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Some Open Questions About the Plain of Troia

Eberhard Zangger

ZanggerPR Postfach 313, 8125 Zollikerberg, Switzerland

Abstract

After 130 years of archaeological excavations at Troia some questions regarding the site are open today as they were when Heinrich Schliemann's workers first set their spade to it. Such questions are, for instance: How was the plain optimised for human exploitation during the Late Bronze Age? Where were the ports of Troia? How far did the outskirts of the city extend into the plain? Reconstructions presented by the current excavation team of Troia suggest that the natural cove at Beşik Bay may have been the harbour and that the plain below the citadel was an inhospitable wasteland controlled by the floods of the Karamenderes River. However, complex hydraulic installations existed at many sites in Anatolia as early as the third millennium B.C. The mole at Limantepe shows that even during the Early Bronze Age ports were artificially optimised. In Syria and Palestine, man-made ports were common place during the second millennium B.C. Many prominent Late Bronze Age hydraulic installations are known from Greece. At Troia, too, wherever scientists looked, human interference with the hydraulic system was discovered: The artificial spring caves below the citadel and the two sizeable artificial cuts through the Yeniköy ridge are the best known examples. What is more, when Troia's significance faded during the Early Iron Age, the city of Alexandria Troas further south in the Troad with its artificial ports became the regional trading centre. Considering the high level of hydraulic engineering skills available during the Late Bronze Age, it is likely that the floodplain below the citadel of Troia was optimised for agriculture and naval traffic. No systematic investigation involving hydro-engineers and port experts has ever been conducted to develop a technical reconstruction of what the plain may have looked like. Thus, we suggested in 1999 to conduct in collaboration with the Troia excavation team a total-coverage helicopter-geophysics survey using ground-penetrating techniques to investigate the subsurface of the Troian plain. Alas, the excavation team rejected a collaboration and the Turkish Ministry of Culture never granted the permission.

1 Introduction

First the good news: I left science 2 years ago and changed fields completely. All my records and notes are either hidden or gone, and I have no intention whatsoever of returning to geoarchaeology. Instead of continuing to look back at the past, I decided to turn in a different direction. I am now engaged in strategic public relations for technology and research companies and operating my own agency in Zurich.

I very much welcome this opportunity to speak to the members of the Troia project directly. However, I am afraid that this opportunity comes years too late to be used in any constructive way. And to be honest, as the first step in communications between us, I would have preferred a more intimate meeting.

My talk today is entitled: "Some Open Questions About the Plain of Troia". I will state these questions at the end of my talk. Please allow me first to tell you how these questions arose and then to describe how I would address them. Using this approach, I believe it would be best to present my arguments in chronological order.

2 Mycenaean Hydraulic Engineering

I first entered the field of geoarchaeology about 20 years ago. One of my earliest projects is very well published. It was an investigation of the Argive Plain on the Peloponnese in southern Greece conducted between 1984 and 1988. The German Archaeological Institute later published this as a monograph (Zangger 1993). The study is well known – here, I just want to focus on the developments of the arguments regarding hydraulic engineering.

We now know that the Mycenaeans were great hydraulic engineers. Much knowledge about their engineering feats was gained during the past 20 years through the research of Jost Knauss from Munich Technical University (Knauss 2001). Knauss, for instance, described a dam below Mycenae, which was assumed to have been a Mycenaean bridge. Knauss, however, concluded that it was actually a dam built to create a water reservoir. He also investigated the drainage of Lake Kopais and concluded that a canal that was able to drain 700 million m^3 of water every year was dug there. This system functioned for a few hundred years during the Mycenaean period.

In my own research, I came across the Late Bronze Age redirection of a stream near the citadel of Tiryns (Zangger 1993). During the Late Bronze Age, a stream passed by the citadel, and in one instance, this stream flooded much of the lower town of Tiryns, burying parts of it up to 5 m deep under mud. To prevent this kind of flooding, the Mycenaeans at Tiryns built a dam and redirected the entire stream through a 1.5-km-long canal. The dam is about 100 m wide, 10 m high and 40 m wide – a construction of considerable size. Similarly impressive hydraulic installations have been detected at a number of other major Mycenaean sites (Knauss 2001).

3 The Pylos Regional Archaeological Project

During the 1990s, we took the methodology of geoarchaeological landscape reconstruction a step further (Zangger et al. 1997a). Now, I would like to show you the insights that were gained during the course of the interdisciplinary surface survey of the landscape around the Palace of Nestor in Pylos, a project conducted by the University of Cincinnati under the direction of Jack L. Davis. John C. Kraft and George Rapp, who are present here today, had investigated the area before (Kraft et al. 1980b). By paying great attention to detail, they were able to discover that the Selas stream that passes west of the palace follows what does not seem to be an entirely natural path. The stream used to feed the extensive floodplain at the northern end of the Gulf of Navarino during the Holocene. Today, however, the Selas River, being the largest stream in the entire region, no longer exits into the Gulf of Navarino, but instead passes over a small ridge and exits directly into the Ionian Sea. Kraft and Rapp interpreted this diversion as another Mycenaean engineering feat undertaken to prevent the coastal plain from flooding. Thus, according to them, the redirection was human-induced and most likely put in place during the Late Bronze Age.

During our research, we gathered evidence that supports this interpretation: a topographic cross section of the northern section of the floodplain between the Palace of Nestor and the Osmanaga Lagoon shows the old stream path during the early Holocene, when the river was feeding the floodplain. It also shows that the present stream is actually passing over a ridge consisting of extremely consolidated conglomerate – the hardest stone in the entire area. It looks as though the stream was forced to go right through the top of a conglomerate knoll. Such a river path can only be artificial. One can actually still today recognise the artificial canal. It is about 10 m deep and has almost perpendicular walls. Hence, people did indeed interfere with the landscape, and they clearly did so to adapt the landscape to their needs. The question is, why precisely did they want the stream to follow this new path?

When I visited the Pylos area in 1991 for the first time, I had just been to Troia a few days earlier. I went to Troia to look at a certain phenomenon in the landscape, and then at Pylos I discovered the same phenomenon: it is an alluvial plain representing a sedimentological environment that is different from its surroundings. At Pylos, I noticed a rectangular floodplain that does not seem to be completely natural. This rectangular plain lies right in the path of the redirected river near the Kokevis estate. I hypothesised that this basin was artificially made, and that it most likely represents a human-made port that is now silted up. I also assumed that the stream diversion must be somehow related to the basin.

The obvious thing to do was to drill into the plain to determine the subsurface stratigraphy. We did so and found marine clay at the bottom of the Holocene sequence, covered by coarse gravel and floodplain alluvium. Hence, the basin must have been artificial, because there is no reason for a marine pool to form in the middle of the landscape. We were able to date those deposits quite accurately to the fourteenth and thirteenth century B.C. (Zangger et al. 1997a). Since there is no need for a water reservoir so close to the coast, the only conceivable function of the basin is that it served as a port.

Continuing the inquiry at this stage required the consultation of experts on hydraulic engineering. We therefore invited Jost Knauss, the renowned expert on Mycenaean hydraulic engineering, to join the project. Not long after he set foot on our study area, Jost Knauss discovered yet another basin upstream from the first one. This second basin, now silted-up, of course, is more irregular in shape. It is connected with the proposed port through the artificial canal adjacent to the Kokevis estate.

As it turns out, it would have been pointless to excavate a cothon-type port by itself, because the long shore current would silt up the entrance to it very quickly. The engineers who constructed the port had to think about ways to prevent the sediment from entering the basin. To keep the basin sediment-free, they constructed a clean-water flushing mechanism. The clean water had to be derived from rivers, of course. Rivers, however, also contain sediment. Directing a river into an artificial basin means that the basin will also fill up over time. That is why a second basin was needed further upstream. The second basin was built by simply blocking the river with a dam. The stream entering this basin lost its energy and thus dropped its sediment load, so that the water at the surface of the lake was clean and sediment-free. This clean water was then diverted into the actual port basin through the artificial canal which is prominently visible even today. In this way, the port basin was always filled with freshwater and kept sediment-free. The freshwater ran out towards the sea and prevented marine water (and sediment) from entering the port.

This solution shows how sophisticated hydraulic engineering was during the Late Bronze Age. From constructions in Egypt, we know of the Birket Habu port basin even 20 times larger which was built under pharaoh

Amenhotep III. during the fourteenth century B.C. in western Thebes in Egypt, where a 1.5-km-long and 1-km-wide basin was created west of the Nile that is still recognisable in the landscape. I believe that we have considerably underestimated the engineering skills of the Late Bronze Age.

The Pylos project with its rigorous interdisciplinary – rather than simply multidisciplinary – approach was, in terms of methodology, a significant step forward from the geoarchaeological research in the Argolid. The scientists participating in the project at Pylos combined their reports in one paper to form a holistic reconstruction of the environment. However, the Pylos Regional Archaeological Project was conceived over 10 years ago. Today, we are able to conduct landscape reconstructions using a much more advanced methodology. Therefore, I suggested about 2 years ago to take the approach to geoarchaeological landscape reconstruction yet another step further – and I suggested to use the plain of Troia as a target for such a state-of-the-art investigation (Zangger et al. 1997b, 1998).

4
Traces of Hydraulic Installations at Troia

My interest in Troia focuses on the wetlands along the eastern side of the Yeniköy ridge running parallel to the coast. I first visited Troia in 1991 and was led over the site by its excavator Manfred Korfmann. Studies of topographic maps had indicated to me traces of silted up hydraulic installations similar to the ones I just described. In order to recognise these traces, one has to see the landscape with the eyes of an engineer who wanted to optimise it some 3000 years ago. Today, after thousands of years of ploughing, we are still able to see the handwriting of these engineers in the landscape, in particular, on the landward side of the coastal ridge. As I said earlier, just before I discovered the basin at Pylos, I saw a similar depression at Troia in the form of the Lisgar marsh. This basin is surrounded by unnaturally steeply sloping hills forming some fossil cliffs. I first saw this plain in the month of May and it was very dry. Later, I visited the area several times including once in February 1999 when the landscape was much wetter. As it turns out, the Lisgar marsh is actually under water during the winter – and, especially from the air, one can then see that it is not an entirely natural formation.

There are, however, other major indications of human interference with the landscape at Troia. In fact, I cannot think of any other Bronze Age site where we have so many indications for human-made landscape changes as we do at Troia. One of them is an impressive artificial cut through the coastal ridge connecting the Lisgar marsh with the beach at the Aegean Sea. In the winter the lake forming on the Lisgar marsh protrudes into this artificial cut. Hence, the cut is clearly related to the basin.

The basin is about 800 m wide. The canal forms a straight line, 500 m long, 50 m wide and about 30 m deep. This canal has been interpreted by members of the Troia project as an unfinished construction, as an irrigation channel, as a drainage channel, as a tectonic fault, as the result of some accidental trafficking of pedestrians walking from the plain to the beach and as a play of nature. After I announced my first theories about the function of the canal, it was investigated by Ilhan Kayan who through drillings determined that the bottom of the cut never reached sea level – in fact, it is up to 11 m above sea level (Kayan 1995).

In my opinion, the Kesik cut could well represent a slipway for ships. Before the canal at Corinth existed, ships were dragged along a track over a distance of 12 km – the cut at Troia is only 500 m long (Werner 1993). Accordingly, the whole basin on the landward side of the cut would have been used in a way similar to that of the port at Pylos. At Troia, too, there is a second basin, much bigger and more irregular than the first one.

What is more, there are two canals at Troia. In addition to the cut at Kesik, there is another canal further south. The two canals differ very much in shape and size. The southern one is much longer, very deep and very narrow. This one was clearly used to divert water – everybody agrees on that. The Kesik cut, however was not built to transport water. Its purpose was clearly to allow the transport of very large goods – goods the size of entire ships – to pass from the coast to the inner plain. All these components could have been combined to produce a clean water flushed port, precisely as we found it at Pylos. In this case, the water of the Karamenderes River would have been directed into the lake on the landward side of Beşik Tepe. Clean water from the lake would have been directed northward into the artificial port to flush it and keep it sediment free. The actual port entrance was at the northern end of the coastal plain at the Dardanelles. One of the major advantages of keeping the ships in a freshwater port basin is that algae and worms are expelled from the wooden hulls. In addition, the basin at Kesik presented an extremely protected port that would have been protected from winds and enemy attack.

We know that the ships at Troia would have had to wait for favourable sailing conditions if they wanted to continue their voyage upstream through the Dardanelles. The artificial entrance to the port through the Kesik cut is actually redundant and not needed to make the hydraulic system work, but it offers a number of additional advantages. The most important one is related to the current conditions in the Dardanelles. Ships sailing towards the mouth of the Dardanelles face an extremely strong current that is equally fast on all sides of the straits. A counter current picks up on the southern side of the straits approximately in the middle of the coastal plain at Troia. Thus, by dragging the ships into the basin at Kesik, they were able to enter first the freshwater current flooding the basin and taking them to the Dardanelles and then – at the Dardanelles – the counter-current taking them upstream like an escalator. Additionally, the Kesik cut made it possible to circumvent a siege of the Dardanelles. Or the port could have been used to separate eastbound trade from westbound trade.

As I said before, this technical reconstruction of the harbour system at Troia is only a working hypothesis, but one that fits the pattern of hydraulic engineering during the Bronze Age. In order to prove or disprove these ideas, we suggested a few years ago that this landscape should be investigated in a broader fashion (Zangger et al. 1997b, 1998). I proposed to conduct a helicopter geophysics study which would have the advantage of covering the entire area of the coastal plain at Troia in about 2 months of fieldwork. In return, we would obtain subsurface information reaching to a depth of about 150 m – evidently, much further than needed. The helicopter of the "BGR" was made available for this investigation. The state-of-the-art system on board comprises a bird dragged by the helicopter holding electrotransmitters and receivers working at five different wavelengths. The electromagnetic signal produced by these transmitters creates a signal in the ground which is then measured by the receivers. Computer modelling allows the combination of the sequences of layers produced by the different transmitters. By using five different wavelengths and penetration depths, the system provides a very high resolution from the uppermost layers all the way down to 150 m. This method would be the ideal way to determine the subsurface shape of the basin and canals at Troia. These data can then be shown in maps, cross-sections and three-dimensional subsurface models.

This project, which I proposed in 1999, was never carried out because the Turkish ministry of culture did not grant permission.

5
The Open Questions

My talk bears the title "Some open questions about the plain of Troia" and I said earlier that I will name these questions at the conclusion of my presentation. In my opinion, the questions about the plain of Troia that remain open are:

1. How was the plain optimised for human exploitation during the Late Bronze Age? The artistic reconstructions we have seen come from the Troia project in which the whole area outside the citadel consists of wastelands and swamps do not seem credible in the light of our knowledge about Late Bronze Age landscape management systems.
2. Where were the ports of Troia? We have been looking for them for over 130 years. Eventually, somebody will film the water-filled Lisgar marsh

during the wet winter months from the air to demonstrate how obviously man-made it is.
3. How far did the outskirts of the city extend into the plain? Since 1988, we have seen how the known parts of the city were extended during almost every excavation season to the extent that they are now about thirty times larger than at the beginning of the current excavation campaign. However, we still do not know how far the city stretched.

6 Conclusion

What I have presented here today – the hydraulic engineering feats of the Late Bronze Age civilisations – has received surprisingly little attention in the scholarly community. Although some of these reconstructions should still be regarded as working hypotheses, there is no doubt that a sophisticated understanding of hydraulic engineering existed during the second millennium B.C. The 1.5 × 1 km large port in ancient Thebes, and the complex nautical installations that we know from Palestine (Raban 1997), as well as the Mycenaean drainage systems, speak for themselves. I believe that an enhanced research of these constructions would significantly boost our knowledge of the Late Bronze Age societies, perhaps even more then the investigation of yet another basket full of pot shards.

During the past 10 years, I have contacted many of the people in the audience, and offered them an open discussion or even collaboration on these issues. I wrote letters, sent faxes, made telephone calls. I visited some of you to propose cooperation. None of my requests ever received a positive response. My letters were not answered.

This setup here today is, in my opinion, not the right way to embark on a fruitful discussion. Thus, I have decided that for the first time, I will not answer questions. Those who are interested in talking to me will find my address on the list of participants. You are perfectly welcome to contact me at any time. I thank you for your willingness to finally listen to me and wish you best of luck with your future inquiries. Good bye.