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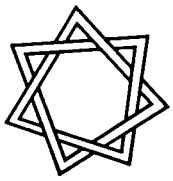

TESA
St. Petersburg-Helsinki

TEXTS AND MANUSCRIPTS: DESCRIPTION AND RESEARCH

Val. V. Polosin

"ALL IS NUMBERS"? AN UNKNOWN NUMERICAL COMPONENT IN THE DESIGN OF MEDIEVAL ARABIC MANUSCRIPTS

1

Despite their production costs, the number of manuscript catalogues with reproductions appended is steadily growing, each time increasing the number of objects accessible to study far from their place of storage. A recently released catalogue of this type [1] includes the title page of an Arabic manuscript from 978/1571 (see *fig. 1*). The catalogue describes it as a "richly illuminated title page" ("reich illuminierte Titelseite"). The reproduction is, however, presented in black and white [2], and one must judge the richness of the illumination more on the basis of the detailed list of its elements in the description of the manuscript [3]. Although the monochromatic reproduction rather fails to live up to the multicoloured original, it in no way prevents the scholar from enjoying another characteristic of the title illumination — the beauty of special proportions of its construction. Elsewhere, I wrote about several types of geometric harmony found in the design of Arabic manuscripts [4]. They turned to have been unexpected and surprising, but here we seem to encounter an unprecedented situation.

The reproduction in the above-mentioned catalogue presents the title decoration of al-Damīrī's "The Life of Animals". Its major component is a rectangular border divided into two unequal parts. The smaller rectangle forms the upper part and lies horizontally (see *fig. 3*), while a larger rectangle, beneath it, stands vertically. Each of these two rectangles possesses its own decorative elements (for example, an octafoil in the larger one and cartouches in the smaller one). Separately, outside of the rectangular border there is also a small, round medallion. The mathematical properties of these figures appear to be so unusual that they require an equally unusual method of demonstrating them.

For the purposes of this demonstration, let us "think of" a number, for example, 12.7 mm. The number could be different, but not, of course, random. The exposition to follow will, I hope, make this clear. Multiplying it by 10, we arrive at the height of the rectangular border which encloses almost the entire illumination on the title page of "The Life of Animals" (127 mm). If we multiply this result by 7 and then divide it by 10, we get the height of the larger, vertical rectangle (88.9 mm). Multiplying this height by 6, and then dividing by 7, we get the width of the vertical rectangle (76.2 mm) — this is also the width of the entire rectangular border, the height of which was calculated above in our first operation. Dividing this number in half, we arrive at the height of the horizontal rectangle. If we multiply the height of this rectangle (38.1 mm) by 4 and divide the result by 3, we arrive at the width of the octafoil at its end points (50.8 mm).

Working from a single number, we have calculated the dimensions of all the basic elements of the title decoration. This counting "game" could be continued to derive, step by step, the dimensions of all of the secondary elements as well. It could also be started differently. For example, the diameter of the octafoil is 50.8 mm. If we multiply this by 2.5, we get the height of the rectangular border (127 mm). If we divide the latter by 5 and multiply the result by 3, we get the width of this same border (76.2 mm), and so on and so forth.

All of the numbers calculated above are multiples of 12.7 [5]. But this is the number which we "thought of" at the beginning of our mathematical exercise. For example, the width of the border (76.2 mm) equals 12.7 times 6; the height of the vertical rectangle equals 12.7 times 7; the diameter of the octafoil equals 12.7 times 4. What sort of number is this 12.7?

To answer this question it is necessary to take another look at the title page of the manuscript. If the artist formulated it as a riddle, perhaps he has given us clues to its solution as well. Surprisingly, there is in fact a solution, and an obvious one at that. One only need to look on the title page as one would look on a pirate map for the sign which marks "buried treasure". The central figure of a octafoil will serves us a sort of the wind-rose to aid in orientation. Expanding on this metaphor, we once again encounter the mysterious number 12.7 as we measure the details of the octafoil: once in its "pure form" as the diameter of the petals, and twice in derivations which reflect the size of the octafoil at its diameter and the diameter of the circle drawn into the octafoil. If we total the diameters of all eight petals of the wind-rose and add to this sum the diameter of the circle drawn into the octafoil, we arrive at a number which very closely corresponds to the distance from the lower right corner of

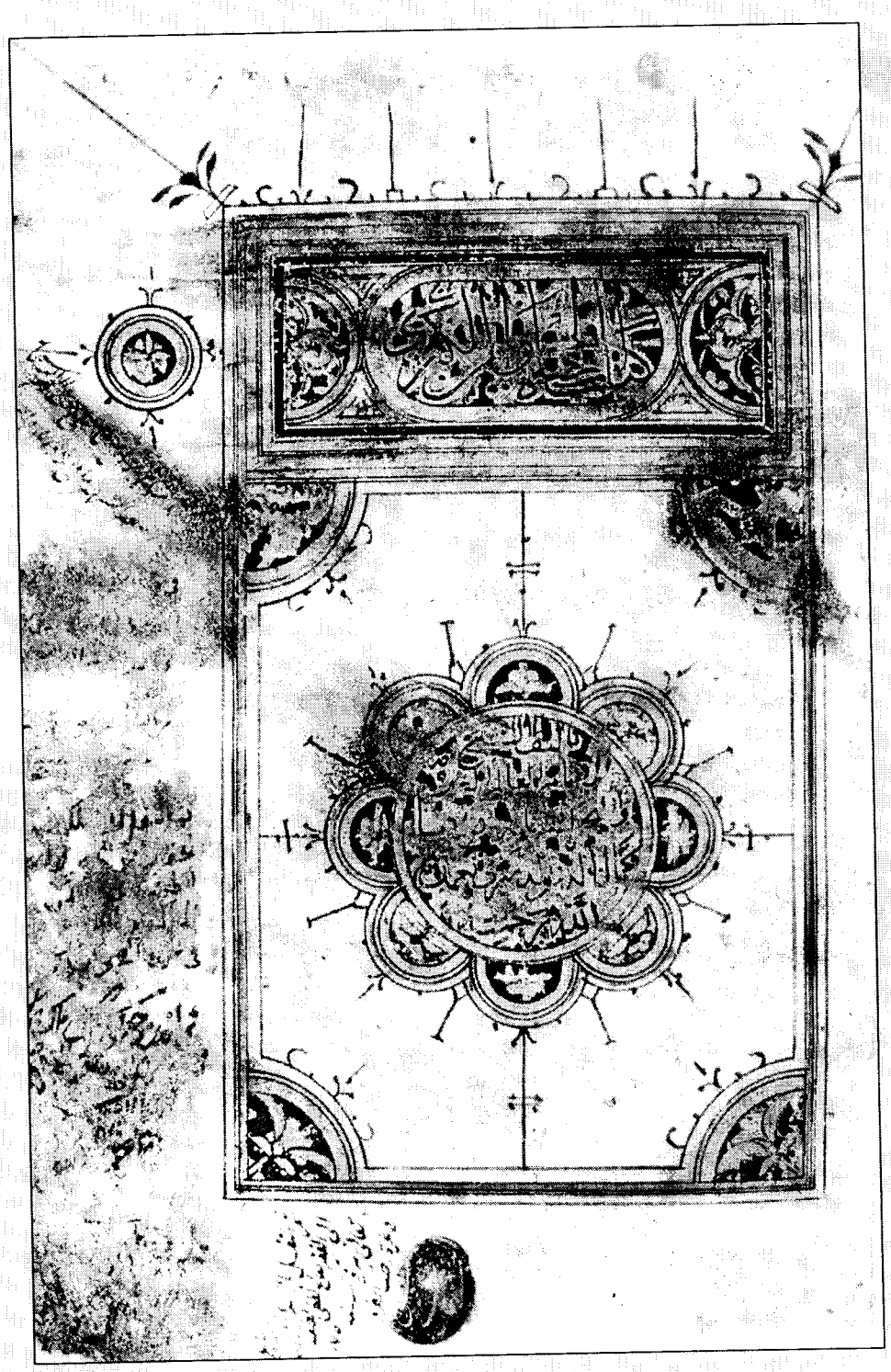

Fig. 1

the rectangular border to the centre of the circular medallion! This number (135.5) indicates that somewhere beyond the border, at a distance of 135.5 mm from its lower right corner, at the end of a line which goes through the centre of the octafoil and the junction of the two rectangles inside the border [6] (see *fig. 2*), lies our hidden something. This something is the circular medallion. Its diameter is in fact 12.7 mm, the number which makes up, like bricks, virtually all of the details in the title decoration.

It is clear that the medallion is the key to the numerical rebus which forms the essence, the "ideology", or the thematic basis of the title design in this manuscript. As a key figure in the decoration, it is drawn outside of the rectangular border, making it more visible. But the path to it (that is, to the solution it contains in the form of a numerical basis for the entire illumination) still passes through the complex cluster of the octafoil. It is carefully hidden, as befits a true treasure.

2

The medallion in which is encoded the numerical basis of the illumination provides a key to the puzzle, but does not explain the origin of the number itself. Why 12.7? It is clear from the first "mystical" transformation of this number (see above) that it is one tenth of the height of the border. But had we started from the other end, this number would not be a tenth of the frame, but a quarter of the octafoil. The number's overall transformability conceals its true origin. In its basic form, the number is present only in the additional medallion and the eight petals of the central medallion. But these are not the figures which set the tone for the sketch. They express a standard but do not enforce it on other figures in the illumination. They could all be given different (and arbitrary) dimensions, and the overall outward appearance of the illumination would remain practically unchanged. The border is another matter.

I have already written on the properties of 5:3 borders, and in particular on the ruler-less method of measuring out on their vertical side one fifth of the height [7]. This method was employed in those cases by illuminators to build within the border the figure of a "square between two rectangles". The current manuscript presents us with such a border, but the illuminator constructed a different figure inside it — "two rectangles (horizontal above vertical)". The division of the rectangular-border into horizontal and vertical rectangles was performed in the following fashion: by setting aside on the height of the border not two, but three tenths of its height. But a "fifth of the height" (= two tenths) remains present in the design of the frontispiece. At this level we find the lower edge of the round medallion together with the border (see arc KL in *fig. 2*). In this fashion, with the aid of decimal fractions of the height (three, to be precise), the total area enclosed by the border was divided in two. As has already been noted [8], spatial divisions of the base area always play an important role in Arab-Muslim book design. Here, the division of the area enclosed by the border (at the level of three tenths of its height) has introduced into the design two unequal, but concretely proportional, rectangles (horizontal — 2:1, vertical — 7:6). This two-part geometric figure displays another curious property on which the illuminator was quick to seize. If one draws an EC diagonal into the rectangle EFCD and extends it until it intersects the axial line (OG) of the rectangle ABFE, a secondary figure appears in the border: a right triangle OGC which stands in a special proportional relation to the border. For example, the line OG stands in a 10:9 relation to the width of the border; 3:2 to its height. The hypotenuse of the triangle (OC) stands in a $4^2:3^2$ (16:9) relation to the width of the border; 16:15 to its height. It is also of interest that the two new segments we have superimposed on the sketch (OC and OG) are in a 8:5 relation to each other.

The proportional relation of the triangle to the border suggests that both figures are component parts of a single construction and should be viewed as a whole. And since the centre of the additional medallion is located not just anywhere, but precisely at point O — the only apex of the triangle which extends beyond the border — one can term the entire figure a "border (or rectangle) with additional medallion" (see *fig. 3*). As Viennese manuscript Mixt. 136 is not the only work with an illumination containing this figure, a real need for a term to designate the construction exists.

Without the explanations given in this section, and without the additional sketches suggested, the format of the title page appears to be a simple colour drawing. Now this drawing reveals itself to be a significantly more complicated artistic structure. The fact that **all** of the linear elements in this drawing [9] present values which are multiples of each other and which are harmonically proportional to each other signifies that purely graphic considerations were linked in the design with rational considerations. To understand the latter, we must make some additions to our set of research tools. As we have tried to show, geometry and a reconstruction of the devices used by the illuminator introduce some clarity. However, even after the elucidations proposed here and in my other articles [10], the veil of numerical mysticism which noticeably covers all of the designs I have studied, does not lift entirely. It remains unclear why the illuminator needed all of the complexities revealed above.

3

The unusual prominence of the rational element in the illumination under discussion is perhaps the most interesting aspect of the example under consideration. The illumination rests on a geometric construction, the parameters of which can be expressed through a fairly long series of numerical quantities. The number of connections between these quantities is large (several times larger than the quantities themselves), but a logical analysis of them provides, with isolated exceptions, a few simple ("everyday") interchangeable proportions [11].

These characteristics of the geometric figure are much more interesting than the outward appearance of the illumination itself. It is, however, possible that such a juxtaposition is unjust, and that the outward simplicity of the drawing is also part of the artist's conception — for example, perhaps he wished to demonstrate something obviously com-

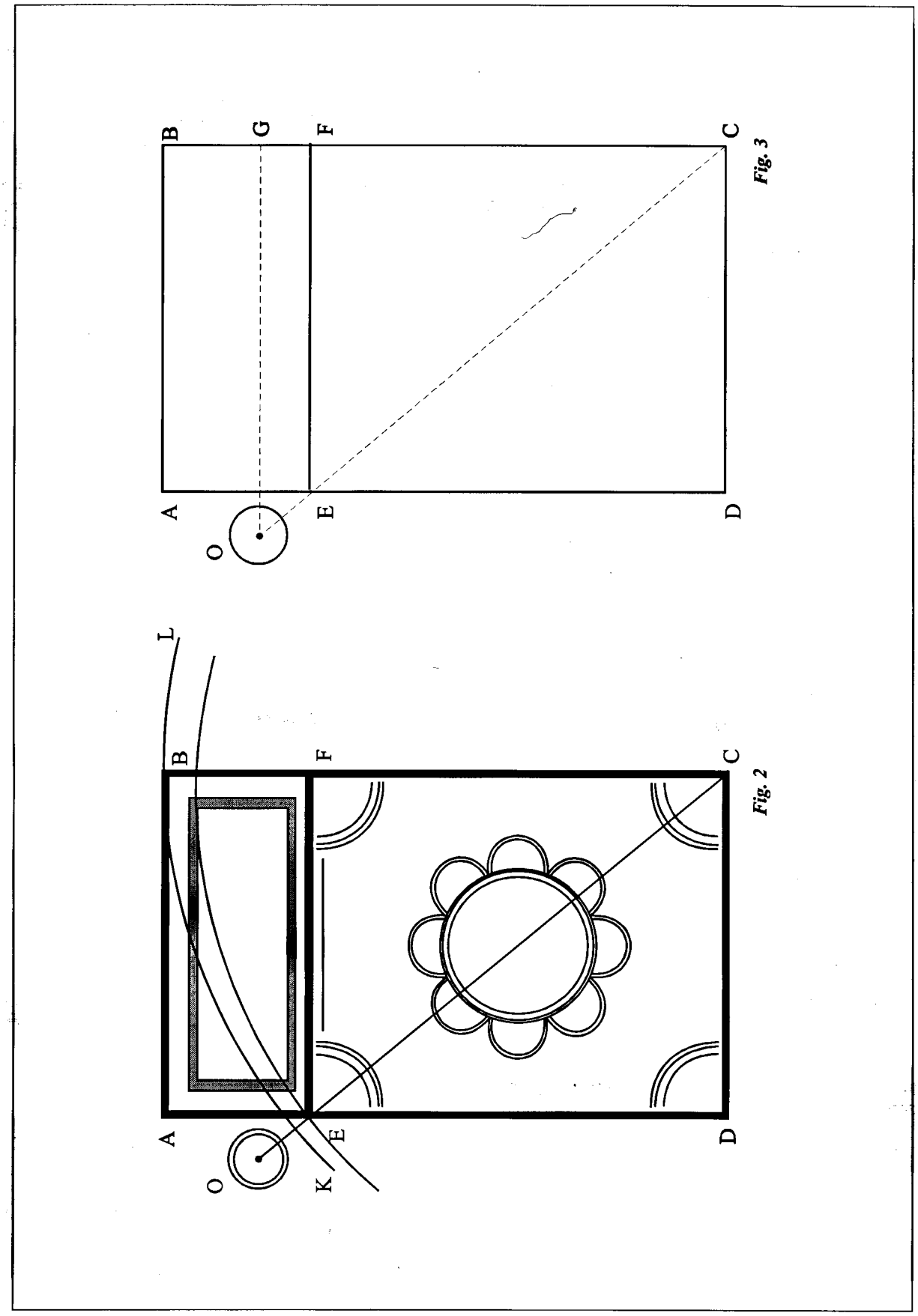

Fig. 3

Fig. 2

plex in a pointedly simple drawing. If this is so, then we must admit that a juxtaposition obscures the main characteristic of the illumination under consideration — the bare harmony of all its elements [12], virtually unmasked by distracting factors [13], but only intelligible through numerical symbolism. The artist merely softened the character of the sketch with colour borders, removed the linear sides of the triangle, employing however all of its apexes. He also added several figures (the octafoil, corner medallions, and others), continuing the numerical play in their dimensions. The removal of several support beams and the addition of multicoloured-golden "make-up" rendered the geometric determinism of the riddle invisible, or at least unrecognisable, while a kaleidoscope of numbers and their proportions remained. Without a visible rational foundation, it became much more mysterious — a trick without any explanation at the end.

Thus, the illumination under discussion exists on two levels. One can certainly examine the visible level — the original has been displayed at exhibitions and reproduced twice in catalogues. The invisible, or more accurately, concealed level must be calculated, revealing everywhere numbers where the first level presents only lines or spaces.

We have analysed in this article a single, concrete fact which concerns book illuminations. But the results, observations and conclusions contained in this analysis can all be applied to those instances (approximately a dozen) surveyed by us in previous articles. In each analysis of an illumination, one could also speak of these two levels. One of them is illustrative and decorative, directly perceived by the viewer. The second is analytical, and, as we have seen, unfolds in three fashions: in geometric figures (and the methods of their construction), in the linear dimensions of these figures, and finally, in the proportional relation of these dimensions to each other. Unlike previous instances, the illumination in the Vienna manuscript reveals a fairly strong preference on the part of the artist for linear dimensions with a consequent reconception in favour of the second, analytical level. This tendency is so pronounced and so clearly underscored by the intentional and unusual harmony of the numbers, that it compels us to recall the familiar maxim that "all is numbers", which is entered in the title of the current article, as well as the Pythagorean preference for viewing the world through numbers and their interrelations.

Scholars have supported the usual understanding of this maxim only in part, and then in extremely cautious formulations [14], but I mention it here in any case in connection with the numerical harmonies revealed in Arabic manuscripts. Is not our illumination, like other examples of "mathematised" design in Arabic manuscripts, a relic of this ancient feeling for the world, which perhaps for the first time appears before us not in historical tales and legends, but in visible form, in its natural sense — as an actual thing?

Notes

1. D. Duda, *Islamische Handschriften II.* Teil 1. *Die Handschriften in arabischer Sprache. Textband und Tafelband* (Wien, 1992). — Die illuminierten Handschriften und Inkunabeln der Oesterreichischen Nationalbibliothek, Bd. 5, Teil 1.

2. *Ibid.*, Tafelband, Abb. 206.

3. *Ibid.*, Textband, pp. 148—9 (MS Mixt. 136).

4. Val. V. Polosin, "To the method of describing illuminated Arabic manuscripts", *Manuscripta Orientalia*, I/2 (1995), pp. 16—21; *idem*, "Frontispieces on scale canvas in Arabic manuscripts", *Manuscripta Orientalia,* II/1 (1996), pp. 5—19; *idem*, "Muslim bindings with *al-Khālidiyānī* double borders", *Manuscripta Orientalia*, II/2 (1996), pp. 9—12.

5. It is for this reason that any of them could take the place of the number we "thought of" initially.

6. The imaginary line, which passes through several significant (supporting) points of the scheme, can also be viewed as a full-fledged element in this construction. The line is derived, but exists quite objectively.

7. See Polosin, "To the method", pp. 16ff.

8. See Polosin, "Muslim bindings", pp 9ff.

9. One need not, of course, take the word "all" literally. We are investigating the basic design scheme, and for this the formulation fits perfectly. But each "basic" figure in the scheme is surrounded by mounting lines which were added in order to make the basic scheme less bare and, consequently, do not fit into the calculations.

10. Polosin, "To the method", pp. 16ff; *idem*, "Frontispieces ", pp. 5ff; *idem*, "Muslim bindings", pp. 9ff.

11. I have in mind the proportional relations between the numbers from 1 to 9 (2:1, 3:2, 4:3, etc.); the exceptions mentioned are the proportions 10:9, 16:15 and 16:9. The last of them can be simplified and represented as the relation between the squares of 4 and 3; I have already noted an analogous instance in my "Muslim bindings with *al-Khālidiyānī* double borders" (see above). A larger sample of examples will show whether we can follow this route and expand by the factors 16 (4 squared), 15 (5 times 3) and 10 (5 times 2).

12. In the first part of the article, we did not introduce **all** of the examples necessary for such an assertion for a single reason: the Catalogue illustration (No. 206) is reduced to two-thirds the size of the original. The dimensions of the secondary (small) elements in the illumination can only be derived by reconstructing them. They seem quite likely to me, but their validity can only be confirmed on the basis of the original and with the aid of instruments more accurate than the human eye and a ruler. For this reason, these measurements are not cited here.

13. Aside from the contouring of some of the basic graphic figures (the main border, the additional medallion, the petals of the central medallion and others).

14. See, for example, L. Ia. Zhmud', *Pifagor i ego shkola* (Pythagorus and His School) (Leningrad, 1990), pp. 159—74; *idem*, *Nauka, filosofiia i religiia v rannem pifagoreizme* (Science, Philosophy and Religion in Early Pythagorism) (St. Petersburg, 1994), pp. 311—32.

Illustrations

Fig. 1. Title page of an Arabic manuscript dated by 978/1571 from the Österreichische Nationalbibliothek (MS Mixt. 136, fol. 1a). Courtesy of the Österreichische Nationalbibliothek (Vienna).

Fig. 2. Elements of the illumination with properties under question in the current article.

Fig. 3. A sketch of the "rectangle with additional medallion" figure arrangement.