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# THE GREAT CHAIN OF THE GOLDEN HORN

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# THE TRUTH ABOUT THE GREAT CHAIN OF THE GOLDEN HORN

#### by Georgios Anapniotis, Architect and Researcher

I recently became aware of two texts online, entitled respectively "The Problem of the Golden Horn Chain" and "The Golden Horn Chain – Laboratory Analyses".

The first is basically a 250-page doctoral dissertation by Uğur Genç, undertaken at the University of Marmara under the supervision of Prof. Dr Selcuk Mülayim.

In this lengthy work, everything begins with the assumption that the various segments of chains and links on display at the Istanbul Military Museum in Harbiye, the Istanbul Naval Museum, the Roumeli Hissar Castle, and so on, belong to the Golden Horn chain. However, nowhere in this extensive text is there any kind of documentation. historical or otherwise. that convincingly demonstrates that these remnants come from the real chain of the Golden Horn. Only in relation to the historical existence of the chain of the Golden Horn are testimonies by historians presented. The work furthermore presents abundant material on the matter of of existing legends and traditions, naval warfare events and various chains of the same type or even smaller used in similar cases.

A large part of the work is taken up by the documentation, description or measurements of the various types of links and chain segments exhibited in the City's museums and the additional inclusion of a number of photographs of the supposed chain of the Golden Horn.

At the end of this long dissertation are two simplistic drawings, a sketched map of the entrance to the Golden Horn and eight very small computer-aided depictions, also simplistic, which awkwardly attempt to show the operating method of the chain, which consists of these unusual and relatively small links. One would have expected a university to guide the text's author, Uğur Genç, to study and research the matter mainly from a technical and technological perspective, which, however, would have been difficult as the writer's area of specialisation as a conservator is not really compatible with the subject.

The real "Great Chain of the Golden Horn" was comprised of very large and heavy links and was a tremendous port, engineering and architectural work, while these minimal representations tacked on to the end of Uğur Genç's dissertation are extremely disappointing. Firstly, in the sketched map the chain has been incorrectly positioned near the Galata Bridge and the length, at 500 to 600 m, is also wrong. In reality it was 750 m long, with one end positioned at a spot 250 m east of the north end of the bridge, and the other 800 m east of the south.



Secondly, the sketch depicting a view of a catenary curve of the chain and a vessel, the passage of which is hindered by it, is out of scale; the curve is too small and the vessel excessively large.

The enlargement of the vessel was probably deliberate in order to show the impenetrability of the obstacle, but the artist was caught in a self-made trap, as he or she did not realize that this small chain, supported to right and left by weak, rudimentary pontoons, would have been unable to withstand violent collision with a bulky vessel.



Thirdly, the eight small representations drawn on computer, which attempt to show the operation of the chain and include a winch and human hands, include many ambiguities and shortcomings.

The second uploaded on the internet is a short, 13-page article, the largest part of which is full of the results of laboratory analyses and tables of the alloy composition of the various links, of a chain presumed to be that of the Golden Horn. In this case too, everything begins with the same assumption that the assorted segments of chains with their links, which are exhibited in the various museums of the City that were mentioned in the previous work, belonged to the chain of the Golden Horn. Extensive laboratory analyses of the alloy composition of the links, of course, are by no means proof of the fact that the various segments of chain that appear in the photographs were part of the "Great Chain of the Golden Horn".



However, the strangest thing is that although the analyses were conducted with state-of-the-art instruments, nowhere in the results is the age of the segments and links in question referenced, which if it were, would perhaps allow certain useful conclusions to be drawn.

In any case, Uğur Genç's main concern regarding the chain in this second article is already evident from the title of his first work. In the second text, too, in one of the last paragraphs on the tenth page, he also notes that, "it would be useful to compare these segments of the chain with the composition of the ore that was extracted from the Demirköy region (Samako) and used as a source for iron production in the Ottoman state.

At the same time, such an investigation would throw light on an existing idea that this chain could be a product of the Ottoman period!"

After everything that has been written so far, the conclusion that emerges is that the identity of the segments and links that are on display in various museums of the City, has not in any way been defined. Which therefore begs the question, why do the titles of both works include the term "*Haliç Zinciri*", i.e. "The Chain of the Golden Horn"?

However, there are other questions too. Could a chain made up – according to measurements – of links only 50 cm long and 5 cm thick, and weighing 12 to 15 kg (even a child could lift one with both hands), withstand the enormous forces exerted on it by the whole system and repeated attacks by Ottoman galleys, firing iron cannonballs?

Between 2000 and 2005 the present writer conducted in-depth study and research on the "Great Chain of the Golden Horn". This work was judged by a panel of scholars from various fields and was consequently presented at the 2nd International Conference of Ancient Greek and Byzantine Technology held from 17 to 21 October 2005 at the Athens War Museum.

The whole process of evaluation and judgement of the submitted study and research, as well as the organisation of the conference, was under the supervision of internationally recognised civil engineer, Theodosios Tassios, professor emeritus of the National Technical University of Athens (NTUA), founder and former director of the Reinforced Concrete Laboratory of NTUA and former chairman of the Society for the Study of Ancient Greek Technology (EMAET).

After the conference, the work was included with the papers of a hundred other participants, both Greeks and foreigners, in a special volume published in 2006 by the Technical Chamber of Greece (TEE).

The subject of the "Great Chain of the Golden Horn" was published as a news item, in December 2005, in the monthly newspaper O *Politis*, under the title "Important Scientific Announcement at the 2nd International Conference of Ancient Greek and Byzantine Technology, by the writer Georgios Anapniotis, Architect Engineer".

In February 2006 the same newspaper published a full description of the same Chain.

Additionally, the Chain is included in detail, with numerous handdrawn sketches and maps in volume III of  $\Delta \epsilon \lambda \tau i \sigma \tau \eta \varsigma E \tau \alpha \rho \epsilon i \alpha \varsigma$  $M \epsilon \lambda \epsilon \tau \eta \varsigma \tau \eta \varsigma \kappa \alpha \theta' \eta \mu \alpha \varsigma A \nu \alpha \tau \sigma \lambda \eta \varsigma$  [Bulletin of the Society for the Study of 'Our Orient'] published in Athens in 2011.

Furthermore, the subject will comprise one of the most significant chapters on technology, in this author's book, currently in press, entitled *In Search of Byzantine Constantinople – Urban Planning, Architecture, Technology*.

Finally, detailed drawings and maps, along with depictions of various views of the Byzantine City, are on permanent display on the walls of the ground floor of the Cultural Centre of Constantinopolitans, at 46 Dimitriou Soutsou Street, Ambelokipi, Athens, tel. +30 210 646 4270.

As far as the shape of the links in the real Chain of the Golden Horn is concerned, there is a highly significant account in a book by Alexandros Paspatis, a doctor and Byzantinist from Constantinople, written in 1877 and entitled  $Bu\zeta\alpha v \tau v \alpha i$   $M\epsilon\lambda \epsilon \tau \alpha i$ [Byzantine Studies]. In footnote 4 on page 179, he references information taken from page 86 of the Greek Literary Association's fourth issue: "Regarding this chain, Mr Glavanis says that a link thereof is held in the arsenal of Tophane, and has the thickness of an arm, an oval shape and a size of over one metre."

Moreover, in his book *AI Eykataotáosiç twv Λατίνων εν Βυζαντίω* [The Settlement of the Latins in Byzantium], reprinted and published in 1996 in Athens by the Athens College Teachers Association, M. I. Nomides, another scholar of Byzantine studies from Constantinople, writes: "Sphrantzes, historian of the Fall, says that the chain was extremely heavy... the emperor ordered that this very heavy chain of iron be placed at the mouth of the harbour" (page 229, in the chapter dedicated to the chain of the Horn).



Furthermore, on page 230 of the same book, Mr Nomides, writes: "A section of chain kept at the church of Aghia Eirini, does not belong, as many have argued, to the chain of Constantinople's harbour, but according to many, to the chain that blocked the harbour of Rhodes." (There are extensive biographies of A. Paspatis and I. Nomides in the encyclopaedia *İstanbul Ansiklopedisi*.)

During the reign of Nikephoros II Phokas, in 969, the historian Leo the Deacon (born c. 950) informs us of the closure of the Golden Horn as a measure against an imminent attack by the Rus', as follows: "... He also secured to the tower that is usually called Kentenarion a very heavy chain made of iron, attached it to enormous logs, stretched it next to the Bosporos, and fastened it to a tower of the Kastellion on the other side." [Translated text from *The* History *of Leo the Deacon*, trans., Alice-Mary Talbot and Denis F. Sullivan, Dumbarton Oaks 2005.]



The historian and politician Niketas Choniates (c. 1150-1215), describing the siege of Constantinople in 1203 by the Franks of the Fourth Crusade, reported that they attacked the Galata Tower from which the chain that closed off the entrance to the Horn was suspended. When the fortress was captured, its defenders were either killed or imprisoned. Some, however, managed to escape by pulling themselves along the chain to thus reach the Byzantine ships.

This highly significant account is included in a small study titled "The Chain of the Golden Horn" by the French Byzantinist Rodolphe Guilland. This testimony by Choniates, would indicate that in order for some of the guards to escape by pulling themselves along the links of the Chain, these must have been very large. On the contrary, if the links had been the small, narrow and short links on display in the City's museums, they would not have been able to hold the fugitives, who would have lost their balance and fallen into the sea. Only had they been acrobats, could they have managed it! Finally, Guilland notes that the segments of chain that used to be displayed at Aghia Eirini, are probably unlikely to bear any relation to the chain that used to block the Horn. These significant accounts, in conjunction with the present writer's study and research, again demonstrate that the chain segments with various relatively small links, on display in the City's aforementioned museums, bear no relationship to the actual Chain of the Golden Horn. However, the testimony of George Sphrantzes – the only eyewitness account of the Siege and Fall in 1453, along with that of Niccolò Barbaro (the Venetian doctor who was in a galley near the Chain) – wherein the Chain is described as "extremely heavy", is sufficient in itself to clearly demonstrate the "truth". The same holds for Leo the Deacon's account, in which the Chain is described as  $\beta a \rho u \tau \alpha \lambda a v \tau o v$ , that is, very heavy.

As is well-known, from antiquity to the late 18th century, the mouths of man-made harbours were always closed with an iron chain the length of which varied from approximately 40 to 60 m. Most likely, the remains of the museum chains come from the many artificial harbors that existed in Constantinople, and throughout the Byzantine Empire. However, there is the possibility that these segments belonged to the secondary chains that were used for the necessary alignment, stabilisation and anchoring of the massive wooden pontoons that held up the many catenary curves of the Great Chain, as they are shown in detail in the present writer's well-regarded study. However, it may be the case, as has been reported, that these same segments of chain came from similar small ports that also existed in the Ottoman Empire.

# Brief History – Revival – Decoding – Results

In the first centuries of the Byzantine Empire's greatest strength, its powerful fleet deflected any risk of the enemy penetrating into the vital core of Constantinople, that is, the Golden Horn. Later, however, at the beginning of the 8th century, with the weakening of the fleet, the risk of invasion was constantly increasing, so architects and engineers devised a very heavy, robust and complex chain system with which they took the bold move of closing off the entrance to the Horn. If this had not been implemented and enemy ships had managed to penetrate into the Golden Horn, then the enemy could more easily have taken action due to the Horn's calm waters and the low and weak walls. The reason for the latter is due to the loose ground and the many alluvial deposits that could not bear the loads of larger and heavier structures.

It should be noted that such a venture to close off a natural inlet had never been done. This was, of course, achieved thanks to the advanced technology that existed in Byzantium and especially in Byzantine Constantinople, such as Greek Fire and the Emperor's Mechanical Throne, among other examples. It seems that in some later periods plans and attempts were made to close the Bosphorus too. However, the distance of more than 1000 m between the two coasts, the relatively great depth, e.g. from 70 to 100 m, the strong currents, the difficulty that guarding it would have entailed and the uncertainty of particularly securing the defence of the "historic triangle" in particular, conspired to prevent the construction – or to result in the failure of its initiation – of the Bosphorus chain, which would, in any case, have been without meaning.

In the texts of the Byzantine and Latin historians and chroniclers, there are numerous fragmentary references to the Chain of the Horn without, of course, providing any particular technical information. An exception is that of the Venetian doctor Niccolò Barbaro, who describes the system to a degree, but nothing more. From his daily record of the successive attacks by the Ottoman fleet, however, we can draw valuable conclusions about the role and function of the Chain in the successful defence of the Horn.

As it was rarely deployed – only in times when a dangerous enemy with numerous ships and an army was approaching – there were many generations who had never seen the Chain. However, there were, of course, many rumours about its existence, which is why it was even described as "legendary".

As a result of all this and the lack of relevant archaeological remains, a project in experimental archaeology was undertaken in order to provide a consistent documentation of the relevant

hypotheses, correlations, rationales, and so on: maps were unfolded, ancient Greek, Roman and Hellenistic technical achievements were studied, new maps and diagrams were drawn up, and, most importantly, a model was made at a scale of 1:80. At the same time, all the military maritime incidents that took place around the Chain were studied very carefully, especially those that occurred during the Siege and Fall of Constantinople in 1453.



ΠΕΙΡΑΜΑΤΙΚΗ ΜΑΚΕΤΑ Φαίνεται ο Μεγάλος Πύργος, ο Μεγάλος Τροχός, το Αντίβαρο, η 1<sup>η</sup> σταθερή αλυσίδα, από πάνω της η κινούμενη αλυσίδα, που γλιστράει, πάνω από τον μικρό τροχό του 1<sup>ου</sup> Πλωτήρα, για να βυθισθεί στο 2° άνοιγμα.

From a combination of all the aforementioned and, of course, the elaboration of a full study, the following technical and numerical results arise.



ALAFPAMMA AEITOVPRIAE THE ANVELAAE

ελέτη-Έρευνα:Γ.Αναττνιώτης, Αρχιτέκτων Μηχ/κος, Αθήνα 2006





# 1. The Exact Position of the Chain

Its southern end was on the side of Constantinople, 800 m east of the New Bridge of Galata, at the large Tower of Eugenius, near the current Sepetçiler Köşkü. Its northern end was attached to the Byzantine Galata Tower, a remnant of which today is the Yeralti Camii (Underground Mosque), which is 250 m east again of the New Bridge of Galata.

# 2. The total horizontal distance between the two ends is 750

**m**. (In Genç's doctoral thesis this distance has been incorrectly calculated as 500-600 m!).

The Chain consisted of a set of nine catenary curves, of which seven were permanently in place and two movable. There were ten support points, two on the towers on each side and eight on the tops of the extremely large pontoons that were pyramidal in shape.

# 3. The Links of the Chain

According to the unique account and description by Glavanis from 1877, the following were calculated:

Each iron link had the following characteristics –

Shape: Elliptical; Length: 1.20 m; Height: 0.80 m, Thickness: 0.18 m, Weight: 550 kg.



#### 4. The Pontoons

According to the calculations there were eight pontoons.

Construction material: Large tree trunks attached by iron plates.

The shape of the pontoons and the catenary curves of the chains comprised an impenetrable barrier.

The rectangular base – Length: 20 m; Width: 15 m; Height: 5 m (3 m below water and 2 m above).

Superstructure: Pyramidal shape.

Each of the first pontoons near the tower from which the chain is suspended, bears a slip wheel that is 3 m in diameter, which protrudes 7.5 m from the sea.

It bore a load of 920 tonnes from the two curved chains. The lowering and raising took place at every second opening which is

why the role of this pontoon along with the mechanism of the Tower, was very important.

At the top of the remaining six pontoons two curves of chain were joined in a stable, permanent fashion, and protruded a total of 6 m from the sea.

Total length of the pontoons:  $8 \times 20 = 160$  m and proportionally to the entire length: 160/750 = 21%

In other words, out of a total length of 750 m, 590 m were covered by the nine curved chains and 160 m by the total of eight pontoons: 590 + 160 = 750 m.

As can be seen from the diagram, for the system to function securely it had to be completely aligned. For this reason, each pontoon was anchored in the Golden Horn at each of its four corners, as otherwise, the currents would have dragged them out of line, with the risk of distorting the connections, disengaging them or breaking them.

(One of the three possibilities for the origin of the chain segments that are on display in the City's museums must be this, i.e. the secondary chains that stabilised the pontoons.)

Calculation of the total length of the auxiliary chains: Four anchorages on each pontoon with an average length of 30 m = 4 x30 = 120 m and for all eight pontoons = 8 x 120 = 960 m.

# 5. Suspension Towers – Operational Mechanisms

The floor plan of the large suspension tower: 22 x 16 m. The Chain's operational mechanism inside the Tower:

- i) A Large Wheel the Chain's suspension and rotation pulley, diameter 7 m.
- ii) A Large Counterweight suspended from the great wheel. With the addition and subtraction of weight, Chain function is achieved. A cylindrical wooden construction with a diameter of 5 m, gross height of 12 m, structural weight of 35 tons, supplemented with 70 tons of seawater on a permanent basis and the addition and subtraction of 47 tons of seawater for upward and downward movement.



#### 6. Water Tower

Attached to the back of the Great Tower, the Water Tower ensured the necessary additional load from the top of the counterweight.

The movement – lifting of the seawater – was done by a small channel that connected to the Golden Horn. The seawater first flowed into a basin within the floor at the base of the Water Tower and was moved upwards using a chained pump.

The above comprise principally the technical and quantitative elements of the Great Chain. However, other important results arise, one of which is directly related to an issue of historical fallacy and truth.

1) It results in the revival of a forgotten "technical work" of paramount importance for the defence of Constantinople, especially the Golden Horn – as vital as the famed Theodosian Land Walls – which is unknown to many.

2) The Chain opened and closed the passage very quickly from both sides, namely those of Constantinople and Galata, in, at most, 20 seconds for each phase. The handling of this gigantic system was very easy; it did not require any particular human strength and only three people were necessary. With this versatility of the Chain, the dromons, armed with Greek Fire – were able to rush out from either the side of the City or of Galata, in order to pursue the enemy, and in reverse, could enter very quickly through the chain to protect themselves without enemy ships being able to enter the Horn in time, as the Chain would immediately block the entrance. From the above, we understand that the Chain functioned as a regulator of the tactics of naval warfare in the Horn, the Bosphorus and Marmara.

3) Enemy ships approaching the Chain would have been under fire from three points at the same time. From the Galata Tower, from the great Tower of Eugenius on the side of Constantinople, and from the ships on guard from within.

4) The Chain, like the battlements of the walls, could not be breached in any way, as long as it was properly guarded. There was no need for many ships to defend it. In the last Siege of Constantinople in 1453, only three Byzantine ships and seven others belonging to Christian allies were arrayed behind the Chain, and these repelled many attempts by 300 Ottoman galleys to breach it.

5) The Chain was not used to block the entrance to the inlet continuously except in very dangerous periods when a great enemy was present. The setting out and gathering up of the Chain was a very difficult and arduous undertaking.

6) The entire system of the Chain was a complex and very largescale technical project, which is basically classed as port works, but also belongs to the categories of fortification architecture, ship building, and mechanical and hydraulic technology.

7) Finally, one of the most important results of this study is the restoration of a historical truth.

a) On 21-22 April 1453, 70 small Ottoman galleys were dragged across the land from the Bosporus to the bay of Krenides / Kasımpaşa to the rear of the Chain.

This endeavour by Sultan Mehmet II has been overestimated by many historians to the degree that they view it as breaking the defence of the Horn.

However, when we very carefully read what Niccolò Barbaro, the Venetian physician who was the only eyewitness to the events in the Golden Horn, recorded in his journal, we find that this small fleet did not dare to aggravate the few Christian vessels guarding the Chain from behind, nor to cooperate with the large fleet outside it, in order to encircle them.

b) This small fleet then made some sporadic assaults on the walls further into the inlet, mainly around the Phanar, and attempted to distract the few Christian ships at the Chain. When, however, it realised that it was in danger from the shots it was receiving from the walls and potential attack

from some of the small Christian ships in the second line, it immediately returned to the deep waters of the great inlet where it was safe from the artillery and guards of Zaganos Pasha.

c) Almost all the later historiography of the events of the Siege and Fall of Constantinople was based on the four main Byzantine historians of the period of the Fall, and of course, Barbaro. Of these only Michael Critobulus references the Great Chain breaking towards the end of the successive attacks on it by the Ottoman fleet. Accepting this account without any further research, many historians tell the same story. When he wrote his story, Critobulus, was far from Constantinople and he collected his information second hand. On the other hand, Barbaro, who was at the scene, records the opposite. He constantly glorifies God, because, thanks to the Chain, they were able to protect themselves and successfully keep the Ottoman fleet out of the Horn till the end.

d) On the morning of 29 May 1453, the Ottoman army entered in waves through the Theodosian Land Walls, heading straight to the residential areas for looting. On the other side, having failed to jointly break the chain and seeing the land army approaching closer and closer to the Horn and Marmara, plundering everything before them, the sailors of the Sultan's two fleets, one small and one large, forced the masters of their ships to drop anchor or haphazardly pull into shore, in order to join in the looting.

NAYMAXIA-MAXH THS METANHS ANVCIDAS-18"ANPINIO 1453-H I" ANOTYXIA NAPABIACHS TISATIO TOS TOPKOS



So, with this opportunity at dusk, under cover of the coming darkness and cannon smoke, the Christian ships sought a way to escape. Soon, however they realised they were trapped behind the blocked Chain, as the operators inside the two towers had either been killed or had escaped.

One of the Christian ships then approached a pontoon which two brawny sailors set upon and by wrenching the connection, opened a passage, through which some 15 Christian vessels come out, one after the other, thus saving the lives of 3-4,000 people of Constantinople, who were able to board these ships in time. Later on, through the same passage of the Chain that had been opened by the Christians, the Ottoman galleys that had in the meantime regrouped, entered the inlet, capturing whatever ships were not able to weigh anchor in time had been or decommissioned.

That was the end of the Great Chain of the Golden Horn, and this is the "Historical Truth", which we can learn with accuracy only from the journal of the sole eyewitness, the Venetian physician, Niccolò Barbaro.

#### EPILOGUE

From when the Chain first appeared in about 715, until the Fall in 1453 – a period, in other words, of 738 years – Byzantine historians and chroniclers recorded only five cases where the entrance to the inlet was closed to enemies. Assuming that at least three more closures were omitted or were not known to the chroniclers, again the total number is extremely small, and the frequency of closure is extremely high. This again demonstrates how difficult and arduous the task of setting out and gathering up the chain was, but also how difficult it was to build such a large, complex and costly defence work.

However, a major question arises: was the Chain that first appeared in 715 always the same chain until its last appearance in 1453?

The present writer is absolutely convinced that yes, it was the same! Of course, whenever its use was required, various repairs or the replacement of worn or damaged parts (as happens with a machine put to use after many years of inactivity), would have been undertaken. Such a difficult and costly construction could only have been carried out when the Empire was still powerful in economic terms and with the appropriate human resources, such as scholars, artisans, engineers, architects and others.

This in particular was still feasible in Byzantium from the 7th to the early 12th century. So, no matter how worthy of admiration the design of the Chain constructions were, keeping, maintaining, and repairing this same tremendous construction for 738 years is equally worthy.

We have come to learn the role and importance of the Chain in the defence of the Horn mainly from the period of the Siege and Fall of Constantinople in 1453. The Byzantium of this period, weakened economically, shrinking territorially and with a paucity of human resources, its life cycle coming to an end, could not have constructed this extraordinary barrier system for the Golden Horn. This was a precious, age-old, ancestral legacy to keep the Queen

of Cities as safe as the apple of one's eye because for centuries this City equalled the entire Empire.

From all that has been said so far, one can understand that the Great Chain of the Golden Horn bears no relation to and cannot be compared either in size or in its operation mechanism with any typical case of closing a small artificial harbor, which was implemented from antiquity until the end of the 18th century.

Never before in history, either before or after Byzantium, has a similar case been recorded.

Finally, in no case do the various small segments of chains that are exhibited as "war trophies" in the museums of the City come from the historically unique Great Chain of the Golden Horn.