to our reinvention and exaltation of His Cross.

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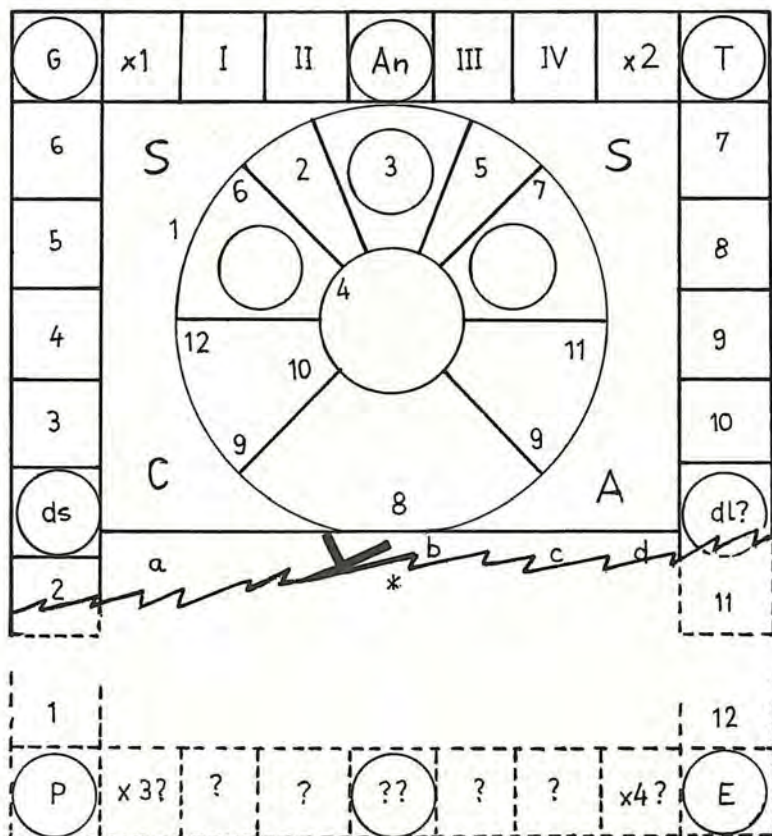


Fig. 1

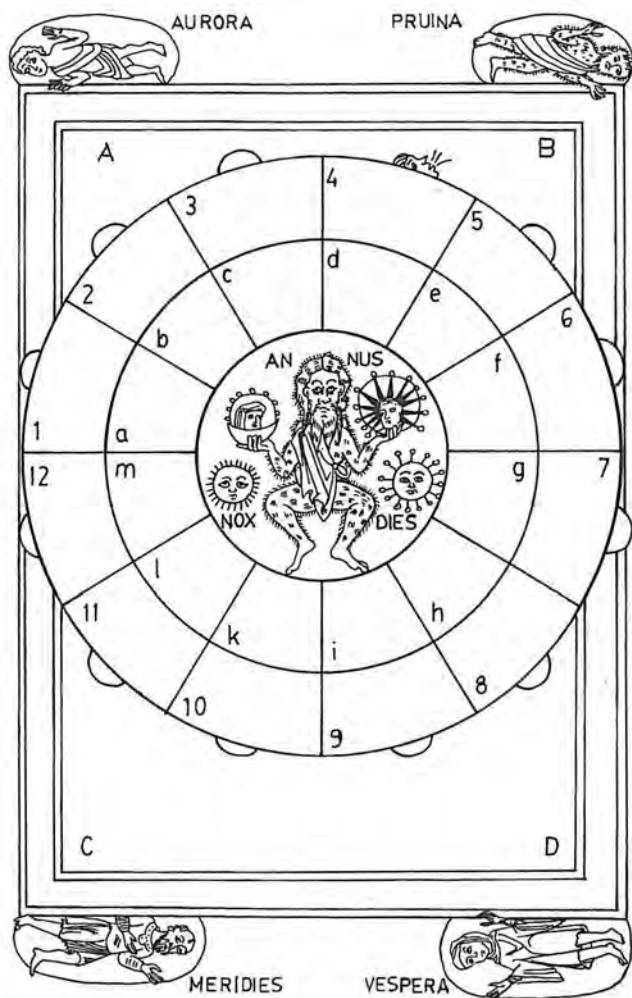


Fig. 2

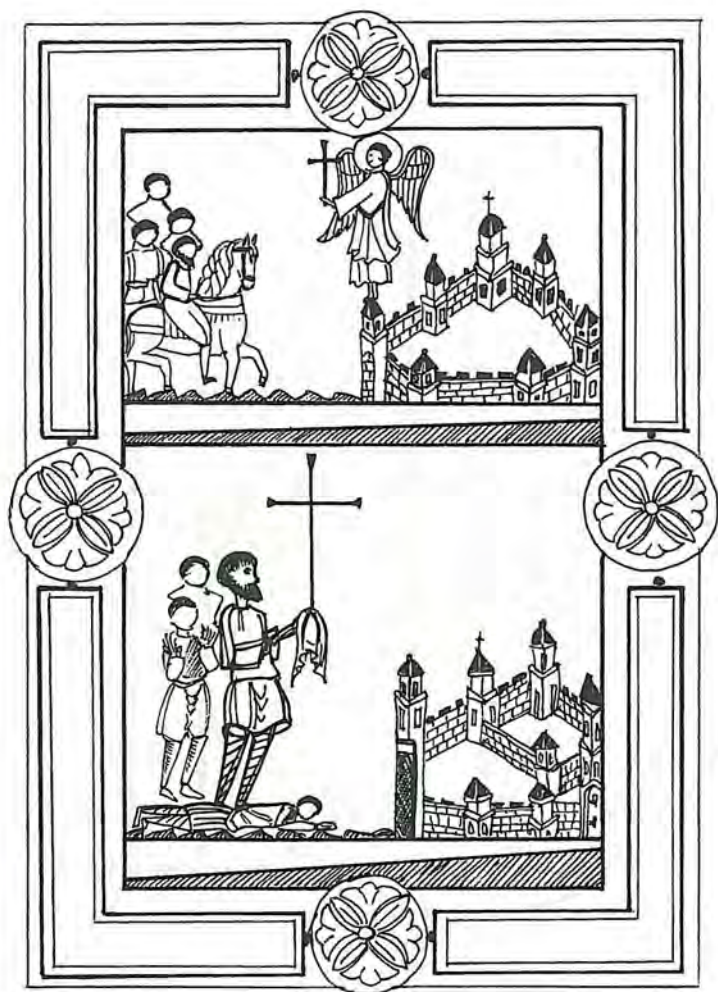


Fig. 3

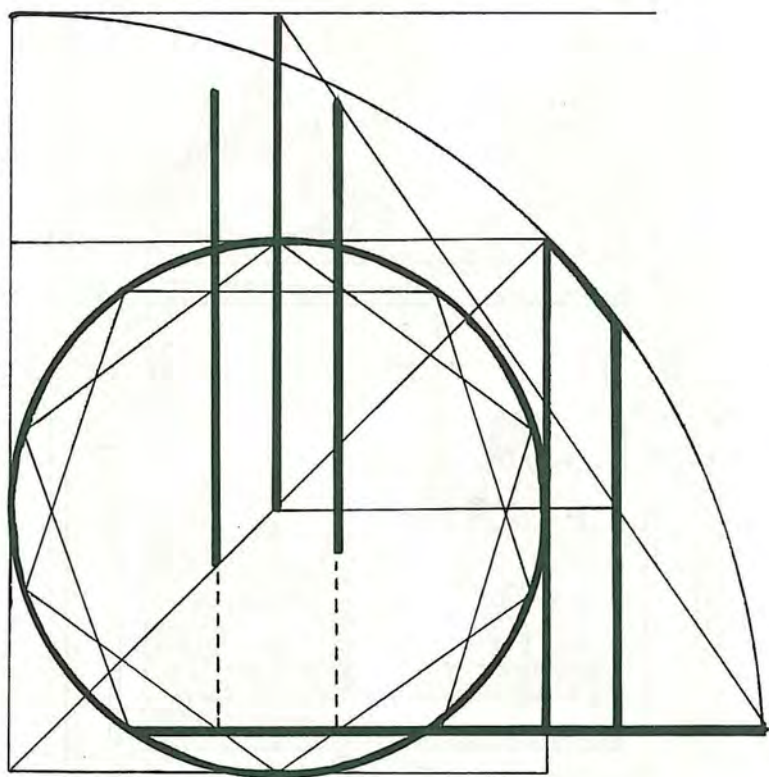


Fig. 4

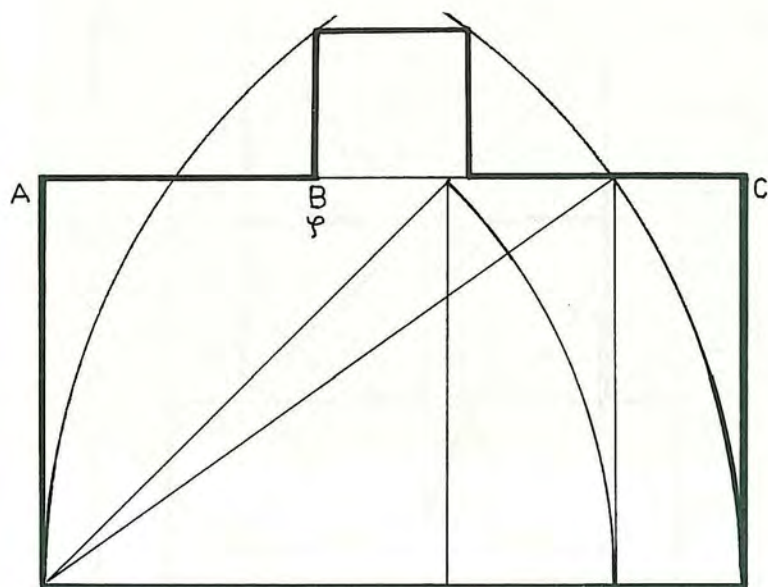


Fig. 5

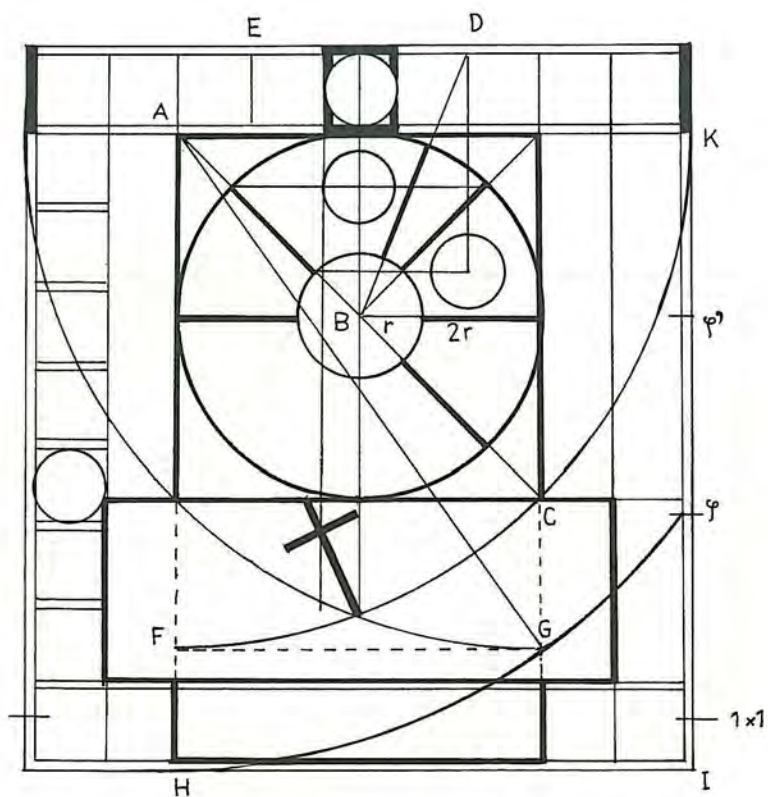


Fig. 6

