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The observation of Angegh–Vulture (Cygnus) constellation in Armenia 32 000 years ago

Malkhasyan H.A

NAS RA V. Ambartsumian Byurakan Astrophysical Observatory (BAO), Armenia

Abstract

The "Qarahunge Observatory"or "Zorats Qarer" megalithic monument-complex has been little studied and till today the opinions of different scholars on the age of its construction and significance vary widely. In this article, using astronomical and geometric methods, we have tried to show that this ancient astronomical observational complex could have been built only 32300 years ago by the Angegh–Vulture (Cygnus) constellation model, when the declination of the Sadr star corresponded to the local latitude. It has also been attempted to substantiate the direct link between the constellation and the structure in several respects, in particular, it has been shown that 7800 years ago, some changes were made to the structure, the opening of some stone holes, and the observations of some of the stars of the Angegh–Vulture (Cygnus) constellation. At the same time, however, the original layout-composition of the complex and its contents have been preserved.

Keywords: *Qarahunge Observatory: Zorats Qarer: megalithic monument: Cygnus: Angegh: Swan constellation: Deneb: Sadr: Göbekli Tepe: Vulture*

1. Introduction

Not far from Sisian town of Syunik region of Armenia there is a historical-cultural megalithic monument now known as "Qarahunge Observatory" or "Zorats Qarer". It is situated at an altitude of 1770 metres above sea level and covers about 7 hectares. The coordinates are North latitude $39°33'$, East longitude $46°01'$ (Figure 1a).

In recent decades, the issue of the name of the monument has become quite controversial due to the conflict of opinions of various authors. In this publication we will use terms "monument", "megalithic structure", or "astronomical observational complex". Ultimately, it is more important to answer the questions connected with age and significance that are constantly discussed. In the 1980s, in their publications, Khnkikian (1984) and Parsamian (1985) re-assigned the ancient menhirs to possible astronomical significance. After that, in the 1990s, Heruni (2006), with his expedition, mapped the monument, measured the azimuthal directions of some stones with holes, and numbered the stones (Figure 1b) and based on the obtained data with 4 independent methods he showed that this structure was an observatory more than 7500 years ago and has operated for about 5500 years.

He also showed stones with holes corresponding to the rising and setting azimuths of some of the brightest stars of that time (such as Deneb's (α Cygni) about 7600 years ago). One of the most interesting notions concerning this megalithic complex is Vahradyane & Vahradyane (www.anunner.com) hypothesis that the composition of the menhirs is almost identical to the modern constellation of Swan-Cygnus (Angegh-Vulture in old Armenian tradition) in general, except for the south angle which is about 120° (Figures 1a,b,c) in the case of constellation γ Cygni - ε Cygni - ζ Cygni angle[1] is about 160° (Figure 4). This inconsistency was explained by the author with a relatively large value of ε Cygni star proper motion (0.4869 angular sec/yr, positional angle of proper motion 47.4°) and by this

[1]Here and thereafter, the angles drawn by the lines connecting the constellations' bright stars will be marked wit hthe corresponding letters of the stars, in the center the star corresponding to the top of the corner will be marked as accepted in geometry.

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method he found correspondence of angles of the south arm of the structure and γ Cygni - ε Cygni - ζ Cygni about 14500 years ago.

This idea is nice and at the same time very logical, but it raises some issues that are still unanswered. In particular:

1) The stars of Angegh (current Swan) constellation ε Cygni, γ Cygni and δ Cygni have never been aligned on a single line, such as the straight line of stones from the south to the north of the monument without "arms" is. Therefore, if it was constructed using the constellation model and the angle of the south arm was taken into account, it would be logical to assume that all angles would have to be aligned, or vice versa, no angle would be clearly preserved. This makes the logic base of calculation of the age of the monument vulnerable, no matter how obvious the similarity of the Angegh–Vulture (Cygnus) constellation and the monument layout is.

2) 14500 years ago the constellation Angegh–Vulture (Cygnus) was near the North pole and none of its stars δ (declination) corresponded to the local latitude $39°33'$ (Figure 6).

3) A problem arises when the angle between the northern direction of the northern arm of the structure and its bend to North-West is compared with the γ Cygni - δ Cygni - ι Cygni angle (about 10 - 15°). These angles would also have to coincide, taking into account that the angular velocities of these stars' proper motions are relatively small (γ Cygni - 0.0027; δ Cygni - 0.068; ι Cygni – 0.1462 angular sec/yr) and during last 40000 years angle, the δ Cygni peak is changing substantially, making about 142° when the corresponding angle of the monument is about 150-162° (The angles were measured on three different angular structure maps (Figures 1a,b,c) and on the constellation map data and their arithmetic means are summarized in Table 1).

The purpose of our study is to answer the above questions, to resolve any problems that may arise and to obtain the most likely period of construction of this multi-layered monument.

To illustrate the layout angles, we will next use the Latin uppercase letters matching the center letter to the angle peak, for example, the KID_1 angle peak will be I (Figure 2b).

2. Material and methods

This monument differs from the many other megalithic monuments in the layout of the menhirs, which is the core of these research material. The other basic parametric data is its latitude $39°33'$. If we look at the structure of the monument as layout-composition, it is obvious that the builders placed the greatest importance on the central part (Figure 1,2,3). This oval-shaped cromlech, centered on a circular structure, intersects with a straight line of stones stretching from South to North, bending South-West at a GEZ angle, and North-North-West (GDI), then turning North. (DIK) (Figure 2a). When looking at the North part, one should first look at its slightly wavy course, which can form two angles that are different from one another: GDI, DIK, and GD_1I, D_1IK (Figure 2a).

If we analyze the data in Table 1, it will be clear that in future calculations the GDI and DIK angles can be used as data, since DIK $\approx 154°$ corresponds to the δ Cygni - ι Cygni - κ Cygni angle, which, as mentioned above, does not change significantly over time. In addition, the ratio of lengths $\frac{DI}{IK}$ (R $\approx$ 3) also corresponds to the current ratio of the projection distances $\frac{\delta Cygni - \iota Cygni}{\iota Cygni - \kappa Cygni}$ (r $\approx$ 3) in contrast with $\frac{D_1 I}{IK}$ (R $\approx$ 2) (Figure 2a). Of course, such mismatch of relations is not accidental, since the stars ι Cygni, κ Cygni and δ Cygni also have their proper motions (the angular velocity of Cygni's proper motion is 0.1466 angular sec/yr), and if we recalculate time, we will see that r $\approx$ 2 about 30000 years ago. This indicates that this multi-layered ancient place has also undergone some changes during the formidable period to accommodate the stellar sky. However, when discussing older periods, it would also be appropriate to consider GD_1I and D_1IK angles to avoid inaccuracies. As one can see, the averaged numbers in Table 1 are closer to the drone shooting data and should be viewed as being true. The GDI $\approx 157°$ angle is more interesting, which differs from the constellation γ Cygni - δ Cygni - ι Cygni angle (142°) by about 15 and cannot be combined. The GEZ angle of the south arm also differs markedly from the current constellation γ Cygni - ε Cygni - ζ Cygni angle, which is due to

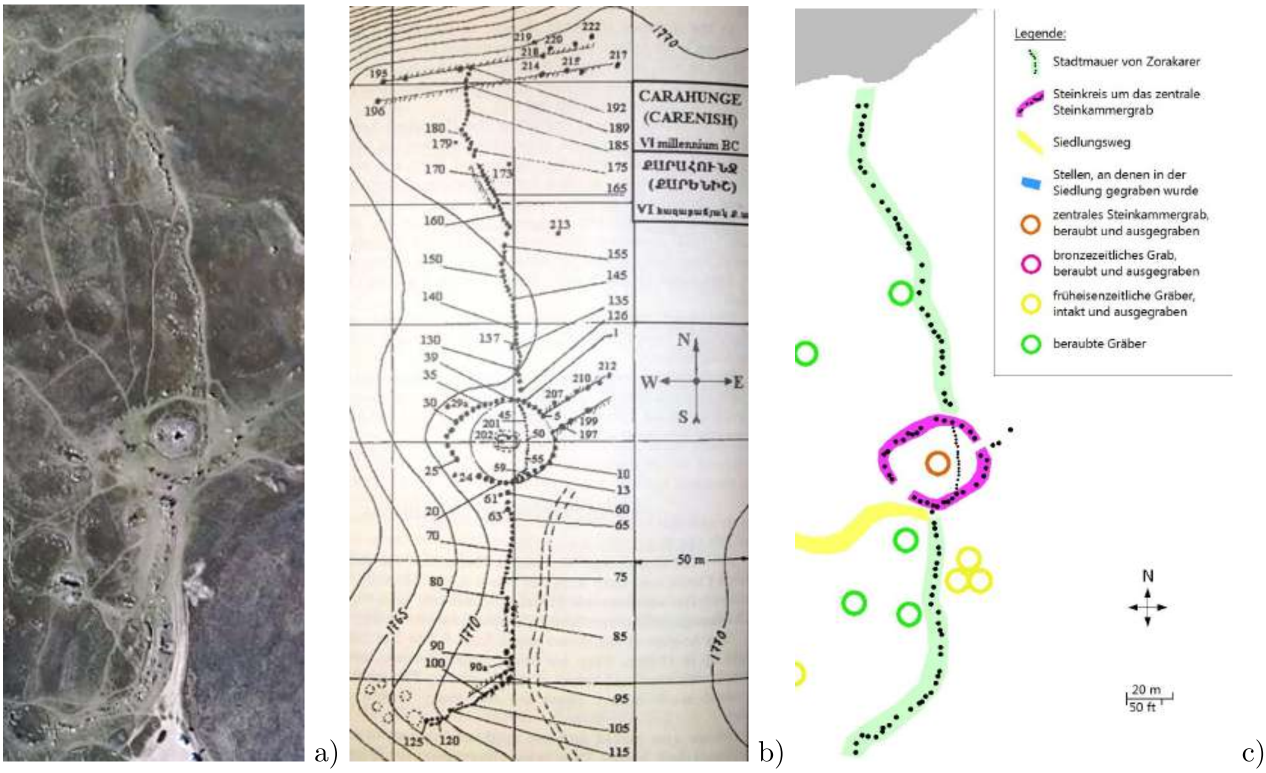
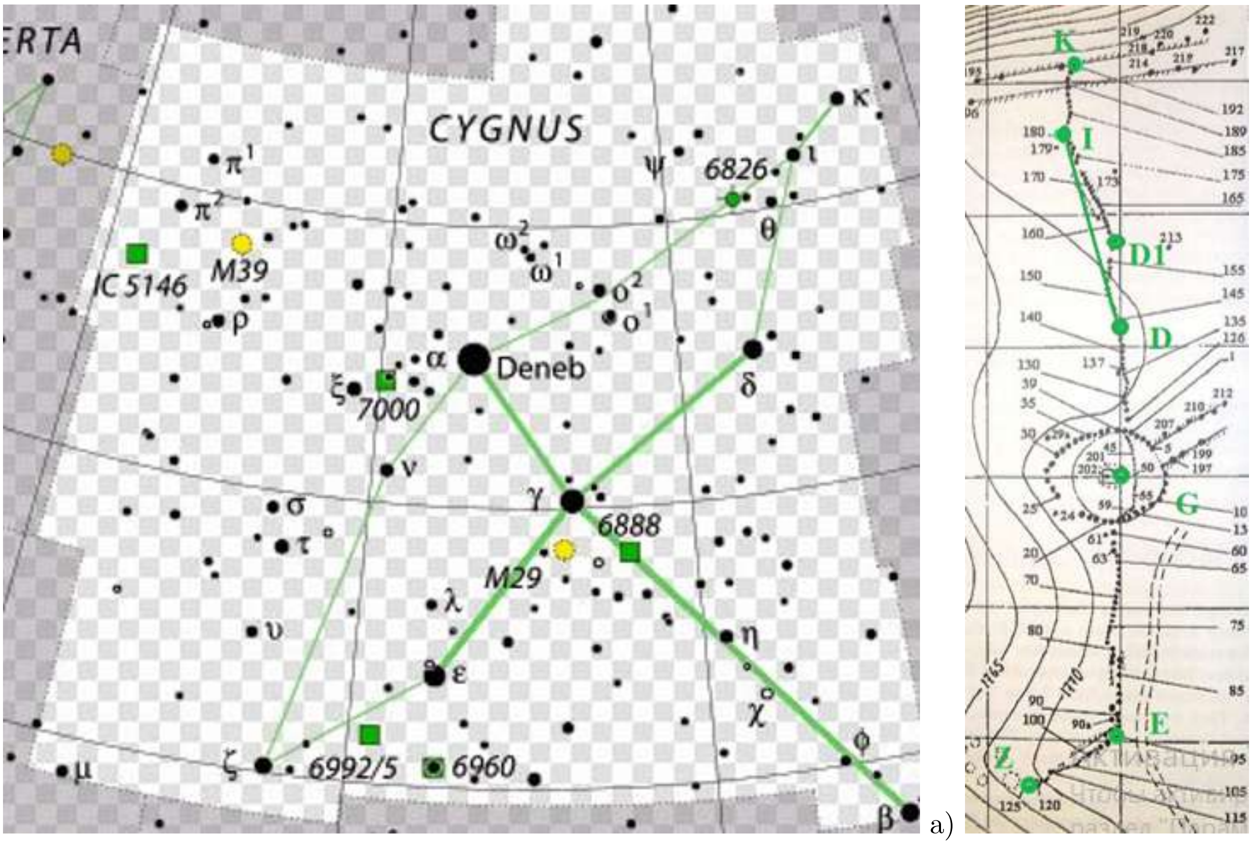


Figure 1. a) The view of the megalithic complex from above. Photo (Drone: DJI, Phantom 4 Advance. 1-inch 20mp, 4K/60fps), b) Map of the monument according to the academician P. Heruni, c) Graphic map (Source: File: Gelände von Zorakarer (Graphik).jpg-Wikimedia Commons). www.wikimedia.org

Angle	GEZ		$GDI(GD_1I)$	$DIK(D_1IK)$
According to P. Heruni's mapping (°)	123	$<$	162(152)	154(149)
Photo of drone (°)	122	$<$	156(150)	154(152)
Graphic Map (°)	127	$<$	154(152)	155(147)
Arithmetic mean (°)	124	$<$	157.33(151.33)	154.33(149.33)
The relationship of angles	$\wedge$		$\vee$	$\approx$
Corresponding corner of the current Cygnus (°)	157	$>$	142	154

Table 1. Comparison of the layout angles of the monument (obtained by 3 different methods) with the corresponding angles of the Angegh (Cygnus) constellation. Possible error of goniometer is 2°.



a) b)

Figure 2. a) Current map of the Angegh–Vulture (Cygnus) constellation, b) The Latin uppercase letters of the points have been matched to the stars: K - κ Cygni, I - ι Cygni, D and D_1 - δ Cygni, G - γ Cygni, E - ε Cygni and Z - ζ Cygni.

the relatively high angular velocity of ε Cygni's proper motion. All this make it possible to compare not only the constellation map with the layout of the monument, but also to observe its position with respect to the celestial meridian and the zenith point. Note that the stars of ε Cygni, γ Cygni and δ Cygni have not been in a single line for the last 40000 years. At the same time, points E and D of the monument layout, which we can compare with those stars, are located on the South-North line (which is the projection of meridian on the ground). This allows us to place the construction of the monument at a time when ε Cygni and δ Cygni stars intersect at the celestial meridian at the same time (when the deviation of the ε Cygni - δ Cygni axis is $0°$ from celestial meridian).

The next most important issue concerns the central structure. Both with its composition, its size and the layout of the structure it should be emphasized. At the same time, the center of the sky is the zenith point for the viewer above the ground. It is therefore logical to assume that the stars corresponding to it would have to pass through the zenith point during the construction of the monument. As such, one can consider the star Sadr (γ Cygni), which joins the parts of Angegh–Vulture (Cygnus) and has a central position in the constellation. It turns out that at the time of construction of the complex Sadr's declination was to correspond to the local latitude of $39°33'$ and that star could have been observed in the zenith. It is noteworthy that 7800 years ago the declinations of Deneb and Sadr were approximately the same (Deneb - $\delta = 39°52'$; Sadr - $\delta = 39°33'$) (*Stellarium 0.19.1* computer program was used). It is also interesting that not even a separate standing stone coincides with Deneb, which allows one to assume that Sadr could have been of greater importance to the observatory builders. At least it is necessary to consider the periods when the declinations of Sadr and/or Daneb corresponded to the local geographic latitude, and the stars of ε Cygni and δ Cygni crossed the celestial meridian at the same time and at that time the obtuse angles with celestial meridian of the constellation ε Cygni - ζ Cygni and δ Cygni - ι Cygni (later we will use α and β names for them, Table 2) also corresponded to the GEZ and GDI angles of the monument layout (Figure 2a,b, Table 2).

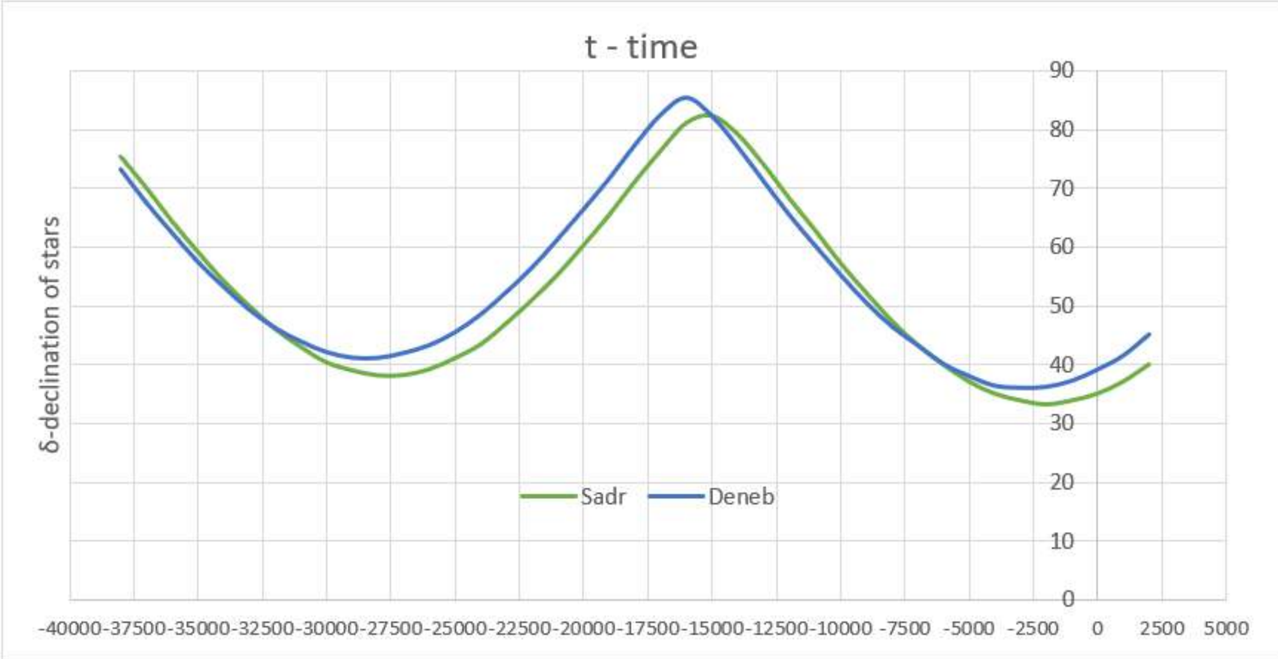


Figure 3. Changes in declination of Sadr and Deneb over 40000 years (Stellarium 0.19.1 computer program was used).

Year before us	250	6650	7800	16500	28000	31300	31400	32300
Declination of Sadr	39°33′	36°30′	39°33′	81°35′	39°33′	39°33′	39°44′	41°13′
ε Cygni - δ Cygni axis	-40°	0°	+10°	0°	-20°	-2°	0°	+7°
β angle	123°	154°	158°	138°	103°	121°	122°	124°
α angle	199°	152°	143°	157°	190°	165°	163°	157°
Relations of α and β angles	$\alpha < \beta$	$\alpha \approx \beta$	$\alpha < \beta$	$\alpha > \beta$	$\alpha < \beta$	$\alpha > \beta$	$\alpha > \beta$	$\alpha > \beta$
Declination of Deneb	44°29′	37°38′	39°52′	79°43′	43°35′	41°35′	41°41′	42°36′

Table 2. Comparison of the Angegh–Vulture (Cygnus) constellation parameters and position with the monument layout at different times. Possible angle error is 2°.

If we recalculate, we will first meet the Sadr 39°33′ declination in the 18th century AD (Figure 3). Of course, this period is not a matter for discussion, especially since at that time deviation of the ε Cygni - δ Cygni axis from the celestial meridian is about 40°. The previous coincidence of Sadr's declination and local latitude was 7800 years ago. In this case, Deneb has a similar declination of 39°52′, and the deviation of the ε Cygni - δ Cygni axis from the celestial meridian is about 10° (Table 2), but the celestial meridian is intersected almost simultaneously by the stars ζ Cygni, Sadr and δ Cygni. At that moment the γ Cygni - δ Cygni - ι Cygni angle is approximately 142° (Table 1), and the γ Cygni - ζ Cygni - μ Cygni angle is about 140°. As we can see, there are many discrepancies, especially if we consider that the ε Cygni - δ Cygni axis can coincide with the celestial meridian only 1150 years after Sadr's declination is 36°30′, Daneb's 37°38′, and in this case angles of γ Cygni - ε Cygni - ζ Cygni and γ Cygni - δ Cygni - ι Cygni are approximately equal (Table 2, in 6650 years ago). Considering such inconsistencies, it is necessary to consider older periods. Figure 3 shows the changes of declination of Sadr and Deneb during the Earth's procession over the last 40000 years.

The graphic in Figure 3 shows that Sadr's declination of 39°33′ (as opposed to Deneb's) was 28000 and 31300 years ago. 28000 years ago the ε Cygni – δ Cygni axis deviated from the celestial meridian by about 20°, and $\beta \approx 103°$, which is also a large difference (the α angle is the obtuse angle of the δ Cygni - ι Cygni celestial axis and the celestial meridian at the δ Cygni peak and the angle is the obtuse angle of the ε Cygni - ζ Cygni axis and the celestial meridian with a peak at ε Cygni). All the parameters discussed above correspond to the position of 32300 to 31300 years ago ($\alpha > \beta$) (Table 2). The combination of the constellation map and the monument layout (if scaled) seems to be ideal

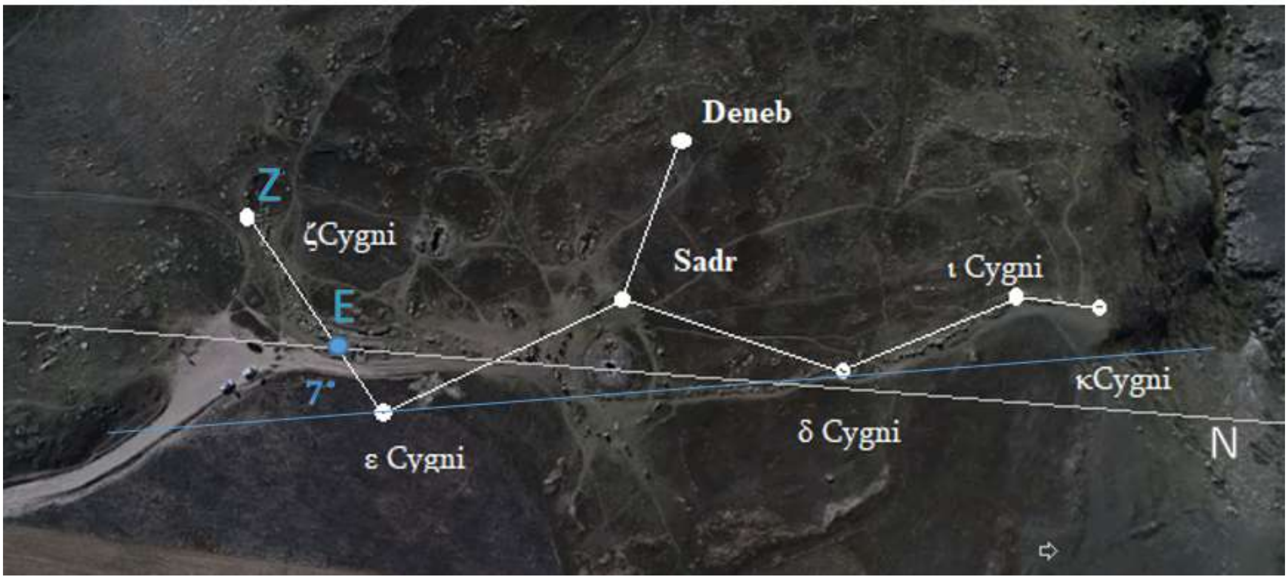


Figure 4. Scale combination. 32300 years ago the 7° deviation of the ε Cygni - δ Cygni axis (blue line) from the celestial meridian is expressed in the layout.

31400 years ago except for one major mismatch. It turns out that the EZ length of the layout is smaller than the ε Cygni - ζ Cygni projection distance (for scaling, Figure 4), and the α angle of the north arm is larger. But these problems are solved 32300 years ago when the axis of constellation ε Cygni - δ Cygni with respect to the celestial meridian is deviated by about 7° (Figure 4, Table 2).

It also explains the 7° angular deviation from the North-South axis (Figure 4) of the menhir range of the line joining the stones № 143 and 56 (Figure 5b), and the projection point of the ε Cygni star on Earth should correspond to the area East to the stones 80-85 where the land was cultivated and very probably the stones were moved from their original places (stone numbering according to P. Heruni). As it can be seen in Figure 4, Sadr overlaps the peak of oval-shaped cromlech. To the South of there is the separate manhir № 24 and circular located stones (Figures 5a,b). The calculation shows that the Sadr's position would correspond to the above mentioned point in the layout 31400 years before us (Figures 5a,b), if we compare δ Cygni with point D rather than point D_1 (in this case, the separate standing stone № 173 is possible to correspond the ι Cygni star) (Figure 5a).

Thus, 32300 years ago not only does the β and α angles directly coincide with the GEZ and GD_1I angles of the monument layout, but also the relations between the projections of the stars and the length of the monument layout, which is excluded during the observation of any other period. This circumstance already proves that the builders of the complex have carried out precise measurements and precise design work, keeping sincerely adhering to the ancient principle of "whatever is in heaven, it is on Earth". If this huge complex was built using the Angegh–Vulture (Cygnus) constellation model, it would be logical to assume that the visible stars of the constellation Deneb, Sadr, ε Cygni and δ Cygni were also observed here. Taking into consideration that the declinations of Deneb and Sadr correspond to the geographic latitude of 7800 years before us (Figure 5), it is possible that more active changes (opening of new holes, movement of some stones, etc.) have been made during this period. Let's consider the azimuths of several standing stone holes facing the stars above 7800 years ago (Table 3, Figure 7b) (stone numbers according to Figure 1b). Of the 37 standing stones with holes, we identified 9 stones through whose holes some stars of the Angegh–Vulture (Cygnus) constellation could be viewed 7800 years ago. Let's consider the positions of some of them.

Let's start by analyzing the North arm. № 181 stone's positioning exactly matches point I (Figure 2b), corresponding to the ι Cygni star (Figure 4), the setting of which can be seen from its hole (Table 4). The positioning of the 143th stone coincides with point D (Figure 2b), corresponding to the δ Cygni star (Figure 4), the rising of which can be seen from its hole (Table 4).

If we compare the angular distance of δ Cygni - ι Cygni with DI length, then the location of the ε Cygni star will be approximately at point E, but 6650 years ago (Table 2). It is more interesting when

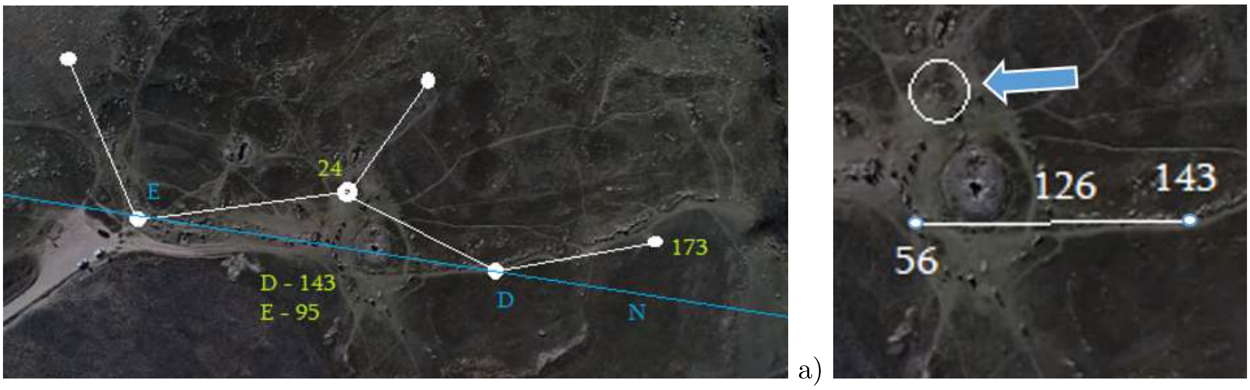


Figure 5. a) Projection curve 31400 years ago; b) the megalithic alignment along the line connecting stones № 143 and 56 is deviated from the North-South line.The arrow shows the positioning of № 24 stone and the circular stones.

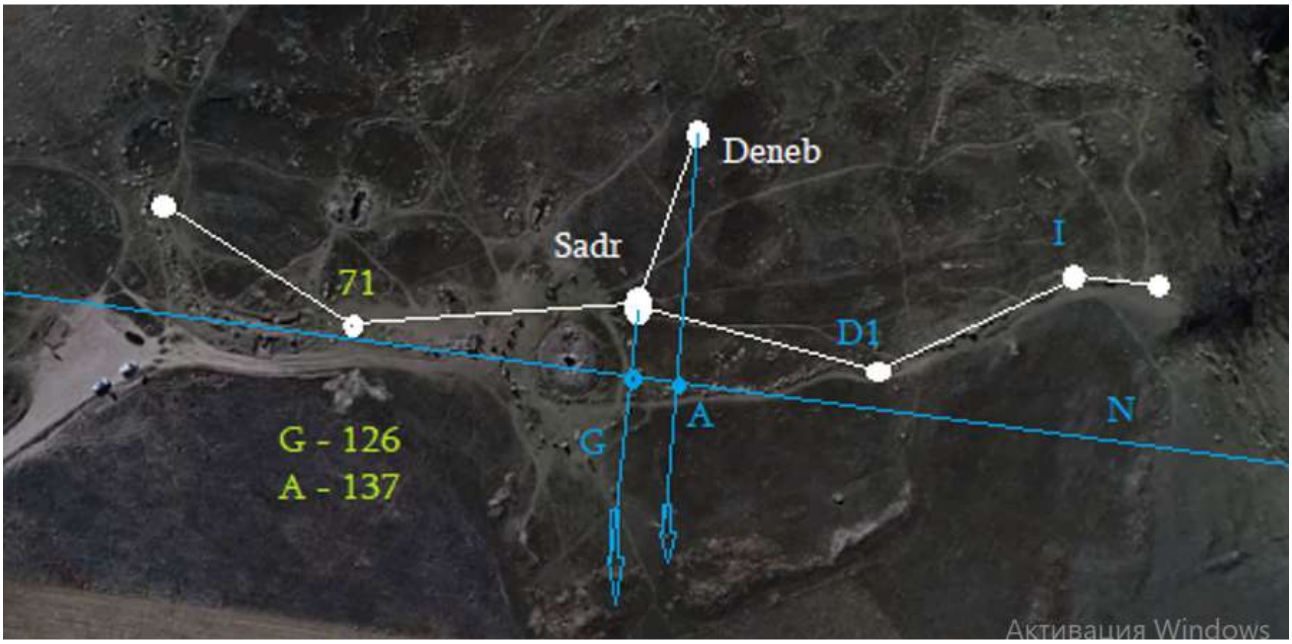


Figure 6. The comparison of the layout and the Angegh–Vulture (Cygnus) constellation 7800 years ago.

we compare δ Cygni and ι Cygni stars 7800 years ago not with DI but D_1I points. (Figure 6). In this case № 71 stone of the South arm would correspond to Cygni with its positioning, from which the Cygni star can be observed (the azimuths in Table 3 are calculated from the South point, as accepted in astronomy[2]). If we project the motion of constellation to the celestial meridian on the layout of the monument, it will be clear from Figure 6 that the star Sadr (γ Cygni) must intersect celestial meridian at point G and Deneb at A. The stone № 126 corresponds to point G, the hole of which the makes it possible to observe rising of Sadr and Deneb 7800 years ago, and the point A corresponds to № 137 stone, which has an angular tubular digging the upward side of which is directed to the zenith point (periscope stone, according to academician P. Heruni), by which Sadr and Deneb could have been viewed 7800 years ago with about 30 minute differency.

Another very important fact was recorded when we considered the azimuthal directions of the holes of chord's stones № 51 and 44. It appears that from these holes, it was possible to see ε Cygni and δ Cygni stars respectively near the horizon at the same time (at the same minute) 7800 years ago. This already means that the azimuths of a large number of holes have not changed significantly over the millennia. In general, it is clearly emphasized that the stones with holes directed at ε Cygni are located

[2]The above mentioned work of P. Heruni gives the geographical azimuths which are calculated from the North point.

The number of the stone (№)	44	51	53	71	84	122	126	137	143	181
The azimuth of the hole axis (°)	142	131	1	107	147	147	223	0	208	158
Elevation (°)	15	2,5	22,5	33	15	16	6	90	8	7
Positioning		Chord			South arm			North	arm	

Table 3. Azimuths of stone holes by academician P. Heruni (corner error 2°)

Stone №	7800 years ago they could have been viewed	Declination of the star	Positioning
44	δ Cygni	47°56′	
51	ε Cygni	31°50′	Chord
53	γ Orionis	-26°50′	
71	ε Cygni	31°50′	South
84	ι Cygni, α Lyrae	53°20′, 54°33′	arm
122	ι Cygni, α Lyrae	53°20′, 54°33′	
126	Sadr (γ Cygni), Deneb (α Cygni)	39°33′, 39°52′	
137	Sadr (γ Cygni), Deneb (α Cygni)	39°33′, 39°52′	North
143	δ Cygni	47°56′	arm
181	ι Cygni	53°20′	

Table 4. Visible stars of the Angegh–Vulture (Cygnus) constellation could be viewed 7800 years ago through the holes of 9 stone.

from center to South, and the stones with holes facing δ Cygni to the North, which further indicates that this astronomical observational complex was constructed by the model of the Angegh–Vulture (Swan) Constellation. Moreover, the positioning of stones № 44 and 51 on the chord[3] in some way confirms the circumference of the ε Cygni - δ Cygni axis being deviated from celestial meridian by approximately 7° during construction (Figure 4).

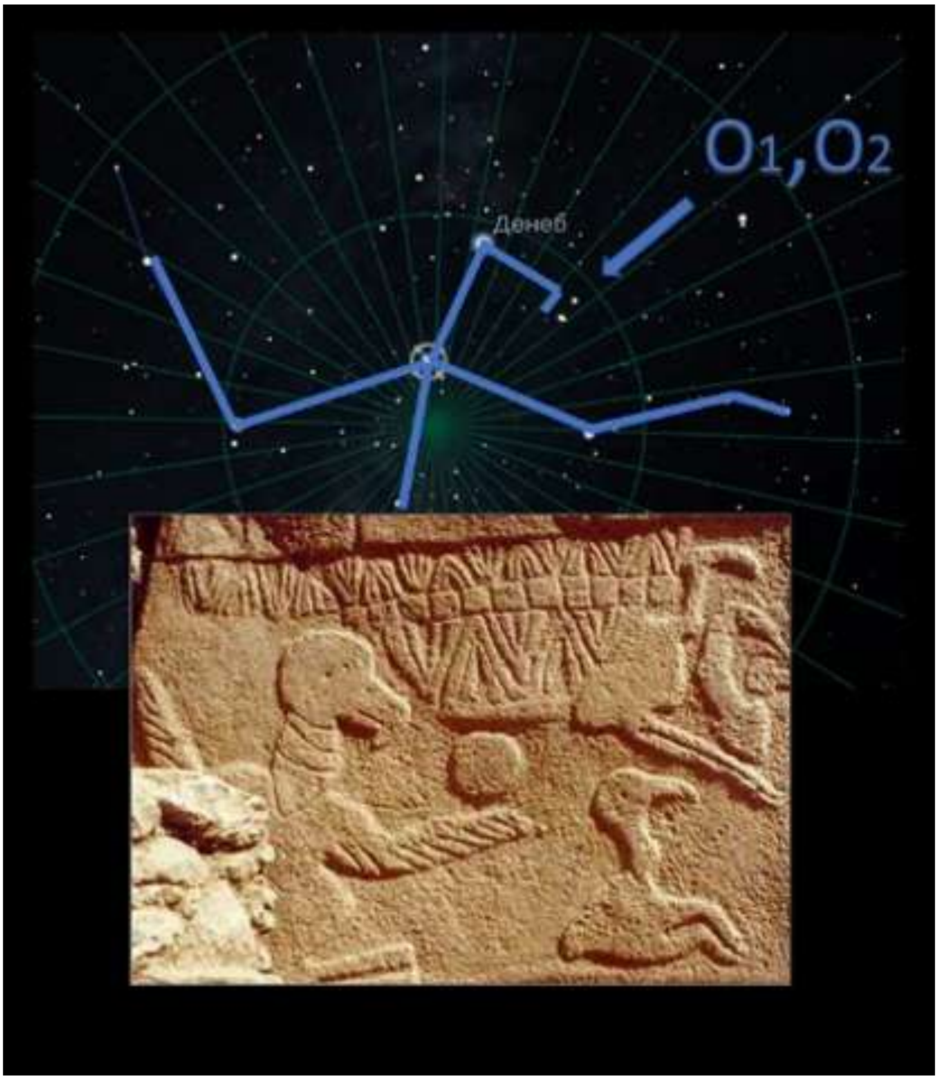
3. Results and discussion

Thus, if we compare the constellation of Angegh–Vulture (Cygnus) to the composition-layout of the megalithic structure in different millennia, the greatest conformity (with all observed parameters) is 32300-31400 years ago (Figures 4,5). This period should coincide with the age of the initial planning and construction of the complex-structure, while the holes on the stones and addition of some new stones may also be attributed to later periods, in particular the last corrections may have been made 7800 years before us (24500 years after the construction, almost 1 full precession period (25776 years). By this logic the separate standing stone № 24 may correspond to the Sadr star 31400 years ago (Figure 5). Taking into account the circumstance that all angles were measured by goniometer (because of which there can be some small errors), except for the comparison of defined angles, we also considered their relationship ($\alpha > \beta$ or $\alpha < \beta$), which allows us to draw more confident conclusions. Even if we assume quite large error of the goniometer, the results will remain unchanged, as the relationship GDI > GEZ (or GD_1I > GEZ) is clearly emphasized in the structure of layout angles of the monument.

In addition to comparison of the layout angles, the relation of the layout distances and the angular distances of the corresponding stars was also compared. This also leads to the same result: More than 32000-7800 years ago the Angegh–Vulture (Cygnus) constellation, the rising and setting of its bright stars, zenith transitions and some other events[4] were observed in Armenia. This is evidenced by the vulture sculpture found in the Portasar (Göbekli Tepe) area dating back more than 11000 years (Göbekli Tepe's Pillar 43, The Vulture Stone Collins (2018) with additional research by Rodney Hale). The shape and position of this bird's beak is a clear proof that the constellation resembled a vulture (angegh in Armneian) and was named Angegh–Vulture by those who observed the visible stars o1 Cygni and o2 Cygni stars (see Figure 7a), and the name Swan appeared much later. Collins (2018)

[3]The central cromlech "intersects" through a series of 20 relatively small stones (from № 40 to 60), which P. Heruni called Chord.

[4]There are other noteworthy observations that we will touch upon in the next article on this monument.



a)

b)

Figure 7. a) The appearance and position of the Angegh–Vulture (Cygnus) constellation on the celestial meridian and zenith 31400 years ago. Göbekli Tepe's Pillar 43., The Vulture Stone: b) A stone with hole.

publication that Deneb and Sadr were viewed in Portasar 11000 years ago in conjunction with ε Cygni and δ Cygni stars also indirectly confirms the validity of our hypothesis. Of course, the observations of azimuths of stone holes and the discussion of the placement of these stones convincingly show that these observations took place 7800 years ago. This leads to the idea that some transformations to the monument must have taken place in those times. The point is that at that time Deneb and Sadr had "returned from the North" (Figure 3) and had been given the opportunity to be included in "observation program". Fortunately, such work, as we have seen, did not bring major changes to the basic layout. Undoubtedly, this astronomical observational complex has many layers, and is also evidenced by the waveform process of the North arm, the position of some of the separate menhirs we have discussed (eg № 173), etc.

If this megalithic structure was built 32300 years ago by the Angegh–Vulture (Cygnus) constellation model and was modified 7800 years ago to observe the Angegh–Vulture (Cygnus) constellation, preserving the logic (composition) of the structure, then it must be concluded that the knowledge was passed down through the generations without interruption and significant changes.

4. Conclusion

1) The Megalithic monument-complex now known as "Qarahunge Observatory" or "Zorats Qarer" was built using the Angegh–Vulture (Cygnus) constellation model for observations 32300-31400 years before us and has been in operation for over 25000 years.

2) During that time, 7800 years ago in particular, some transformations were made to adjust the positions of several stones with holes and the directions of their holes to the position of stars at the given time.

3) During this great period of time the transmission of astronomical and no doubt ritual knowledge has been without serious interruptions.

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