Ring at Clava as the allusion to the dimensional features of the pyramid of Cheops

Alexander Shatalov

Abstract. The proposed study was devoted to the analysis of the scheme of dimensional and geometric ratios of the circle of stones in Clava and is a kind of continuation of the topic raised in our previous publication, analyzing such megalithic monument as "calendar circle" in Nabta Playa. Like the previous study, this one relies on the application of some prime numbers, most commonly 37, but also others related to the "Cupola Algorithm's" sequence of numbers. The article shows that the creators of the circle in Clava were well acquainted with the methods of precise geometric constructions, and with the ancient Egyptian system of linear measures, in addition, the dimensions of this circle with a high degree of probability is the allusion at the dimensional and geometric features of the Cheops pyramid.

1 Methodology and units used in this study

Although at present researchers in the field of landscape design prefer to study modern specimens in this area of open spaces (see, for example, [1-3]), the author of the proposed article considers no less important a direction of research that relates to the ancient origins of this genre. Such objects represent amazing examples of the skill of their creators in the field of operating with dimensional and geometric parameters, with the achievement of amazingly consistent systems. This is due to the methodology we have identified for assigning sizes, which used in the most ancient monuments. It described in sufficient detail in [4], so here we present only its basic principles.

It is a reliance on the use of prime numbers associated with the Cupola Algorithm, as well as with some proportions of pseudo-Pythagorean triangles related to the pyramid of Cheops (23, 29, 37.01… and 29, 37, 47.01…). In the first place here is the identification of the multiplicity of the size of a prime number 37 (the principle of "modulation-37", hereinafter M-37), which manifests itself with some historical linear measure. As our latest research shows, ancient Egyptian and, in some cases, Mesopotamian measures deserve special attention.

Note that the historical linear measures used by us differ somewhat from the generally accepted ones (justification for this is given in the same publication [4]).

* Corresponding author: shatalov_iarhi@mail.ru

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In addition, with repeated checks, we have reason to include in the list of ancient Egyptian measures units that are identical to the so-called "English" foot and currently used meter too. In this way, the measures we identify in this paper will be:

- Ancient Egyptian royal cubit (meh, mehi), equal 0.523599 m;
- Ancient Egyptian foot (zereth), equal 0.3490659 m;
- Ancient Egyptian finger (djeba), equal 0.021817 m (21.817 mm), 1/24 of meh;
- Ancient Egyptian finger (djeba), equal 0.0187 m (18.7 mm), 1/28 of meh;
- "English" foot, equal 0.3048 m;
- "English" inch, equal 0.0254 m (25.4 mm);
- "Early meter", equal 1 m (hereinafter referred to simply as "meter").

Thus, the methodology of our research reduce to searching for enlarged dimensional agglomerations in the sizes of ancient structures based on the above-line measures, and these agglomerations must correspond to simple multiplier coefficients 23, 29, 37, 47. Further, we will call such correspondences M-23, M-29, M-37, M-47, etc.

2 Megalithic yard and prior dimensional research of Clava stone ring by Professor Alexander Thom

We also quote from [6] “… All data in Thom's data-sets not deriving from well-preserved stone circles are removed, so that these proposals can be tested on this one category of monument. The statistical evidence for the existence of the megalithic yard is found to be equivocal. …”.

One more opinion related to the characterization of the problem of MY and MR, from [7], which notes the illogical, from the point of view of this author, approach of some researchers: “… they attempt to apply the modules that they have identified elsewhere upon all other monuments that they investigate. A more efficient way of module identification is to look for the module that is self-evident in the structure through rational numbers that emerge”.

At the same time, the idea of a megalithic yard supported by serious researchers, see, for example, the section "Geometric and Metrological Arguments for the Megalithic Yard", in the publication [8]. In other cases, the authors of the studies, while generally supporting the idea of the existence of a megalithic yard, but they come to the conclusion that in the Scandinavian region it could have had a slightly different size, estimated by them in the range from 753 mm to 810 mm [9], compare with 0.829 m by Thom.
Else, from our point of view, the ratio $\frac{10 \text{ MY}}{4 \times 4} = 16$ cubits of Nippur given in [10] is also of interest. Independent source [11] provides a geometric diagram using the "two-square system" to reveal the relationship between the ancient Egyptian royal cubit and MY. The check carried out by the author of this article (Fig. 1) indeed revealed a certain dependence, it is also noteworthy that the intermediate measure (remen) introduced in [11] turns out to be 37.024 cm (with a relative error of 0.00065 corresponds to $\text{M}_{37}$ based on the centimeter). The size of $\text{M}_{\text{Y}}$ obtained here (about 0.8279 m) is somewhat different from that given by Thom (0.829 m).

Fig. 1. The system of two squares as the connection of the royal elbow with the megalithic yard (a variant based on the materials [11], but a circle with our version of the royal elbow (0.523599 m) was adopted as the initial construction.

As for the archaeoastronomical aspect in the studies of megaliths initiated by Tom, the number of such studies does not decrease and covers all new regions, from Yorkshire to Machu Picchu, while not depriving the African continent of attention. By the way, the area of Nabta Playa is also in the field of view of researchers of the archaeoastronomical direction (see, for example, [12-13]).

In turn, we note that the analysis carried out by the author of this article of the available drawing of the circle of stones in Clava (Wood J. E., “Sun, Moon and standing stones”, 1978, p. 50, Fig. 3.10) did not determine the correspondences to the megalithic yard indicated on it. Yet the author of the article has a word in support of the megalithic rod from Thom, because the size of MR (2.073 m) leads to the hypothesis that there are dimensional units in the Clava circle corresponding to the ancient Egyptian ones. The fact is that the size of the megalithic rod with practical accuracy corresponds to 111 Ancient Egyptian djeba (equal 0.0187 m): $\frac{2.073}{111} = 0.0186757$ m. At the same time, $111 = 3 \times 37$ (so we get principle $\text{M}_{37}$ for MR), which is quite consistent with the methodology we have identified for assigning the sizes of the most ancient structures. The result just obtained prompts us to study the stone ring of Clava using the features of ancient Egyptian metrology, and without of megalithic yard.

3 Ancient Egyptian measures of length and modulations based on prime numbers in the Clava's stones ring
In [4], in particular, the angles 37°, 53° and 90° contained in the “quasi rhombic skeleton” of the scheme were revealed, and the largest of the overall dimensions was determined with high accuracy as 10 ancient Egyptian zereths-feet. The perimeter of the rectangle described around the ship-shaped outline (this is one of the stages of building the “small circle” scheme) turned out to be 40 zereths (with a relative error less than 0.00003).

We now proceed directly to our dimensional and geometric analysis of Ring at Clava. At first, let try to give a preliminary estimate of the outline length using a flat spline (Fig. 3).

The resulting outline length (about 146.804 m) is very close to the height of the pyramid of Cheops (the initial height is now estimated as 146.6 m), according to our evaluation, it is 146.6088 m also, perhaps, slightly less-146.608 m. Couldn’t it be a coincidence? To show that the size deliberately designed, we will perform a number of analytical constructions based on the linear measures described in section 1, while fulfilling the modulation principles described there.
The first stage of our construction will be the execution of two circles with centers at a distance of 10.952 m (10952 mm, which is equal to 37×37×8 mm), see fig. 4, left. The same size of 10.952 m corresponds to 37 ancient Roman feet (pes) of 0.296 m. The assigned radius of both circles is 1480=37×40 djebas (0.0187 m each), which is 27.676 m.

Fig. 4. The first stage of our building the scheme of Ring at Clava: a) drawing in assigned dimensions

The result of the distance between the points of the intersection of the circles is 178=89×2 “English” feet of 0.3048 m (intercept I₁I₂), relative error 0.000061, and 178 = 89×2. Prime number 89 is the perimeter of the pseudo-Pythagorean triangle {23, 29, 37}, proportionally linked to the half-profile of the Cheops pyramid (see [4]).

The second overall dimension due to our constructions (AB), is 44.4 meters (or 444 decimeters, 444=12×37), see fig. 4, right. However, at the same time, 44.4 m is equal 2035 Ancient Egyptian djebas of 0.021817 m (1/24 of royal cubit), 2035=37×55, relative error 0.000073, and it’s not trivial.

In addition, we get one more excellent non-trivial result for the length of the “leaf-shaped” contour—it is equal to 290=29×10 royal cubits (0.523599 m), with great precision, the relative error is 0.000002 (Fig. 4, right).

Thus, already the first stage of the analysis confirms the adequacy of both the direction of this analysis of Ring at Clava and our entire methodology as a whole.

The second stage is the execution of conjugating, assigned diameters of circles (centres O₃ and O₄) are 111 feet (111=3×37) and 2368 djebas by 0.0187 m (2368=37×64), Fig. 5 (left).

Fig. 5. Left: execution of circles for conjugating, assigned diameters are 111 feet and 2368 djebas (obtained centres O₃ and O₄). Right: the length of obtained egg-like contour is 146.634374 m, it is very close to the height of the pyramid of Cheops.
The junction points of the arcs that make up the egg shape designated from J1 to J4.

Result of the performed conjugations are two interesting dependences with M37 (Fig. 5, right):

- The obtained length of egg-form (intercept S1S2) is 49.12646 m, almost equal to 2627 = 37×71 djebas of 0.0187 m, relative error 0.000032.
- The obtained egg-like contour is 146.634374 m, or 481 = 37×13 feet (r. e. = 0.000174), that is close to the height of the pyramid of Cheops (146.608 m).

We have no less interesting results when analyzing the area of an egg-like shape, as well as when constructing a volumetric ovoid based on the obtained flat figure (Fig. 6):

- The obtained area of egg-form is 1702 square meters, 1702 = 37×2×23 (relative error is less than 0.00014).
- The obtained volume of the three-dimensional ovoid is 50246 cubic meters, 50246 = 37×2×7×97 (relative error: 0.0000135).

Fig. 6 The resulting area of the figure (left) and the volume of the ovoid (right).

On fig. 7 shown a comparison of the egg-form we received with the location of the stones, with the turn of our figure in accordance with the orientation of the megalithic ring of Clava. The resulting superposition allows us to consider the dimensional and geometric hypotheses that we have made as adequate to the intention of the creators of the object.

Fig. 7 Comparison of the outline of the resulting egg-shape and the location of the stones.

Another option for constructing a dimensional and geometric scheme of the Clava circle can be based on a preliminary setting of the overall dimensions of the scheme (Fig. 8):

length equal to 2627 djebas of 0.0187 m (which gives 49.1249 m), width equal to 2368 of the same djebas (this is will be 44.2816 m). The assigned dimensions correspond to M37:

2368 = 37×64 and 2627 = 37×71.
Fig. 8. The second variant of constructing the circuit gives the length of the ovoid contour, which practically does not differ from that obtained in the first variant. However, in this case, the circumference circumscribed around the dimensional rectangle, with high accuracy (0.000001) is equal to 11111 djebas of 0.0187 m.

In this rectangle we will inscribe the circles already used in the first version with diameters 111=37×3 feet and 2368=37×64 djebas (see Fig. 5 above). For mating arcs, we also use the already known value of the radius: R=1480=37×40 djebas (see Fig. 4 above). The resulting value for the length of the ovoid outline will be 146.630981 m, which is somewhat less than that obtained according to the first version of the scheme: 146.634374 m, the difference is slightly more than about 3.4 mm and the relative error is 0.000023.

However, we get an amazing result for the circumference circumscribed around the dimensional rectangle—it is equal to 207.775825 m, which corresponds to 11111 djebas of 0.0187 m, with an excellent relative error of 0.000001. Here it is worth paying attention to the possibility of a kind of “symbolic link” to the binary system, then a logical transition to the octal system gives the entry "37", since 11111 (2) = 37 (8), see Fig. 8. Of course, chance not ruled out here, but given the general context of the dimensional-geometric scheme, there is also the possibility of a conceptually embedded number. Note that in the first version of the construction (Fig. 4, 5) such a result not obtained. At the same time, the competing first and second options for constructing the circuit are practically equivalent in terms of reaching the result along the outline of the ovoid contour (146.634374 m and 146.630981 m).

Those who are interested in additional coverage of Clava complex, we may to recommend the information contained in [14].

4 Conclusions

Summing up the above analysis, we can draw the following conclusions:

1. Creators of the Clava circle had a very developed geometric knowledge.
2. When developing the geometric scheme of the Clava circle, modulation principles of dimensions forming the plan applied.
3. The most used type of modulation was M-37 (in other words, the dimensions had to be a multiple of the prime number 37).
4. The linear measures of the ancient Egyptian system used as basic sizes for modulations: royal cubit (meh, mehi), zereth, palm, finger (djeba).
5. As shown by the results of our geometric studies, along with those mentioned above, measures equivalent to the English foot and modern meter also systematically applied, also using M-37.

6. The overall system built with geometric relationships that provide a highly accurate combination of measures and modulations.

7. The applied principles of creating the Clava circle and the “small circle” of Nabta Playa [4] are essentially the same.

8. The author’s methodology for studying the dimensional features of ancient structures, which has been under development for quite a long time [4], [15], [16], received additional confirmation.

References


