Flying Buttress and Pointed Archin Byzantine Cyprus

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The island of Cyprus is situated where the Mediterranean Sea meets the continents of Asia, Africa, and Europe. As a consequence, artworks of every major western civilization have been preserved within its borders. For the architectural historian, the island's Byzantine monuments are especially intriguing due to the quantity, typological variety, and experimental forms.[1] For example, the earliest systematic use of both the flying buttress and pointed arch appear on Cyprus.

Flying buttresses have been documented throughout the former Byzantine Empire. In most cases this feature was added to preexisting buildings, and as such, they have been difficult to date without textual evidence. And so it was assumed that the establishment of the Latin Empire of Constantinople in 1204 introduced this new "Gothic design" to older Byzantine monuments.[2] This was not only a convenient way to privilege western innovation, but for 19th c. scholars, like Camille Enlart, Crusader architecture also symbolized western hegemony in the Near East.[3] Such beliefs coincided with European imperialism at the time.[4] Archaeological research in Cyprus over the past hundred years has begun to challenge such notions, and now a different narrative is emerging.

Flying Buttresses in Salamis-Constantia

Salamis-Constantia was once the Byzantine capital of Cyprus, as well as the seat of its powerful archbishop. There in 1964, Dr. Vassos Karageorghis uncovered a series of preserved flying buttresses at the Grand Baths near the exterior side of its north wall.[5] (**Figs. 1–2**) A fourth one is located inside the north wall, near the praefurnium (**Fig. 3**), while other examples once stood on the east and south wall but had already collapsed. (**Fig. 9**) For the sake of brevity, I will only provide here an analysis of the preserved examples. Those on the north walleach consisted of a massive pier-buttress built against the wall, measuring about 2 m wide, 1.5 m deep, and 5 m tall. Their masonry is made of large ashlars, rubble, and spolia, including column drums.[6] In order to brace the upper extremity of each pier, quadrant arches—known as flyers—rise from the ground at a 30 degree angle; these foundations are about 5 m in depth. (**Fig. 4**)

1 Stewart (forthcoming).

2 *See* the discussion in Ćurčić 2004, 7-8.

3 Stewart 2010, 180.

4 Stewart (forthcoming).

5 Karageorghis 1966, 297-389.

6 Ibid. *Compare* the slightly restored sections in the photograph here (Fig.2) with Karageorghis' excavation photo, fig. 144, pg. 382.

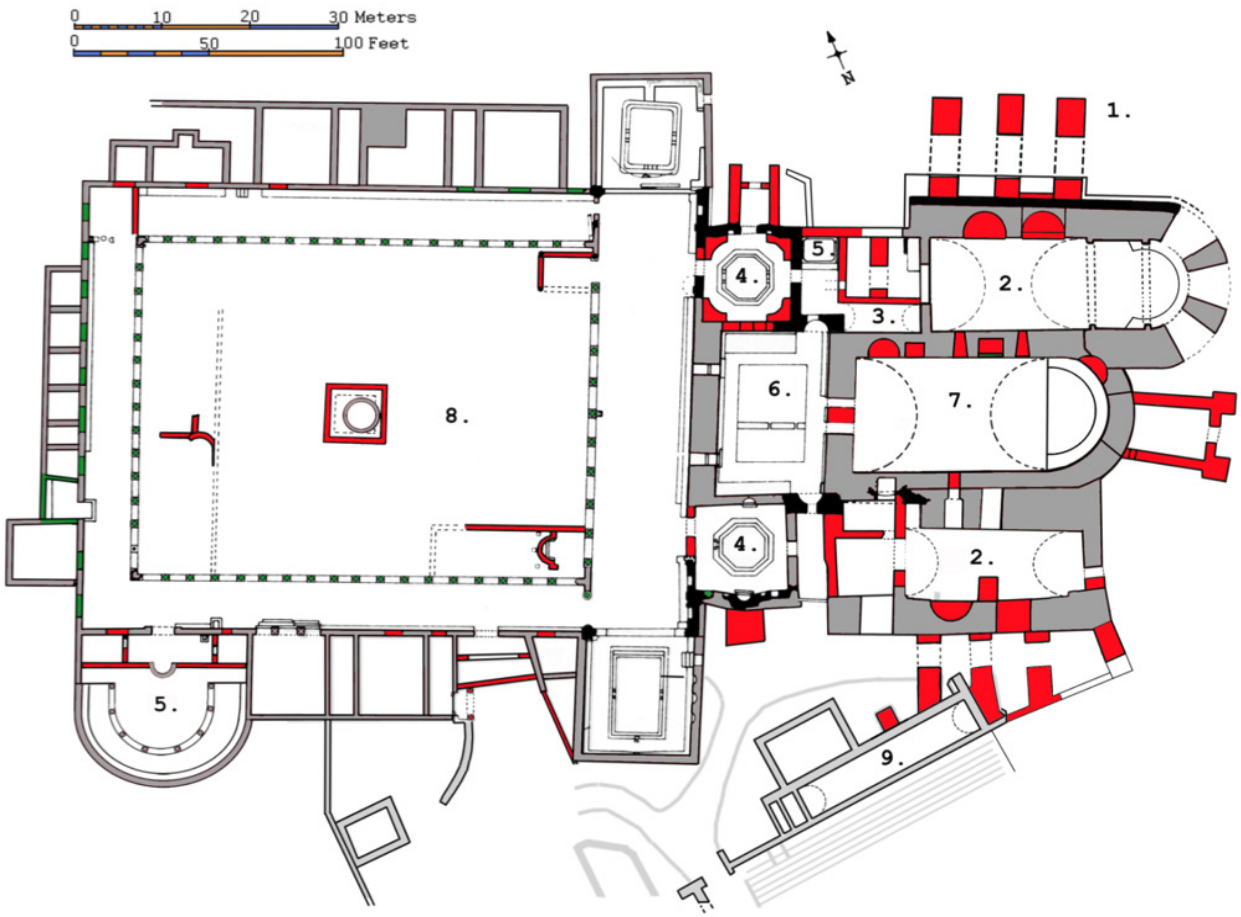

Fig. 1: Plan of the Grand Baths at Salamis-Constantia. Key: Black = 3rd century remains or earlier; Grey = 4th century reconstruction over earlier foundations; Red = later renovations up to the 7th century. 1. Flying Buttresses; 2. Sudatoria; 3. Praefurnium; 4. Frigidaria; 5. Conclavia (latrines); 6. Tepidarium; 7. Calderium; 8. Palaestra; 9. cistern. Redrawn with sketched modifications after Karageorghis, 1969b.

Fig. 2: Grand Baths at Salamis-Constantia. View of north wall's flying buttresses, towards the west.

Fig. 3: Grand Baths at Salamis-Constantia. Internal flying buttresses near the praefurnium. Substructure is beneath floor level.

In order to prevent shear failure of the north sudatorium's barrel-vaulting, the buttresses were placed along the exterior where the vault sprung from the wall. (**Fig. 5**) The area was weak due to the original design of the floor plan, which included two semi-domed chambers embedded in the wall. (**Fig. 6**) This is further supported by the fact that these chambers were entirely filled-in with masonry when the buttresses were added.

The pier-buttresses were constructed first. At some point, however, these were reconstructed to include flyers. It is important to note that all three piers appear to bend slightly outwards, which indicates that some time had elapsed, causing the vaults to push the tops of the piers outward. When the flyers were added later, their voussoirs were built into the piers rather than against them. The slanting surface of the arches served as a counterforce, pushing the piers against the vault's springing.

It must be stressed that this was an experimental solution. If the pier-buttresses were successful, the flyers probably would not have been employed. In fact, massive pier-buttresses had already been used on the Bath's southern wall. (**Fig. 8**) So why did the builders use flyers instead of merely thickening the pier-buttress? I propose that the water channel underneath provides an obvious answer. (**Fig. 7**) This channel runs from the cistern in the

Fig. 4: Grand Baths at Salamis-Constantia. View of north wall's flying buttresses, towards the south.

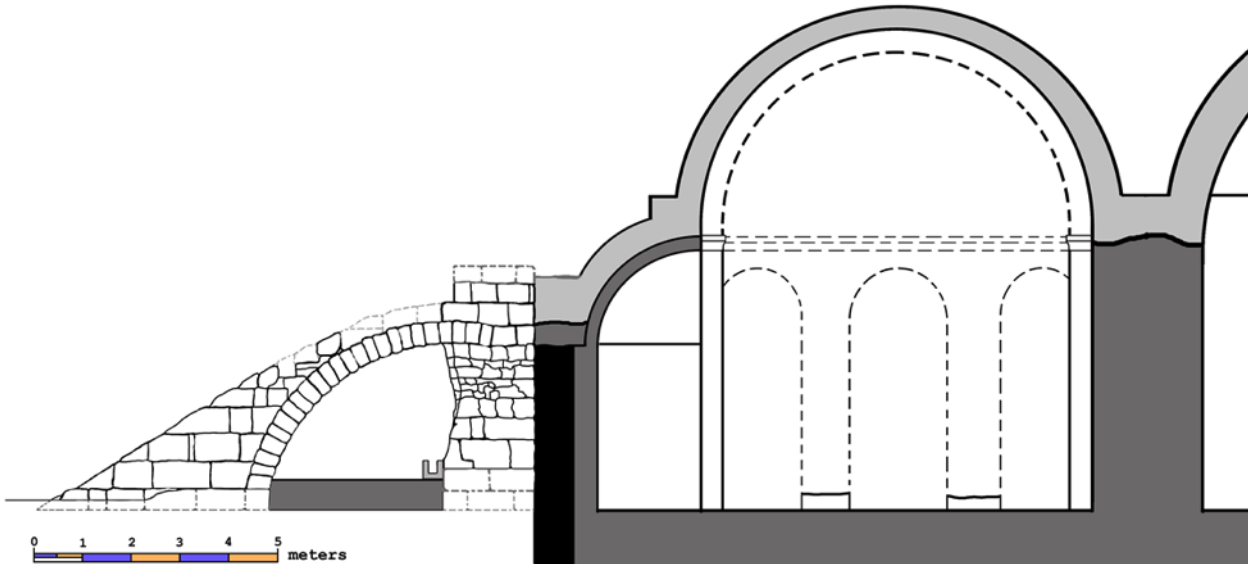

Fig. 5: Grand Baths at Salamis-Constantia. Diagram illustrating the how the flying buttresses strengthened the barrel-vaulting of the north sudatorium. Key: black = original Roman wall; dark grey = current remains of the bath; light grey = hypothetical vaulting.

south, around the eastern end, and then on to the praefurnim and latrines. So the flyers gave the necessary support, while also bypassing the water channel that was already calibrated and functioning in place after the pier-buttresses were constructed. In other words, the construction of flying buttresses allowed the water to keep flowing, permiting the Grand Bath to stay open while repairs were made.

Fig. 6: Grand Baths at Salamis-Constantia.North wall of the sudatorium showing two apsidal chambers blocked-up which coincided with the construction of the flying buttresses on the other side.

Fig. 7: Grand Baths at Salamis-Constantia. Exterior of north wall showing the water channels running beneath the flying buttress.

Dating the Flying Buttresses

While the foundations of the Grand Bath go back the 3rd c. AD, most of the structure was rebuilt and modified in the middle of the 4th c. Afterwards there were several phases of restoration. Because the entire complex was abandoned by the eighth century and subsequently buried, the archaeological context was sealed. The excavators, using stratigraphy that contained coins and inscriptions, were able to match building phases with those layers. However, the complexity of the building caused competing interpretations to develop.

It was clear that the water channels below the flyers were built immediately above the debris of a 4th century earthquake providing a *terminus post quem* date. Initially, Dr. Karageorghis attributed the flying buttresses to the same century, assuming that the earthquake damage necessitated these remedial measures.[7] While this interpretation is still valid, there are other factors to consider. In fact, his thesis was slightly at odds with his co-excavators, A.H.S. Megaw and A.I. Dikigoropoulos, who had already identified several phases of rebuilding in the sixth and seventh century.

Earlier in 1957the team had discovered an inscription associated with a final restoration above the tepidarium. It stated:

ΑΓΑΘΟΙΒΑCΙΛΕΙCΕΥCΤΟΡΓΙC[ΤΗ]ΝΠΟΛΙΝΑΕΝ[ωCΑΝ]

(…the Holy Emperors…out of love…the city restored…).

Thiswall inscription had collapsed with the vaulting into the hypocaust, which sealed coins within, dated to the middle of the 7th century.[8] Regarding the inscription, there were not many periods in Byzantine history when there was more than one emperor. The most common occurrences of the title "Holy Emperors (Αγαθοι Βασιλεις)" is found in texts dating to Justinian and Theodora. So the excavators tentatively hypothesized that the earthquake of A.D. 528 recorded at Antioch had also affected Salamis-Constantia; and so, they argued, Emperors Justinian and Theodora had sent funds to repair the damage at the Baths a few years later.[9] This interpretation was strengthened by the similarities between this inscription's epigraphy and the "ChytroiTitulature Inscription" which was, at the time, assumed to be Justinianic.[10]

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7 Karageorghis 1967, 354.

8 Megaw1957, 47.

9 A.H.S. Megaw reported: "In their last state the walls and vaulted roof of the tepidarium were…plastered and painted…with simple geometric patterns…It seems reasonable to connect this inscription with the Byzantine restoration, of which the building of the tepidarium where it was found was one of the major undertakings. That restoration had already been dated tentatively to the reign of Justinian… [prompted by] the possible effects on Salamis[-Constantia] of the earthquake which destroyed Antioch in A.D. 528…: 1957, 47. Other inscriptions discovered within the Bath in 1958 mention a hypatikos and consularis named Ioannes who restored the sudatorium, which was also attributed to the mid-6th c.: Mitford and Nicolaou 1974, 76.

10 The "Chytroi Titulature inscription" is a significant monument that testifies to imperial Byzantine activities on the island. It was found in the mountain city of Chytroi where the springs fed the aqueduct to Salamis-Constantia. During the Byzantine period the city held one of island's 12 bishoprics: Sodini 1973, 373-384. The inscription was most likely set up by the Emperor Phocas and was later modified by Heraclius (*see* note 19 below).

Fig. 8: Grand Baths at Salamis-Constantia. Massive pier-buttress on the exterior of the south frigidarium.

As time progressed, however, this thesis was modified due to the irregularly of the massive pier-buttresses on the southern wall, which seemed to belong to a much later period (**Fig. 8**). Their masonry and construction were conspicuously unlike the rest of the structure. A.H.S. Megaw suggested

> …in the last repairs a massive buttress was built against its outside face, an addition which evidently post-dates the mid-seventh century Arab raids, since late material and much burnt matter is used in its construction…But the building is unlikely to have survived…[after] 691 A.D."[11]

If this were the case, then the inscription most likely dated to the same phase. Therefore Megaw and Dikigoropoulos, who were both Byzantinists, concluded that the "Holy Emperors" inscribed were Constans II and Constantine IV (co-reigned 654-668).[12] Few were persuaded by this new interpretation, including Dr. Karageorghis, who continued the excavations after Megaw and Dikigoropoulos had left the project. Being an expert in the pre-classical and classical world, Dr. Karageorghis' publications would emphasize the Roman fabric of the building.[13] Moreover, since the 1974 Turkish invasion of Cyprus, Salamis-Constantia was inaccessible to architectural historians working in the Republic of Cyprus, and so the Byzantine phases of the Baths were all but forgotten.

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11 1957, 47-48. Today archaeologists working in Cyprus no longer associate burnt materials in the mortar as necessarily a post-Arab characteristic of construction. This kind of mortar seems to have been used in the Levant from the early 7th century through the 13th: *see* Balandier 1999, 676 n.16.

12 Megaw 1958, 31-32; Dikigoropoulos 1961, 22-23.

13 Karageorghis 1969b; 1999.

Fig. 9: Grand Baths at Salamis-Constantia. Remains of the flying buttress on the exterior of the south sudatorium, east of the cistern. Notice the water channel underneath.

In 2003 the political situation eased travel restrictions, which allowed me to spend considerable time reassessing the construction of the baths, in conjunction with reviewing the excavation archives in the Department of Antiquities in Nicosia. It became clear to me that the Byzantine phase belonged to a much more substantial rebuilding program than previously thought. The blocking of doors and chambers, as well as the massive pier-buttresses, changed the character and ground plan of the complex. The flying buttresses and the massive pier-buttresses plainly belonged to same renovation phase, since their design and masonry are identical. Two of these piers sloped upward at an angle like a counterfort, which in principle is similar to how the flying buttresses were designed. Likewise three of the southern buttresses seemed to also have had flyers, though they do not survive—this is made evident by the water channels that lay underneath (**Fig. 9**). If this were the case, then a sense of symmetry was preserved with three flyers to the north and three flyers to the south (**Fig. 1**). In certain areas the upper levels the walls were rebuilt, which would imply that the vaulting was also reconstructed during this period. Afterwards the interior rooms were redecorated with aniconic frescos, marble revetment, and opus sectile floors in thoroughly Byzantine fashion.[14]

So if the all buttresses are Byzantine, when were they built? All scholars had agreed that they were constructed after the mid-4th c. but prior to the 8th. The inscription and coin evidence thus become key indicators for narrowing down the date. It seems highly unlikely that the "Holy Emperors" mentioned were Justinian and Theodora, simply because they

14 Megaw1957, 47; *see* note 9 above.

were uninterested in Cyprus.[15] That is why the excavators changed this attribution in favor of Constans II and Constantine IV.[16] As mentioned above, this new designation was not well-received by the scholarly community. The reasons are clear. In 649 and 650 Cyprus was invaded by the Arabs which caused much destruction throughout the island. Moreover, Arabs began to colonize the island under a treaty, in which Cyprus became a neutral territory, paying taxes to both Constantinople and Damascus. This arrangement would last for 300 years.[17] In other words, it seems rather unlikely that these emperors would send money to repair a bath, while allowing the island to be pillaged and occupied by foreign troops.All archaeological and textual evidence indicates that the Empire had ceased investment on Cyprus after the initial Arab raids.[18]

This leaves us with only one possibility. I suggest that the inscription refers to the Emperor Heraclius and his son Constantine III who ruled jointly from 613 to 641.[19] Thus the flying buttresses belong to this timeframe.[20] They should be associated with Heraclius' interest in the Cyprus as a testing ground for Monotheletism.[21] In return for the Church of Cyprus' cooperation, the emperor invested in the island's infrastructure, attested by a large spike in coins found in controlled excavations.[22] As explained below, the renovation of the Grand Baths coincided with the reconstruction of the adjoining aqueduct which was clearly paid for by Heraclius and the local archbishop.

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15 Procopios only mentions Cyprus once, and that concerned a relatively unimportant rural aqueduct: *Buildings*: V.ix.36, ed. Dewing 1940, 361. It seems unlikely that he would record this structure, but omit mention of the Grand Baths at Salamis-Constantia. While many, including myself, have searched for Justininianic investment in Cyprus it has been difficult to establish with the current archaeological evidence.

16 The primary reason why they changed their interpretations is found in A.I. Dikigoropoulos' doctoral dissertation, which argued that Salamis-Constantia was renamed "Nea Justinianopolis" under Justinian II in 691. By establishing the Heraclian dynasty's investment at Cyprus' capital at an early date, it made this thesis more tenable. However, Benedict Englezakis has persuasively shown that this hypothesis was incorrect: 1995, 63-82.

17 For a thorough overview of the Arab occupation of Cyprus *see* Christides 2006.

18 Bruce Mitford and Ino Nicolaou put it this way: "The lights already had gone out on the Cilician and Pamphylian coastlands as far west as Lesser Cibyra. That [Salamis-Constantia]…sacked and its population massacred, should now indulge in a *floruit* is to us barely credible." 1974, 6. Regarding imperial indifference towards Cyprus, *see* Mango (1976) and Dikigoropoulos (1940-1948: 94-114).

19 A.H.S. Megaw initially dated the Grand Bath's inscription to Justinian I based on the close epigraphic similarities between it and "Chytroi Titulature inscription": Megaw 1957, 47. He assumed the later was Justinianic based on the earlier analysis of Mitford (1950, 128-132). And Mitford and Nicolaou would later uphold Megaw's original dating: 1974, 69-70. Apparently they were unaware that Jean-Pierre Sodini persuasively argued that the Chytroi inscription had to be later, attributing it to Tiberius II (reigned A.D. 578-582): 1973, 373-384. And yet, Sodini admitted that the chiseling-out of the emperor's name meant a *damnatio memoriae* was issued. The only emperor who garnered such hostility was Phocas during the reign of the Emperor Heraclius: Ostrogorsky 1969, 85; Varner 2004, 8; or less likely, the Emperor Maurice; Efthymiadis 2011, 53.

20 Dr. Karageorghis has kindly affirmed that his interpretation of the flying buttresses allowed for an Early Byzantine date (Personal communication 2/30/11).

21 The Third Council of Constantinople of 680 records the special role that Cyprus served under Heraclius' attempts to implement Monotheletism: Mansi, XI, 525B, 561AB. J.B. Bury puts it this way: "Perhaps the success of this attempt at unity [regarding Montheletism] on a small scale within the limits of the island encouraged him to apply afterwards the same balm to the wounds of the entire Empire": 1889, 251.

22 Metcalf 2009, 151-155.

Fig. 10: Chytroi-Salamis-ConstantiaAqueduct. View southward.

Fig. 11: Chytroi-Salamis-Constantia Aqueduct. Remains of seven piers. View eastward.

Pointed Arches in Salamis-Constantia

The Grand Baths could only function if there was a steady supply of water toSalamis-Constantia. While the island is surrounded by the sea, fresh water becomes scarce during the arid summer months. The main aqueduct to Salamis-Constantia spanned 25 miles northwest from the springs of Chytroi in the Kyrenian Mountains.[23] Seven piers of the aqueduct still stand above ground, the furthest about 2.3 km to the northwest of the city (**Fig. 10**). A dozen more piers have been exposed over the last two years due to farming and road repairs (**Fig. 11**). The westernmost section is the best preserved, displaying two intact pointed arches. By calculating the slope and distance between the other piers, we can assume that all the arches were pointed. In terms of measurements, the intact section stood about 7.5 meters in height; each base was roughly 2 meters square; from the base to the point of the arch was 3.2 metersin height; and the arches spanned 3.5 meters (**Fig. 12**). The masonry consisted of local irregularly-cut Cypriot limestone with a rubble core, mixed with tile fragments and burnt material.[24] Curiously, the masonry between arches and the channel consisted of smaller irregular stones laid in either two or three courses.

23 Chytroi also held an important bishopric in the Byzantine period: Grégoire 1907, 209-212; Jenkins 1949, 267-275.

24 For the analysis of the water capacity in the Chytroi-Salamis-Constantia Aqueduct, *see* Baur 1989, 208-211.

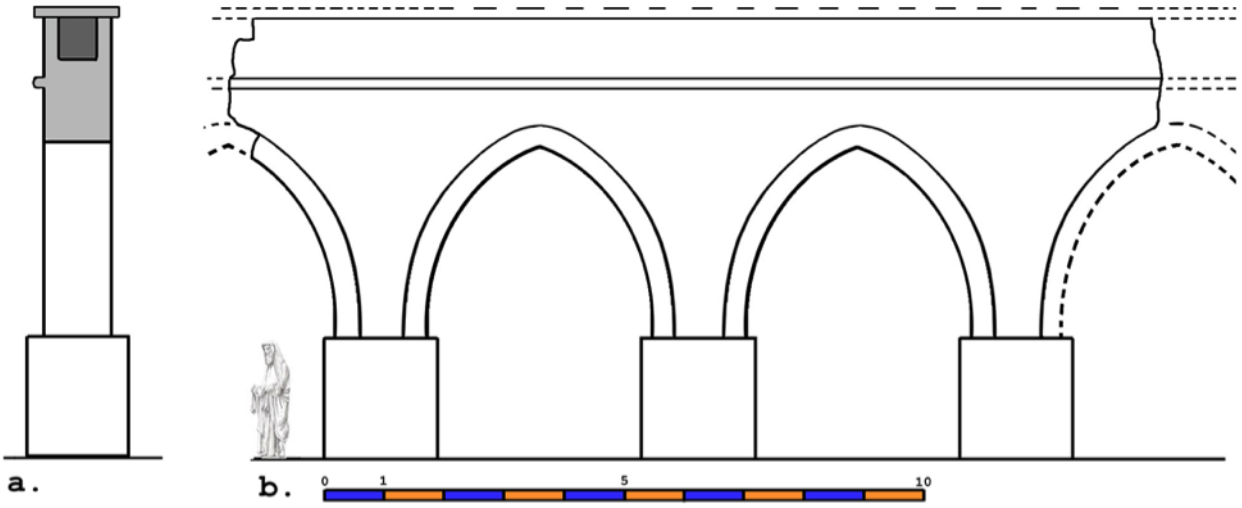

Fig. 12: Elevation of the Chytroi-Salamis-Constantia Aqueduct: a. cross section; b. elevation.

Fig. 13: Inscription (red highlight insert) on the Chytroi-Constantia Aqueduct. A.D. 619.

The Chytroi-Salamis-Constantia Aqueduct dated back to at least to the time of Emperor Nero.[25] But remains of this structure have not been found. In the city of Chytroi was found an imperial "Titulature Inscription" which implies a major rebuilding of the aqueduct took place in the Byzantine period.[26] Though the remains are fragmentary, it is clear that at some point, theEmperor's name was deliberately chiseled-out, which meant a *damnatio memoriae* was issued—most likely targeted at Phocas (reigned A.D. 602 to 610) by Heraclius.Such epigraphic evidence indicates that the Roman emperors had maintained the Chytroi-to-Constantia Aqueduct for about 600 years.

25 Neronian inscription: Nicolaou 1963, 48; *Supplementum Epigraphicum Graecum* 23 (1968), no. 675.

26 *See* notes 10 and 19 above.

The aqueduct, however, is far from the "typical" Roman examples in the region, such as at Caesarea in Palestine (**Fig. 16**) or Aspendos in southern Anatolia. The surviving sections near Salamis-Constantia were built from scratch, showing no evidence of earlier foundations or spolia. Either these pointed-arched sections replaced older areas of the Roman aqueduct or were built alongside it. But, as I already mentioned, foundations of an earlier aqueduct have not been found.[27]

Dating the Pointed Arches

On the surviving sections of the aqueduct two inscriptions remain in the spandrels. The one illustrated here (**Fig. 13**) states:

ΨΕΓΕΝΕ[ΤΟΤΟ] ΕΡΓΩΝΕ[ΚΤ]ΟΥΤΩΕΠΙΠΛΟ[Υ]ΤΑΡΧ[ΟΥ] ΤΩ

[Α]ΓΙΩΤΑΤ[(ΟΥ) ΑΠΡΧΙ]ΕΠΙCΚ[ΟΠ]Ο[Υ] Ψ

[Ψ Erected were these, under Ploutarchos, the very holy Archbishop Ψ]

Though these do not mention a date, six other inscriptions survive with their indiction dates intact, and these have the same formula and style.

Professor Jean-Pierre Sodini has fully analyzed and published these inscriptions, so I will only briefly describe them here.[28] Three inscriptions mention Archbishop Ploutarchos; two mention the Archbishop Arcadios, and one mentions the Emperor Heraclius.[29] We can assume that the latter inscription was the last, since it contains the most information at the terminus:

ΨΕ[ΓΕΝΟ]ΝΤΟCΥΝΘ[Ε]Ω Κ[ΑΙ] ΑΥΤΑΙ Ε ΑΙΠΤΑ ΑΨΙΔΕC ΕΚ ΤΟΝ

ΦΙΛΟΤΙΜΗΘΕΝΤΩΝ ΠΑΡΑ ΦΛ(ΑΒΙΟΥ) ΗΡΑΚΛΙΟΥ ΤΟΥ ΘΕΟCΤΕΠΤΟΥ ΗΜΟΝ

ΔΕCΠΟΤΟΥ ΑΠΟ ΤΟΥ ΙΠΠΟΔΡΟΜΟΥ. ΜΗ(ΝΟΣ) ς'Ιδ Ψ

[Ψ Were made, with the help of God, these seven arches, also
thanks to generosity of Fl(avius) Heraclius, our ruler crowned by God, from the hippodrome
the sixth month, 4th indiction Ψ]

According to Sodini, these inscriptions can be dated as follows: Ploutarchos was responsible for portions of the Aqueduct built between 619 and 625; he was succeeded by Arcadios who

27 According to Eugen Oberhummer, who conducted surveys around Chytroi, the aqueduct was "partly constructed above ground, and partly lying on the ground as a channel": 1931, 232. Perhaps most of the older Roman aqueduct was at ground level and therefore, less conspicuous and easier to dismantle over the centuries.

28 Sodini 1970, 477-486; 1998, 619-634; *see* also the analysis of Denis Feissel, in Pouilloux et al. 1987, 83-85; Mitford 1950, 128-132.

29 Sodini 1998, 633. While no Byzantine source records the Archbishop Ploutarchos, the early 7th c. Archbishop Arcadios was mentioned by John, Bishop of Nikiu (Egypt) in his *Chronicle* 120.64 (ed. Charles 1916, 190) and the Syrian Bishop, George of Reshaina, *Syriac Life of Maximus the Confessor* (ed. Brock 1973, 315–7).

Fig. 14: Inscription (red highlight and insert) with the date A.D. 625 from the Chytroi-Constantia Aqueduct, in secondary use within the late-11th c. PanagiaTheotokos Church at Trikomo.

constructed the final arches to Salamis-Constantia; and lastly, Heraclius was credited for its completion in 631.

Because we have dates and fixed distances, calculation of the construction rate is possible. It took about twelve years to build the last 2.3 kilometers of the aqueduct. That seems rather slow. If the aqueduct was built from scratch beginning at Chytroi, using the same work rate, then the entire project would have spanned 208 years. However, the inscriptions provide us a second set of information we need to consider: the final portion was completed in phases, with some inscriptions specifically marking out the number of arches built at each stage. These mention 5, 3, 10, and 7arches. Therefore, none of the phases were consistent in duration or output; the workers' productivity was affected by external factors, such as the availability of local and imperial funds, and thesefluctuated widely. Nevertheless, we can as-

sume that the project started either in the late 6th century or in the early 7th at Chytroi, as indicated by the "Titular Inscription".

The two inscriptions on the standingaqueduct are contemporaneous with the pointed arches. As Sodini observed, it is highly unlikely that these inscriptions were reused in a secondary context, since 1.5 km separate them and yet they appear exactly the same way. That is, both inscriptions are in the center of the spandrels, between voussoirs at the same level, and on the same side, below the molding marking the bottom of the water channel.[30] They appear to have been carved in situ after the arches was erected since some of the letters mark the adjacent ashlars. And besides, the masonry is uniform indicating no later repair or intervention.[31] By 1100 the aqueduct was no longer in use, since its ashlars were mined and reused by the builders of the nearby Panagia Theotokos Church at Trikomo (**Fig. 14**).[32]

Why the Pointed Arch?

Round arches had a long history in the Roman monuments of Cyprus. What would prompt Cypriot builders to break from this tradition? While any answer without documentary evidence is speculative, there is enough data to provide a reasonable hypothesis. Cypriot engineersand architects were confronted with considerable problems. They were commissioned

30 Sodini 1998, 623. In comparison, the Trajanic inscriptions at the Caesarea Maritima (Israel) aqueduct are located in the same areas of between the spandrels below the water channel molding. They mention the Tenth Legion as its builders.

31 Though the Byzantine dating of the aqueduct is straightforward, some prominent publications have described them as Gothic. This idea was first propounded by Camille Enlart who assumed that pointed arches were a distinctly French invention: 1899, 514. Though his scholarship was pioneering, Enlart's theories were colored by his slight nationalistic tendencies: Coldstream 1987, 3-4. And so he hypothesized that the Greek inscriptions were reused, when the aqueduct was rebuilt with the pointed arches in the Gothic period (13th or 14th century). He imagined that the Crusaders rerouted it to the relatively new city of Famagusta. Famagusta is located five miles south of Salamis-Constantia; and by the thirteenth century, the former city had eclipsed the latter. It should be mentioned that even earlier, the 18th c. writer, Richard Pococke, categorized the aqueduct as "Gothic": Cobham 1908, 256. But Enlart's assessment had more influence on scholars; for example his hypothesis was republished by the art historian Rupert Gunnis and, rather surprisingly, by archaeologist G.R.H. Wright: Gunnis 1936, 420; Wright 1992, 233. However, most archaeologists rejected Enlart's theory, since Famagusta never had an aqueduct, as exhibited by its archaeological remains: Oberhummer 1903, 232; Jeffery 1918, 233; Chrysos 1993, 9; and Megaw 1986, 508 note 17. In addition, there are no Gothic arches in Cyprus designed with the same curvature as those found on the aqueduct. By the time Famagusta became a major city around 1220, Salamis-Constantia was all but abandoned. In 1989 A. Baur published an important analysis of the aqueduct, but further confused the issue. He provided an elevation that depicted it employing "lancet arches" common to 14th c. Gothic buildings: Baur 1989, 209 (*compare* Baur's Bild 4 with my Fig. 12). His illustration was dramatically different than the actual monument. It seems that Baur made the honest mistake of measuring from the ground to the rise which was 5 meters, and then he added the base's height again to the total height—this distorted the elevation by about two meters. Baur shows the total height of the aqueduct at this point being 9.10 m—instead, it is actually about 7.5 meters tall. Moreover, his thick black outlines further narrowed the arcades, conveying an acute Gothic appearance. Nevertheless, he suggested that the pointed arches were categorically Byzantine.

32 This church has well preserved frescos which are reliably dated to the early 12th century: Winfield 1972, 285-291. Therefore the structure was built sometime earlier.

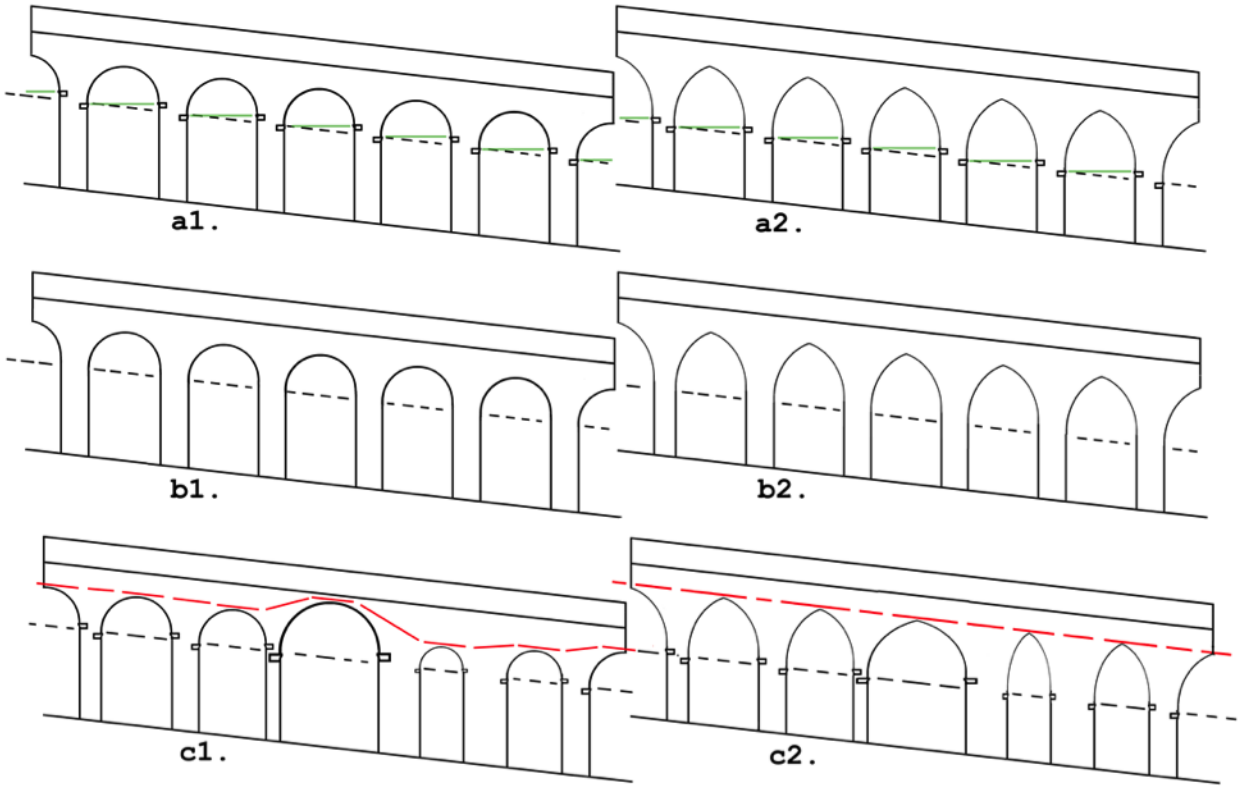

Fig. 15: Diagram comparing round and pointed arches on an aqueduct with a 7° slope; dash line represents the slope of the impost level; (a.) ideal plan with consistent pier width and span; imposts are level (indicated in green); (b.) with imports hidden b2 appears more proportional than b1; (c.) hypothetical example of an aqueduct with variable pier and span lengths but maintaining consistent impost height; c1 shows how round arches would lead to variable rise height (indicated in red); c2. shows how pointed arches on the same foundations could still achieve a consistent rise height.

to rebuild an ancient aqueduct in a piecemeal fashion. Funding was erratic. Most major aqueducts in the region were built by Roman legions, as at Caesarea Maritima (**Fig. 17**). However Cyprus was not garrisoned and so the builders weredrawn from the local population who, we can assume, were less disciplined and experienced. Construction would start and stop over several years, if not decades. These conditions made traditional Roman building practices difficult. An aqueduct can only function if there is a constant slope from its tallest point to its lowest. Because months or years separated each phase, the Cypriot builders had the difficult task to recalculate the slope anew, and then design each section accordingly to match the previous work.

Traditionally the Roman aqueduct employed round arches.[33] These arches were preferred because of their regularity: the width of the arch is consistently twice its height. Both imposts must be level, that is, parallel with each other to maintain the arch's integrity (**Fig. 15a-b**). A horizontal arcade with these constant proportions is aesthetically pleasing because it has monophonic rhythm. However, with sloping aqueducts, this rhythm was not easy to achieve. Aqueducts use the natural slope of the ground, which meant that theirarcades' height could

33 Hodge 2002, 93 ff.

Fig. 16: Aqueduct at Caesarea Maritima (Israel). Early 2nd century.

Fig. 17: Aqueduct at Caesarea Maritima (Israel) inscription recording the Tenth Legion of Trajan.

only be controlled by having different impost levels for each arch; likewise if the span varied from arch to arch, so would the height of the rise (i.e. the bottom of the keystone) (**Fig. 15c1**). Therefore, each span, pier, and impost required precise calculation and, in turn, precise stone dressing, since each courses' height contributed the slope above. These factors are clearly illustrated at the Trajanic aqueduct at Caesarea Maritima (Israel), where span variation led to changes of impost, springer, and rise height. To compensate, secondary imposts were added which were diagonal; in some cases, a catenary arch was employed where the span was shorter (**Fig**. **16**). In contrast, the Cypriot master-builders realized that the pointed arch would free them from these constraints.

By using the pointed arch, Cypriot workers could build more efficiently and rapidly, with little peremptory guidance. This was achieved in four ways. First, slight irregularities in pier spacing and springer levels would not affect the slope above,and so proportions could be estimated rather than precisely measured (**Fig. 15c2**). Second, the pier bases were designed to support the centering for the arches, minimizing amount of wood needed. Third, the arches could spring directly from the pier bases, since each arches' height was not determined by the width, as in round arches. Fourth, the calculation of the water channel's slope could be determined *after* the pointed arch was already in place, which was easier to measure at this point than at ground level. That is why the masonry above the keystones varies in size and number of courses; this was where all the adjustments were made for the slope. These four

advantages would allow construction to continue, even if months or years separated each phase.

How did the Cypriot architects arrive at this novel solution? I can imagine a frustrated draftsman realizing the constraints of the round arch while calculating the aqueduct's slope. A compass makes drafting round arches effortless when working with right angles, horizontal ground lines, and roof levels, since the arch dimensions repeat. In contrast, drafting an aqueduct's arcade, with variable slopes and ground levels, necessitates calculating each arch's impost level separately.Therigidity of the compass on a blueprint leaves no room for miscalculation in the actual construction process. By abandoning the compass, the pointed arch suddenly emerges as the only practical alternative (**Fig. 15c2**).

Discussion

Flying buttresses and pointed arches belong to the greatest engineering project in Cyprus. Both were associated with the Emperor Heraclius' interest in the island as a cultural center. In the process of *renovating* older structures, Cypriot master-builders found themselves *innovating* new designs. Their flying buttresses can be considered the earliest datable examples; their pointed arches were the first to be employed on such a conspicuous and monumental scale. These achievements should be recognized in Byzantine architectural history, while admitting that it remains unclear how influential they were outside of Cyprus. The island's location along the pilgrimage route to the Holy Land may be an important factor to consider, as well as Salamis-Constantia's own status as a pilgrimage center.[34]

For architectural historians, there is a consensus that stone engineering evolved over time, culminating in the achievements found in Gothic architecture. However, the question is still open regarding how key designs, such as flying buttress (concealed under the aisle roofs) and pointed arches at Durham Cathedral, suddenly appeared well-developed with no intermediary forms in Norman England.[35] Is it possible that the experiments with these designs were first conducted on Byzantine monuments, and later adopted by Romanesque masons?

For centuries western Europeans freely traded with and traveled to the Eastern Roman Empire. A steady stream of Latin pilgrims made its way to the Holy Land encouraged by Charlemagne's interest in strengthening Christian communities there.[36] Many, if not most, who traveled by sea would have stopped at Salamis-Constantia as their last port of call. Fulk Nerra (972–1040), who commissioned many churches and the first stone castles in France, went on pilgrimage to Jerusalem no less than three times.[37] Perhaps more significant is the large Norman pilgrimage of 999, which eventually led to the establishment of the Kingdom of Sicily.[38] Later Duke Robert of Normandy also went on pilgrimage in 1034, in which he travelled through Constantinople and, on his return journey, died in Nicaea. His son William the Conqueror would commission the most innovative Romanesque architecture in France and

34 A variety of historical documents mention Salamis-Constantia as a destination of pilgrims from the 5th to 8th century: Stewart 2008, 66 and 236 notes 20-21.

35 Regarding early Romanesque flying buttresses *see* Prache (1976), Clark and (1984), and James (1992).

36 Gabriele 2011, 73-96; McCormick 2011, xiii.

37 Bachrach 1993, 277-280.

38 Matthew 1992, 11-12.

England. These Normans, who themselves did not have a strong tradition of vaulting in their native Scandinavia, assimilated the culture and technologies they encountered in northern France and the Byzantine south.[39]

Likewise, the Byzantines were open to Norman support and military strategies. For instance, Roussel de Bailleul, would join the Empire, leading 3,000 Norman troops at the Battle of Manzikert in 1071.[40] We can assume that these warriors kept their familial ties back in France. Though we do not have many examples, we know that at least one Scandinavian traveled through Cyprus on pilgrimage—KingEric of Denmark died there in 1103 where his tomb is still enshrined.[41] In short, the inextricable economic, military, and cultural networks between medieval Latins and Greeks were well-established by the Gothic period. It is from this global setting that distinctive Middle Byzantine and Romanesque style emerged contemporaneously. Medieval Latins had experienced the Early Byzantine monuments of Salamis-Constantia. While it is remains uncertain if these structures had any influence on the course of western medieval architecture, we cannot rule it out.

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39 One important instance is the adoption by Normans of Byzantine military ideas, such as the stirrup, arrow-loop, and the donjon. The Byzantines were using these concepts by the end of the seventh century: for the stirrup, *see* Luttwak 2009, 59, 275 and McGeer 211. For the Norman "stirrup theory" *see* the literature noted in Morillo (1997, 222 n. 9). I am currently preparing a publication on the Byzantine origins of the donjon.

40 Anna Komnene, *Alexiad*, pp. 9–10, 30–31, ed. Frankopan and Sewter 2004. Earlier Byzantine military treatises, such as Emperor Leo VI's *Taktika* discuss the battle strategies and techniques of the "Franks": 18.74, ed. Dennis 2010. Since there is no recorded battle between the Holy Roman Empire and Byzantium, we can assume that these observations were made from a neutral or allied position.

41 Hill 1940, 304.

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