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The study of military architecture can reveal much about the ongoing "conversation" between offensive and defensive strategies, a dialogue of violence and counter-violence that has defined the practice of warfare since antiquity (Ober, 1991 & forthcoming). This paper looks at one example of offensive-defensive dialectics in late Classical and early Hellenistic Greek military architecture: the response of some details of tower design to innovations in artillery technology. I hope to show that in the century between c. 375 and c. 275 B.C. there were two distinct periods in the design of Greek towers and that these architectural periods reflect the evolving threat of offensive artillery and the evolving understanding by military architects of potential uses for defensive artillery. While many aspects of tower design could be analyzed in terms of their relationship to artillery, I concentrate here on the design of chambers and apertures.

Bibliographie

BÖLTE, F., 1921: "Keleai", *RE* XLIII: 137.
PHARÁKLAS, Nikólaos, 1972: *Phleiasia* (= AGC II; Athènes).
WISEMAN, James, 1978: *The Land of the Ancient Corinthians* (Göteborg).

8.

TOWARDS A TYPOLOGY OF GREEK ARTILLERY TOWERS: THE FIRST AND SECOND GENERATIONS (c. 375-275 B.C.)

Josiah Ober

1. Introduction

The study of military architecture can reveal much about the ongoing "conversation" between offensive and defensive strategies, a dialogue of violence and counter-violence that has defined the practice of warfare since antiquity (Ober, 1991 & forthcoming). This paper looks at one example of offensive-defensive dialectics in late Classical and early Hellenistic Greek military architecture: the response of some details of tower design to innovations in artillery technology. I hope to show that in the century between c. 375 and c. 275 B.C. there were two distinct periods in the design of Greek towers and that these architectural periods reflect the evolving threat of offensive artillery and the evolving understanding by military architects of potential uses for defensive artillery. While many aspects of tower design could be analyzed in terms of their relationship to artillery, I concentrate here on the design of chambers and apertures.
The usefulness of this sort of study is threefold. First, it should help military historians to refine their understanding of the defensive/offensive dialogue alluded to above. Second, it should help students of Greek architecture to determine how architects responded to technological challenges. And finally, it should allow tentative chronologies for fortifications that cannot be independently dated by either historical or archaeological means. Once we have defined the chronology of specific details of tower architecture, it is possible to assign closer termini post and ante quos to the circuits walls bonded by the towers in question. My investigation of the relationship between artillery and tower architecture builds on the fundamental studies of Krischen (1922), Maier (1959), Marsden (1969), Winter (1971), Garlan (1974), Lawrence (1979), and Adam (1982); my debt to these (among other) scholars will be obvious throughout.

Unfortunately, we know almost nothing about the superstructure of towers built in the pre-artillery period, that is to say before the first quarter of the 4th century B.C. There is, to my knowledge, no surviving tower securely dated to the pre-catapult era which preserves traces of superstructure. There are literary references to towers in 5th century authors and a few vases of the 6th century preserve depictions of towers. For what it is worth, this evidence contains no hint of fenestrated fighting chambers. The defenders are described or depicted waiting (sometimes between or behind merlons) on the wall-walk and on the roofs of the towers, never as fighting the enemy from inside the towers or as shooting out of windows (cf. in general Childs, 1978: 58-64, 71-73, 76-78; see also Lawrence, 1979: 386-91 on the representation of fortifications in art). It seems reasonable to suppose that Archaic and Classical towers were used as bastions, and were important primarily for the provision of enfilading fire at enemy besiegers who might attempt to assault the wall using ladders (Aiskhylos Ἐπι θῆβαι, 466-467; Euripides, Phoinissai; see also Nereid Monument Frieze II, Block 872; Tysa, Heroon, External South-East Wall, Block A4. With Childs, 1978: 72-73, 77, Pl. 51, 10.2).

We are on firmer ground when we get into the second and third quarters of the 4th century B.C. The remains of several well-preserved Theban-built towers at Messene and Boiotian Siphai can be assigned on historical grounds to the period c. 370-360 B.C. (Ober, 1987: 572-582). Several other towers in Megarid and Attike can also be assigned to this general period (c. 370-340 B.C.), on the basis of historical considerations and their close similarity to the Theban constructions (Ober, 1987: 1-2).

As Table I demonstrates, the range of window sizes in first generation towers is fairly limited. Window height ranges from 0.81m to 0.88m; my debt to these (among other) scholars will be evident throughout. For what it is worth, this evidence contains no hint of fenestrated fighting chambers. The defenders are described or depicted waiting (sometimes between or behind merlons) on the wall-walk and on the roofs of the towers, never as fighting the enemy from inside the towers or as shooting out of windows (cf. in general Childs, 1978: 58-64, 71-73, 76-78; see also Lawrence, 1979: 386-91 on the representation of fortifications in art). It seems reasonable to suppose that Archaic and Classical towers were used as bastions, and were important primarily for the provision of enfilading fire at enemy besiegers who might attempt to assault the wall using ladders (Aiskhylos Ἐπι θῆβαι, 466-467; Euripides, Phoinissai; see also Nereid Monument Frieze II, Block 872; Tysa, Heroon, External South-East Wall, Block A4. With Childs, 1978: 72-73, 77, Pl. 51, 10.2).

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A tower depicted in a relief on the "Landscape Tomb" at Lykian Pinara (panel D) seems to fit in this series. It is shown as tall and thin with a crenellated roof, and has two closely-spaced windows opening in the front side of an upper chamber. The relief is dated by Childs (1978: 12 [date], 40 [description], Pls. 22.1, 22.2) - on stylistic grounds - to c. 370-350 B.C. I have previously argued that the Attic, Boiotian, and Messenian towers should be designated "first generation" towers and that they were built in response to the introduction (from Syracuse) of non-torsion artillery technology (Ober, 1987: 569-604, esp. conclusions: 596-604). The present study is an attempt to elaborate upon the findings presented in that preliminary article.

There are some structural differences among the towers I have designated as first-generation, but I believe that these differences are outweighed by the similarities in the design and placement of windows and slits and in the structure of the walls. I have excluded free-standing towers from the present list, since all of the "second-generation" towers discussed below are built into circuit walls and free-standing towers have somewhat different structural properties.

Table 1. First generation towers: windows and chamber wall thicknesses

<table>
<thead>
<tr>
<th>Tower site</th>
<th>Window size (w x h)</th>
<th>Wall thickness (upper chamber)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Messene N</td>
<td>0.74 x 0.88</td>
<td>0.58</td>
</tr>
<tr>
<td>Messene L</td>
<td>0.73 x 0.81</td>
<td>0.48</td>
</tr>
<tr>
<td>Siphai 3</td>
<td>0.72 x 1.12</td>
<td>0.50</td>
</tr>
<tr>
<td>Siphai sea gate</td>
<td>0.76 x 1.10</td>
<td>0.42</td>
</tr>
<tr>
<td>Gyphiotokastro 7</td>
<td>0.85 x</td>
<td>0.40</td>
</tr>
<tr>
<td>Aigosthena A</td>
<td>0.84 x 1.10</td>
<td>0.60</td>
</tr>
</tbody>
</table>

As Table I demonstrates, the range of window sizes in first generation towers is fairly limited. Window height ranges from 0.81m to 1.12m; window width from 0.72m to 0.85m. Total window area ranges from 0.59m² (Messene L) to 0.92m² (Aigosthena A). Wall thickness in the uppermost chamber varies from 0.40m to 0.60m, and the upper chamber masonry is invariably single-wall construction. Furthermore, the floor-space in the first-generation towers is quite limited in relation to the number of windows. This means that the size of the machines that could be accommodated in these towers was also limited. At Messene N and L, Siphai 3, and Gyphiotokastro 7 the bows of the catapults could not have exceeded 1.8m and stocks could not have been longer than about 1.48
2.1 m. Aigosthena A could have accommodated slightly larger machines, with stocks of up to about 2.5 m, but only if we assume that the catapult stands were shifted in order to achieve a reasonable horizontal range of fire (Ober, 1987: 574, 576, 578, 583-584, 588).

Because of the limited size of the artillery pieces that could have been fired from the "first generation" towers, and because of the light walls of the chambers, I argued that the machines they were built to accommodate and defend against were non-torsion catapults. Non-torsion catapults were the only sort of artillery available from the invention of the catapult in 399 until c. 350-340 B.C. when the torsion catapult was developed, apparently by engineers in the employ of Philippos of Makedonia (Ober, 1987: 569-572, 597-600, with references cited). Torsion machines were widely available by c. 300 B.C. and had apparently displaced non-torsion machines in the armories of the larger and more sophisticated states. Torsion machines offered a great increase in potential power, but at the expense of increased size, as the two tables below demonstrate (Marsden, 1969: passim [esp. 86-91]; table reproduced from Ober, 1980: 600-601, based on Marsden's calculations).

Table 2. Sizes of Torsion Bolt-shooters

<table>
<thead>
<tr>
<th>Missile mass [cubit] (dactyl) m</th>
<th>Stock length m</th>
<th>Arm width m</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
<td>[24]</td>
<td>0.5</td>
</tr>
<tr>
<td>[60]</td>
<td>0.7</td>
<td>2.3</td>
</tr>
<tr>
<td>[48]</td>
<td>0.9</td>
<td>3.1</td>
</tr>
<tr>
<td>[64]</td>
<td>1.2</td>
<td>4.1</td>
</tr>
<tr>
<td>[72]</td>
<td>1.4</td>
<td>4.6</td>
</tr>
<tr>
<td>[80]</td>
<td>1.5</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Table 3. Sizes of Torsion Stone-throwers

<table>
<thead>
<tr>
<th>Missile mass [minas] kg</th>
<th>Stock length m</th>
<th>Arm width m</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 0.44 kg</td>
<td>2.7 m</td>
<td>1.1 m</td>
</tr>
<tr>
<td>(5) 2.20 kg</td>
<td>5.1 m</td>
<td>2.0 m</td>
</tr>
<tr>
<td>(10) 4.37 kg</td>
<td>6.4 m</td>
<td>2.5 m</td>
</tr>
<tr>
<td>(20) 8.70 kg</td>
<td>7.3 m</td>
<td>2.9 m</td>
</tr>
<tr>
<td>(30) 13.10 kg</td>
<td>8.4 m</td>
<td>3.3 m</td>
</tr>
<tr>
<td>(60) 26.20 kg</td>
<td>11.6 m</td>
<td>4.6 m</td>
</tr>
</tbody>
</table>

As Tables 2 and 3 show, all but the smallest bolt- and stone-throwers would require rather more space than the older style, non-torsion, machines they replaced. This meant in practice that torsion-era catapult towers would either have to be built with larger tower chambers or designed to house fewer machines per chamber. It also meant that windows would need to be built taller and wider so that the long-stocked machines would be able to achieve a full range of fire. Furthermore, the use of torsion machines by besiegers threatened the relatively light tower chamber masonry that characterized first-generation towers. Thus it is to be expected that circuits built after the widespread adoption of torsion artillery in the period c. 325-300 B.C. would employ thicker chamber walls.

There were practical limits to how large circuit-wall towers could be built if they were to retain their primary function of enfilading the circuit wall. The biggest torsion stone-throwers (those of a half-talent or more of throw weight) had stocks of over 8 m and could not have been accommodated in an ordinary tower. These weapons were useful against enemy siege towers and were evidently deployed in the most vulnerable sectors of the circuit, where the enemy might be able to bring up siege towers against the wall. Thus, we would expect to find the largest catapults defending main gates and sectors of the wall which faced open terrain – and to find them housed in huge gate-towers or in open bastions. But there remained good reasons for military architects to design less vulnerable circuit-wall towers to house somewhat lighter torsion artillery. The tower form combined height (which increased catapult range) and security (both from the elements and from enemy fire) with the ability to enfilade enemy troops who approached the walls. Thus, even on 3rd century circuits which employed bastions and gate-towers for the largest calibers of artillery, we should still expect to find towers capable of housing catapults that were somewhat larger than those housed in first-generation chambers.

The sites discussed below are all quite well known to students of Greek military architecture; plans and elevations are for the most part readily available in the standard handbooks but precise measurements of apertures and wall thicknesses for individual towers are still fairly rare.

1. 30-mina stone-throwers recommended for defence against enemy siege towers (Philon, Poliorketika. iii.67-71). For an example of a major bastion, see Bakhuizen, 1986: 315-321; Lawrence, 1979: 223.
even in the specialist literature. The tower descriptions below are abbreviated, and concentrate on the structural details that are the specific concern of this paper.

2. Second Generation Towers (c. 325-285 B.C.)

Latmian Herakleia (Plates 59 & 60).

The site of Herakleia, founded by Kassandros very early in the 3rd century B.C., is one of the best preserved circuits of the period (Krischen, 1922: passim [esp. 23-43]; Marsden, 1969: 152-154; Winter, 1971: Index: s.v. Herakleia; Garlan, 1974: Index topographique: s.v. Héraclée [du Latmos]; Lawrence, 1979: Index: s.v. Heraclea-by-Latmus; Adam, 1981: 110-111, 235-245 [with good photographs]). Krischen's careful study of the fortifications of Latmian Herakleia was a landmark in the history of the scholarly study of Greek military architecture; his detailed plans and elevations facilitate analysis of specific architectural details. A good number of the towers on the Herakleian circuit have preserved superstructure, and the circuit sports a variety of tower sizes and window arrangements. The fortifications of Herakleia were erected by a major dynast and designed to resist assault by even the most powerful siege army. Thus, the site gives an excellent idea of the state of the art of tower architecture in the early 3rd century B.C. Herakleia serves as a type-site for the study of towers built near the beginning of the torsion artillery era.

The masonry at Herakleia is very consistent: ashlar with string courses. The upper-chamber masonry at Herakleia's towers is invariably double-walled, header-stretcher construction. Corners are drafted. Most of the preserved windows in Herakleian towers feature chases flanking the lower window-edges; these originally held hinges from which were suspended bottom-hung shutters (Ober, 1987: 578-579, 603-604 for mode of operation). The lower window-edges of the preserved windows in Herakleia feature chases flanking the lower window-edges; these originally held hinges from which were suspended bottom-hung shutters (Ober, 1987: 578-579, 603-604 for mode of operation). Windows at which chases were not observed are noted below. Tower numbers are those assigned by Krischen.

Tower 22 (Krischen, 1922: fig. 22): This two-chambered tower, on the lower circuit, is fairly small and slightly off-square; the internal dimensions of the upper chamber are 4.8 w x 4.9 d; the internal floorspace of 23.5 m². The upper chamber walls are 0.92 thick; a single, central, window is preserved in each of the front and right-side walls. Presumably there was another window in the now-fallen left-side wall. Part of a sill-block is preserved in the right-side window; allowing for sills, the windows measure 1.25 w x 1.03 h. The floor of the upper chamber was supported by a set-back on all sides and five front-to-back joists. The distance from the lower window edge to the set-back is 1.35.

Doors (2.07 w x 1.01 h) enter the back-side walls of the lower chamber from the wallwalk. There is one large (2 course) slit in each wall of the lower chamber. These slits measure 1.07 h x c. 0.17 ext/0.51 int. The bottom edges of the slits average 1.03 above the chamber floor.

Tower 20: Located North of Tower 22, on the lower circuit. Less well preserved than Tower 22, it was originally a 3-chamber tower. A preserved chase shows that the top chamber had windows. The chase placement suggests that, as at Tower 22, there would have been three windows, one centered in each wall. The floor of the top chamber was supported by a setback and a line of large, square front-to-back joists, reinforced by a row of smaller, round side-to-side joists (Ober, 1987: 590-591, for flooring system). The middle chamber has a single large (2 course) slit in the middle of each wall. The middle chamber floor was supported by another setback and by front-back joists. The lower chamber has a large slit in the centre of the front wall (1.03 h x 0.17 ext/0.68 int). The lesser-well preserved side walls apparently each had two small (one course) slits (0.53 h x 0.17 ext/0.53 int). The one preserved side-wall small slit is located in the mortar course above the two-course large slit. The interior of the lower chamber was 5.1 wide; thus the tower floorspace was probably rather greater than at Tower 22.

Tower 18 (Krischen, 1922: fig. 24): A large, and well-preserved two-chambered tower North of Tower 20 on the lower circuit. The upper chamber (internally 8.15 square, thus floorspace of 66.4 m²) featured two windows in each of the side and front walls. The windows measure 1.60 x 0.95; they are 2.5 apart and set 2.10 from the wall edges. The window has 0.95 thick. The floor is supported by joists (0.26 x 0.30) and a setback (0.45 d); from the bottom edge of the windows to the setback level is 1.52.

There was a large back door into the upper chamber: c. 4.0 w x 4.8 h; Krischen (1922: fig. 24) shows the door a little narrower, about 4.0 wide. The lower chamber features hour-glass window/slits (1.62 h x 1.13 w, tapering to 0.63 in the middle) in the centre of each wall. These are not provided with chases and so apparently did not use drop-shutters. The hour-glass slits are flanked by 2 ordinary 2-course large slits (1.12 h x 0.17 ext/0.68-0.72 int). The large slits are set one course below the bottom edge of the hour-glass window/slits. Both types of lower-chamber apertures are canted in order to cover the ground in front of the wall most effectively. The lower chamber walls are 1.45 thick. A doorway (1.48 w) leads into the lower chamber from wall-walk level.
Tower 56: Only the lower chamber of this small tower on the upper circuit is preserved. The chamber measures 3.90w x 4.35d internally; the walls are 1.25 thick. Two-course large slits open in the centre of each wall. These measure 1.06-1.09h x 0.17-0.19ext/0.63-0.77int. A door (1.06w) opens into the back of the tower from the ground level. The general layout and size suggest that it might have resembled the better-preserved tower 22.

Tower 58 (Krischen, 1922: fig. 21): This is a single-chamber, windowed tower; its location on a hillock made the added height ordinarily provided by a full lower storey unnecessary. Internally, the tower measures c. 3.6w x 4.2d. Only the front wall (1.07h) is well preserved; a single window (1.59h x 0.88w) opens in its centre.

Tower 59 (Plate 59; Krischen, 1922: fig. 19, 20, 21): This fairly well preserved, two-chambered tower measures 4.5w x 5.5d internally in its lower chamber and c. 4.7w x 5.7d in its upper chamber. The lower chamber walls are 1.07 thick; the upper chamber floor was supported by a rather shallow setback and a row of 7 or 8 joists (c. 0.20m sq.). A single window is preserved roughly in the centre of the North side wall of the upper chamber; it incorporates a sill and measures c. 1.40h x 1.15w. The front and South side walls are ruinous. A doorway (2.00h x 1.07w) from the wall-walk entered from the back (East side) of the upper chamber. In the centre of the North wall of the lower chamber is a single two-course slit, 1.07h x 0.17ext/0.56int. Another door (1.26w) entered the back of the lower chamber.

Tower 60: A single window is preserved in the side wall (North East) of the upper chamber of this ruinous tower; it is c. 1.6h x 1.0w, without sill-block. The absence of preserved chases suggests that there would have been a sill-block (with chases), and so the window may have been only c. 1.4 high originally (similar to the height of the window at Tower 59).

Tower 61 (Krischen, 1922: fig. 26): This large, shallow, two-chamber tower was located on a corner of the upper circuit. The upper chamber was c. 10.9w x 5.0d. The upper chamber walls were 0.75 thick (Krischen). The well-preserved North side wall of the upper chamber contains an oddity: a central window, blocked apparently at the time of the original building (the masonry style is identical to the rest of the tower). Since the front and side walls are fallen, it is not possible to determine whether there were other windows, blocked or otherwise. The back wall of the upper chamber was largely taken up by a doorway (5.45w and over 4.0h) that was entered from the wall-walk. The floor was supported by a setback on all walls; no joist cuttings were observed. From the setback to the bottom window edge is 1.40. The lower chamber had only a single aperture: a slit on the front wall (Krischen). A doorway 1.42w x 2.7h opens in the back of the lower chamber, from ground level.

Tower 62 (Plate 50; Krischen, 1922: fig. 25, 26): The upper chamber of this off-square two-chambered tower/bastion measures 11.1w (along the internal back wall) x 4.1d (Krischen). The South side wall is angled inwards towards the front, so the inside front wall is only c. 9.0w; the total floor-space is c. 41m². The upper chamber has two windows in the front wall and one in each side wall. The windows measure 1.52h x 1.00-1.05w. There are no chases on any of the windows. The walls are 0.85 thick. The upper-chamber floor was supported on setbacks (0.35); no joist holes were observed. From the setback to the lower window edges is 1.35. Four two-course slits open in the lower chamber, one in each side wall and two in the front wall. These average 1.02h x 0.22ext/0.49int. No trace of the back wall survives. It seems quite possible that the back wall was simply open, and that this tower housed artillery only when conditions warranted. It may not have been fully roofed. Krischen (1922: fig. 25) restores no. 62 as a fully enclosed and roofed tower, but there is no physical evidence for either the roof or the back wall. The hypothesis that it was an open bastion explains why there was no need for shutters: there was no chance of enemy artillery returning fire because of the inaccessible terrain.

Summary of tower characteristics: There appear to be two basic types of tower employed at the upper North West and lower South East circuit walls of Herakleia: Type A is a relatively small, two- or three-chambered tower with a single window centred in the front wall of the upper chamber and (presumably in most cases) in each of the upper-chamber side walls. Towers 20, 22, 56, 58, 59, and 60 fit this type. Type B is a much larger two-chambered tower with two windows in the front wall of the upper chamber and one or two windows in each of the side walls. Type B towers are also characterized by high and wide doorways in the back of the upper chamber (or, perhaps, by an open back in the case of Tower 62). These large doorways presumably facilitated winching in large-calibre catapults (cf. Lawrence, 1979: 225-226). Towers 18, 61, and 62 conform to this second type. In both general types large, two-course slits are typically used in the lower chambers; with some exceptions (Towers 18, 20, 61) the distribution of
slits on the lower-chamber walls mirrors the distribution of windows in the upper chamber.

We may hypothesize that a type A tower housed a single catapult in its upper chamber, and that a type B tower housed (at least) two catapults in the upper chamber.

**Ephesos**

The main circuit on Mt. Koressos was built in the early 3rd century B.C. by Lysimachos (for Ephesos fortifications and date cf. Bendorf, 1899: 19-26; Maier, 1959: 236-242; Winter, 1971: Index, s.v.; Lawrence, 1979: Index, s.v.; Adam, 1982: 229-231). Like Heraklea, Ephesos was a large, important city fortified by a great Hellenistic dynast. The approaches to the fortifications are generally less precipitous than the Heraklei North West circuit, but are comparable with the approaches to Herakleia's South East circuit. The Ephesos fortifications, including the towers, are, in general much less well preserved than the fortifications of Herakleia.

"St. Paul's Prison": This is a monumental tower, overlooking the harbour, on the North-West corner of the circuit. It is much larger than the other preserved towers of the Ephesos circuit, and presumably was a watch and command station, as well as an artillary bastion. The masonry is quite strict ashlar header-stretcher construction, with drafted corners. The outer block-faces bulge noticeably; blocks are smooth-cut on the inside. The tower is externally 14.6m square (Bendorf), preserved only to something over 2m from external ground level. Internally it measures 7.9w x 10.3d. The tower wall is 1.6t. The back wall is widened into a platform. A doorway (2.0w) enters the tower from the back. Two other narrow (0.90w) doors open in the sides of the tower to the outside of the circuit wall; these must have functioned as postern doors.

Tower on the upper circuit (A): Most of the towers on the Koressos ridge are also very ruinous. But one tower (c. 600m straight-line South East of "Paul's Prison", on the ridge North West of the peak of Koressos) is better preserved than most. The tower faces South across moderately steep terrain. The masonry is somewhat rougher and more irregular than at "Paul's Prison"; there is quite extreme bossage on some blocks, especially those at the drafted corners. It is fairly well preserved in its lower storey; a few bits of the walls of the upper chamber are also preserved. The lower chamber measures 6.07w x 6.27d internally; the walls are 1.70t. The tower wall is double-faced masonry; the inner wall is of smaller blocks. One large slit (0.20ext x 1.08int) is partially preserved in the centre of the West side wall. The slit is canted forward so as to allow forward fire from the side wall. Part of the back wall of the second storey chamber is preserved. It is 1.42t. A doorway (1.24w) opened into the back wall of the second chamber from the wall-walk. A stairway at the back of the tower gave access to the wall-walk at this point. Assuming the setback was constant on all walls the upper chamber would have been c. 6.65-6.85, a floor area of c. 45.5m².

Tower on the upper circuit (B): About 700m (straight-line) further East on the ridge, on the East end of the ridge-hill that lies just to the West of the peak-hill of Koressos, is a tower with a well-preserved slit/window on the West side face. The rest of the tower is ruinous. The window is 1.88h (4 courses) x 0.72ext x 1.25int. It is canted forward, like the slit in Tower (A) to the West. The bottom sill of the window is something over 2m from external ground level.

Iasos "Mainland Wall" (Plates 61 & 62)

The long wall at Iasos that extends North West from the main site on the peninsula, is built of rough, but well-laid masonry. It probably dates to the very late 4th or first quarter of the 3rd century B.C. (Levi, 1969-70: 526-529; Winter, 1971: 241-243; Lawrence, 1979: Index s.v.; Adam, 1981: 97 ill. 125 [photo] and fig. 63 [plan], 234). A well-preserved stretch of wall and two towers c. 1km North West of the neck of the peninsula give a good idea of the fortification's architecture. The circuit wall itself is c. 1.6-1.9 thick and provided with numerous small slits (av. c. 0.58h x 0.12ext x 0.55int). The wall features short (c. 11m) jogs; each jog is provided with a postern gate (av. 1.1w x 2.0h). The wall faces North and the approaches are quite easy (the slope is only c. 13 degrees).

Tower (A): The tower is half-round and partially preserved. Internally it measures 7.9w x 10.3d. The tower wall is 1.6t. The back wall is widened into a platform. A doorway (2.0w) enters the tower from the back. Two other narrow (0.90w) doors open in the sides of the tower to the outside of the circuit wall; these must have functioned as postern
gates. A single window is preserved on the East side; it is 1.6h x 0.62 ext/0.90int. From the bottom edge of the window to external ground level is 3.0.

Tower (B): The next tower to the West is better preserved. It is similar in dimensions to Tower (A): (8.0w x 9.0h); again the wall is 1.6h. A stairway on the inside face of the wall behind the tower leads to a platform (3.4w) that forms the back wall of the tower. As in (A), a doorway opens in the back of the tower and two postern/doors provide exits from the tower at the sides. Five windows are arranged at equidistant intervals around the curve of the tower (inter-window spacing av. 2.4). Clockwise from the West, the windows measure 1.23h x 0.65, 1.50h x 0.60, 1.7h (fallen) x 0.6ext/0.74int, 1.50h x 0.60, 1.35h x 0.62. There is no indication that either this tower or (A) was ever provided with more than the single, ground-level chamber. It is not possible to determine the nature of the roofs, if indeed the chambers were roofed. The distance from bottom window edge to ground level at the centre-front window is 3.2.

Samos. Second Circuit.

The fortifications of Samos were the subject of a careful and recent study by H.J. Kienast. The second of the three Samos circuits is dated by Kienast to c. 310-290 B.C., on both historical and architectural grounds. It includes walls on the akropolis and long walls down to the lower town. This second circuit included numerous towers in various shapes (pentagonal, hexagonal, and rounded-front, as well as rectangular), some of them quite large - up to c. 8.5m sq. internally (Tower 10). Unfortunately most of the towers at Samos are not preserved much above the foundation level (Kienast, 1978: 94-97 [Date]; 85 with fig. 45 [tower 27, plan and elevations]).

Tower 27. This is located on the end of a short spur which protrudes Westwards off the West wall that leads down to the harbour from the akropolis. The approaches are very difficult; the hillside falls away steeply to the South. This is the best-preserved tower on the circuit; its lower chamber is largely intact. The masonry is very regular ashlars double-walled, header and stretcher construction. The internal dimensions are 4.5 square; the walls are 1.1 thick. A doorway (1.94h x 1.08w) leads into the back (East) wall of the tower. Two large (two-course) slits open on the downhill side (South), and front (West) walls; a single slit opens on the uphill side (North) wall. The slits measure 0.92h (with one exception, see below) x 0.20-0.30ext/0.76-0.83int;

the side-wall slits are canted forward for concentrated fire; the North front-wall slit is canted to the right (towards the uphill side). The slit in the North wall faces a steep uphill slope; in order to compensate for this the top edge of the slit was cut at an upward angle and the external aperture is thus 1.17h. The bottom edges of the slits are 1.02 above floor level. There is no evidence for the arrangements of the upper chamber, although it seems likely that one existed.

Tower 24 (Kienast, 1978: 81 with fig. 39): The ground floor chamber of this largely collapsed tower measures c. 5.3m sq. internally. The front wall is much thicker (1.56t) than the side walls and features a single, centered, slit/window. This is c. 1.4 (three courses) high x 0.70ext/1.02int.

3. Comparison of first- and second-generation towers.

Apertures.

Full, shuttered windows, preserved in the second-generation series only at Herakleia, are invariably in the top chamber of the tower. They range in height from c. 1.25 to 1.6, and in width from 0.88 to 1.15. Window area ranges from 1.29 to 1.61 m². In comparison, first generation tower windows are considerably smaller in area (Messene L = 0.60m², Siphai 3 = 0.81m², Siphai Sea Gate = 0.84m², Aigosthena A = 0.92 m²).

The size and upper-chamber floor-space at the Herakleia towers varies considerably, but only the larger, "type B" towers employ two windows in the front wall. In the smaller, "type A" towers a single window is centered in the front (and each side) wall; notably, the towers depicted on a Megarian bowl from Athens (National Museum 2104: late 3rd/early 2nd century B.C.), have single windows on each face of their upper chambers, and one or two slits on the faces of a lower chamber (Childs, 1978: fig. 31). Most first-generation towers had upper chambers roughly the same size of those at the Herakleia type A towers; Winter (1989: 192 n. 8), in a discussion of the typology suggested in Ober, 1987, quite rightly points out that small chamber size is not, in and of itself, indicative of an early date. But, in contrast to the Herakleia type A towers, the first-generation towers ordinarily have two windows in their front walls. Of the towers I have designated as first-generation, only Aigosthena A is comparable in size to Herakleia type B towers. But at Aigosthena A there are three windows on each wall of the upper chamber, which suggests that the greater floorspace of this tower was not
utilized to house catapults significantly larger than the other first-generation towers.

The study of window size and spacing leads to an obvious conclusion: Herakleia’s upper chambers were designed to house catapults that were larger than those housed at the sites I have designated as first-generation.

One step down from the full window is the aperture type I call the slit/window. These are found in lower chambers of several towers discussed above and are never present at first-generation towers. Slit/windows come in two basic shapes: the hour-glass style found at Herakleia 18, and the internal-splay apertures at Ephesos B, Iasos A and B, and Samos 24. Slit windows are about as tall (or even taller) than the shuttered windows of Herakleia. Most are about a metre and a half high; the range is from 1.23 (the smallest window at Iasos B) to 1.88 (Ephesos). Because of their tapering (either single- or double-taper) form slit/windows are narrower (at their narrowest point) than shuttered windows, ranging from 0.60ext (Iasos) to 0.72ext (Ephesos). Unlike ordinary windows, slit windows never incorporate chases for shutters; perhaps simple removable shutters were used instead. Slit/windows were obviously designed for catapult fire; the machines used at slit windows may have been similar in size or somewhat smaller than those that fired through ordinary windows.

The next step down in second-generation tower apertures is what I have called the large slit. These are single-taper apertures, generally two courses in height and somewhat shorter than full windows or slit/windows. Large slits are found at most of the Herakleia towers, and at Ephesos A and Samos 27. The height of large slits is typically in the one-metre range; the extremes are 0.92 (Samos) to 1.12 (Herakleia 18). External apertures are much narrower than slit/windows, generally about 0.2; the range is from 0.17 (Herakleia 18, 20 etc.) to 0.30 (Samos 27).

The only first-generation tower discussed above to utilize apertures that could be described as large slits is Messene L: four (two front, one on each side) two-course slits, measuring 0.84h x 0.23ext/1.12int in the lower chamber. The presence of large slits at Messene might possibly be explained as a later remodelling, but this seems to me unlikely (cf. Ober, 1987: 573 n. 14). The Messene L large slits splay quite radically: 1.12int in a thin (0.66, single block thickness) wall; the splay of each slit therefore describes c. 65 degrees of arc. By contrast the internal splay of large slits in second-generation towers is much less pronounced, ranging from 0.49-1.08int in walls that are much thicker (see below). The second-generation large slits discussed above never describe much over 30 degrees of arc. This rather narrow splay is, I believe, to be explained by a security concern: the greater danger from artillery-bombardment faced by second-generation towers led the architects to avoid extreme flaring because it might weaken the wall’s resistance to bombardment by heavy stone-throwers.

Large slits are ill-designed for archers; they offer more vertical height than an archer would need to achieve a full range of fire and so would unnecessarily expose the archer to enemy fire. We should therefore assume that large slits were employed to fire relatively small catapults. Perhaps these were light enough to dispense with the stands that supported larger artillery (for artillery stands: Marsden, 1969: Index s.v. “base.”). Catapults that could be manipulated easily by hand would be able to fire across a relatively wide range through the narrow external apertures. Surely these were bolt-shooters, rather than stone-throwers.

The smallest apertures on second generation are what I have called “small slits.” These are found at Herakleia 20, “Paul’s Prison” at Ephesos, and on the circuit wall at Iasos. The height of small slits ranges from 0.53 to 0.62, the external gap from 0.12 to 0.17. Small slits are also found at first-generation towers (Gyphiotokástro 7: 0.50h x 0.08ext/0.55int, Aigosthena A: 0.60h x c. 0.1 ext; cf. also slits on free-standing first-generation towers: Mánda 0.50h x 0.12int/0.55ext, Vatthékhoría C 0.6h x 0.09ext; see Ober, 1987: 591, 594). Notably, at Herakleia 20, where small and large slits are used in the same chamber, the small slits are higher above floor level than the large slits. This suggests that, as at first-generation sites, small slits in second-generation towers were designed for standing archers.

Wall construction.

The walls of second-generation sites are relatively thick and always built of double-wall masonry. Lower chamber walls are typically a metre and a half or more in thickness; the range is from 1.1 (Samos) to 1.7 (Ephesos). Upper chamber walls are double-walled (usually header-stretcher construction) and generally around a metre thick, ranging from 0.75 (Herakleia 61) to 1.42 (back wall of Ephesos A). In comparison walls at multi-storey first-generation towers are in general much thinner. Lower-chamber walls are generally a metre or less in thickness even when they are built of double-wall construction (Siphai Sea Gate = 0.60, Gyphiotokástro 7 = 0.60, Messene L = 0.66, Phyle = 1.0,
The differences between first- and second-generation towers in window size and placement, slit design, and wall thickness and construction are quite clear. The second-generation towers were built at a time when torsion artillery was quite widely available. Their design shows that military architects of the generation that flourished around 300 B.C. were well aware of the dangers torsion artillery presented to tower security and the advantages torsion machines offered for tower defense.

It is not possible to determine in each case what calibre of machine a given tower was built to house, or whether stone or bolt-shooters would have been employed. The upper chambers of larger second-generation towers (e.g. Herakleia 18, Samos 10) were large enough to accommodate two 10-mina stone-throwers — the size Philon (iii.5-6) suggested would be ideal for destroying enemy catapults. Other, smaller upper chambers were perhaps designed to house lighter stone-throwers or heavy bolt-shooters. Slit/windows might have been used as apertures for heavy bolt-shooters or light stone-shooters; large slits were probably employed for firing light bolt shooters. As noted above, small slits were presumably used by archers.

None of the second-generation towers studied here could have accommodated the very heavy calibre stone-throwers that Philon suggests would be needed against enemy siege towers (see above). But, with the possible exception of Iasos, none of the towers studied here could have been approached by a siege-tower. Presumably a good military architect, working within a budget, would not build a given tower bigger than necessary to house the sort of artillery needed to counter the worst threat that the enemy could bring against the wall sector in which the tower was located. Some of the towers considered here (e.g. the upper circuit towers at Herakleia) were presumably intended primarily to counter assault by enemy infantry, since the steepness of the extra-mural terrain must have rendered it difficult or impossible for the enemy to bring up heavy artillery.

**4. Dating some problematic sites by tower typologies.**

Having formulated a general typology for first- and second-generation sites, it should be possible to apply the typology to certain sites with well-preserved towers for which there is no secure archaeological or historical chronology.

**Phokian Tithorea and Lilaia.**

The chronology of the extant ancient fortifications of the cities of Phokis is a long-standing problem in Greek military architecture. The basic study remains Tillard's 1910 article, in which he suggested a late 4th century (338 B.C. or after, and probably last quarter of the century) date on historical and stylistic grounds. But some of Tillard's military-architectural assumptions are now outdated, and his historical dating was based on the dubious assumption that Philippos II must have razed the walls and towers of the Phokian cities to the ground when he demilitarized the cities of Phokis in 346 B.C. Tillard's chronology has been questioned, but no alternative has been argued in detail. Tillard (1910-11; but chronology questioned: Maier, 1961: 98 n. 154. Lawrence, 1979: 385, 423) suggests that the towers of Tithorea and Lilaia (at least) were not destroyed in the demilitarization program, and should date to shortly before 346 B.C.

**Tithorea, tower on the lower circuit (Plate 63):** The two-storey tower, on the North West corner of the circuit, is quite well preserved. Approaches to the tower are easy from both North and West. Tillard (1910-11: 71) states that: "it occupied a low-lying and exposed position and had consequently to be of great strength" (see also for the fortification Tillard, 1910-11: 56-60, 71-72; Mansden, 1969: 133-134, 159 (diagram 8); Lawrence, 1979: Index s.v.). The masonry is single-wall construction ashlar (with some rabbeting). Block-surfaces are striated inside and out; corners are drafted. The tower measures 5.65w x 5.70d internally; wall thickness is 0.48 on both the lower and upper chambers. The lower chamber was entered from the wall-walk level from doors (0.90w, 1.00w) in the East and South walls. There are six small slits of this level, two each on the West and North walls and one each on the East and South walls. These are 0.55w x 0.70t internall; 0.50h. The floor of the second chamber is supported by a single large joist (0.40 x 0.35) that runs from front to back and 16 small cross-joists running side to side. There is no setback. Remains of two windows are preserved on the North wall. The better preserved West window is 0.71h at its top, a bit wider at the bottom. The windows utilized sills, and were 1.01h.
Each window's area is therefore c. 0.75m². No chases were observed. Assuming that the placement of windows followed the pattern of the lower-chamber slits we should imagine a total of six windows. Window bottom-edges are 1.13 above the top row of counter-joists.

Lilaea. Tower on the lower W wall (Plate 64): This two-chamber tower is on quite flat ground; the approach from the West is very easy (for the tower see Marsden, 1969: 134, 159 [diagram 9]; Lawrence, 1979: Index, s.v.). The less-well preserved large (13.1 x 7.50) tower on the upper circuit is probably later; it conforms to the type of the artillery bastion (Tillard, 1910-11: 70 [with fig. 8]; Marsden, 1969: 137-138 [with fig. 4]; Lawrence, 1979: 457 n. 6). The North West corner of the tower is well preserved; the rest very ruinous. The masonry is single-wall ashlars-to-trapezoidal with much variation in course height. The tower is 4.75w internally (depth cannot be determined); the walls of both chambers are 0.55t. The lower chamber has a single large slit in the centre of the front (West) wall, measuring 0.92h (one very high course) x 0.13ext/0.84int. The splay, describing 67 degrees of arc, is almost identical to the large slits at Messene L. There are no slits on the well-preserved South wall. A single joist-cutting (0.29 x 0.26) on the front wall is the only evidence for the upper-chamber floor; there are no cuttings for counter-joists on the South wall and no setback. The South window of the front wall is well preserved, and a preserved edge of a North window shows that there were two windows on the front wall. The South window is 1.07h (no sill preserved) x 0.86 at the bottom edge; the window tapers slightly at the top. Window area is thus c. 0.88m². No chases were observed. The distance from the window bottom edge to the top of the joist cutting is 0.99.

Conclusions

In wall-thickness and construction, in window size and placement, and in slit configuration the two best-preserved towers at Tithorea and Lilaea fit easily within the first-generation series. It is notable that both towers are in strategic and very exposed positions on the circuit. Presumably, therefore, they represent the acme of tower-strength at their respective sites. Thus there is no reason to put these towers very late in the first-generation series and it seems unlikely that the Tithorea and Lilaea circuits were built in the last quarter of the 4th century, as Tillard supposed. A more likely historical date for the Tithorea and Lilaea circuits is the era of the Third Sacred War (356-346 B.C. [cf. Bucker], 1989)), when the Phokians faced a series of invasions and were wealthy enough (thanks to the looting of Delphi) to be able to afford top-line military architects and up-to-date artillery.

Aitolian "Khalkis" (Plates 65-67)

On the Aitolian coast (North coast of the Gulf of Korinthos) about mid-way between Naupaktos and Kalydon, just West of the modern village of Vasilikí, two stretches of ancient wall block the North and South approaches to a hillside (Woodhouse, 1897: 106-112 [with photographs]; Noack, 1916: 233-239 [with site map and hypothetical restored elevation of walls and towers]; Lawrence, 1979: Index s.v.; Bommelje et al., 1987: 112: [noting "several internal structures" and with full bibliography]). To the East the mountain rises precipitously and to the West a deep ravine apparently made side walls unnecessary. Woodhouse supposed the site to be that of the town of Khalkis (mentioned in the Homeric catalogue of ships), but the site does not really give the impression of a town (I saw very few sherds on the ground); rather it appears to me to be a fortress, temporarily occupied for a single, perhaps brief, period. The site sits above two good little harbours, but is defended on the sea side and so was evidently built by forces that had reason to fear attackers coming by sea. Stretches of the North wall and two towers are well preserved. The masonry is single-wall trapezoidal-to-ashlar; most blocks are quarry face, but door lintels and some blocks are striated (as at Messene and Gyphlókastro).

First tower West of path into site. This tower, like its twin to the West, occupies a jog on the wall: the North East corner of the tower extends out from the wall and so enfilades the wall sector to its East; but at the North West corner of the tower the wall continues the line of the tower wall and so the tower does not enfilade the wall stretch to its West. The tower's single chamber is 5.3w x 4.1d internally; the walls are 0.6t. A doorway (0.78w) enters from the wall-walk on the East side wall; presumably another door entered on the (fallen) West side. A single pentagonal window is preserved on the East wall; it measures 1.7h (at the peak of the pentagon) x 55ext/68int.

Second tower West of path into site (Plates 65 & 66). This tower, somewhat uphill from the other, is rather better preserved and identical in form. It is 5.5w x 4.1d. Walls are 0.50-0.55t. Doors (0.92w x 1.93h, 1.03 x 2.23h) enter from the East and West, from the wall-walk. At the East doorway the epalxis of the wall-walk comes up to the top of the doorway, providing good security (cf. preserved evidence of similar arrangements at Messene l, Gyphlókastro 7, and Siphai 3). Two pentagonal windows (1.10 x 0.41ext/0.50int, 1.08h x 0.43ext/0.58int) open...
in the front (North) wall. One window (1.06h x 0.47ext/0.56int) opens in the East wall.

The windows of the "Khalkis" towers are strikingly similar in form to the pentagonal windows at Messene N (Messene N av. = ~0.88h x 0.37ext/0.74int) and just slightly larger in size. The wall thickness is also similar (Messene N ~ 0.58s). No evidence for the nature of the roof survives, but it seems likely that the roof would have been a platform, as at Messene N (cf. the restoration of Noack [1916: fig. 17]). In terms of window size, form, and placement, and wall thickness and construction, the towers of "Khalkis" fit well within first-generation parameters. One is tempted to suppose that the site (like Messene) was built as a base by the Theban architects during the period of the Theban hegemony (371-362 B.C.). A Theban fort here would not be odd: Epameinondas captured Naupaktos and Kalydon from the Akhaianins in the mid-360s and returned them (briefly) to the control of the Aitolians with whom he made an alliance (Buckler, 1980: 188-191). On the other hand, we do not have enough well-preserved sites to make secure assumptions about "national" styles in architecture, and the architect of "Khalkis" may simply have been working in the same tradition as the architect of Messene.

The epalxis of the circuit wall at "Khalkis" (Plate 67) deserves mention here, because it has some bearing on the issue of windows and shutters. A stretch of the North wall East of the first tower described above is very well preserved. The wall is 2.4 wide, with an epalxis 0.58s. The epalxis is buttressed every c. 3.5 (buttresses ~ c. 0.65 x 0.60). Offset between each set of buttresses there is a window-shaped aperture; in no case is there a lintel, but several windows are otherwise intact. Four that are well preserved range in width from 0.80 to 1.03. The windows are either two or three blocks in height (1.03-1.44). Beneath each window, generally cut through the bottom edge of a sill block, is a set of two chases.

Noack (followed by other scholars) restored the epalxis as fully fenestrated (Noack, 1916: fig. 17) each window as capped with a massive stone lintel and by another course of masonry. This is not impossible, but neither is it a necessary restoration. An alternative restoration is to suppose that the windows did not have stone lintels, and that they served rather as crenellations. The top sides of some of the upper window-edge blocks are very rough and do not appear to me to have been prepared for another masonry course; the roughness could, of course, be due to weathering, but the stone is very good and dense and I did not observe similar weathering on the sill-tops. The chases demonstrate the presence of drop-shutters. I would suggest tentatively that the shutters were used to protect a battery of light non-torsion catapults. The use of pentagonal windows without chases and shuttered windows in the same circuit may appear peculiar, but is paralleled at Messene where the West wall towers use pentagonal windows and the North wall towers use (side-swinging) shuttered rectangular windows.

Aitolian "Boukation" — modern Paravóla (Plates 68 & 69)

The town of Paravóla, located just North of Lake Trikikos between Thermon and Agríton, has been tentatively identified as the site of the ancient town of Aitolian Boukation (Woodhouse, 1897: 190-196; Lawrence, A.W., 1962: pls. 124-126; Lawrence, 1979: Index [for other literature]).

Half-round tower (Plates 68 & 69). The most impressive ancient structure at the site is a well-preserved half-round tower on a hill near the centre of the town. The tower faces East; approaches are steep and difficult from that direction. The back wall of the single-chambered tower bonds to a circuit wall (2.6t). The wall extending from the front of the tower (with a rectangular tower facing North) does not bond the tower, and the tower face has been smoothed to ensure a good join. Thus the centre wall is clearly later than the half-round tower. Tower masonry is single-wall trapezoidal with much use of rabbeting. The tower measures 7.10w x 5.55d internally; the floor space is c. 33m². The walls are 0.60-0.64t. Doors (2.60h x 1.40w, 2.18h x 1.05w) open at the back sides from the wall-walk, allowing defenders moving along the wall walk to go through the tower. Three windows open in the curved front of the tower, they are 1.12h x 0.67w, 1.13h x 0.80w, 1.10h x 0.68w (average window area = 0.80m²). No chases were observed. Joint holes (0.25 x 0.20) in the third course (0.86) above the window level and in the back wall apparently supported a platform-roof that sloped back at an angle of about 1 degree; it could, of course, be the floor of a second storey.

1. The problem how the shutters were pulled shut might be solved by assuming that light wooden cross-bars were placed across tops of windows. The catapults could have employed stocks up to c. 2.1m if we assume that the stocks protruded out into window a bit. The depth of the wall-walk is only 1.8m. The existence of the buttresses is the limiting factor on bow-spread. Bows could not have been wider than c. 2.5m in some cases.
but this seems rather unlikely given the excellent state of preservation of the tower to the rafter level (cf. Woodhouse, 1897: 193). A stairway built into the inside wall of the tower between the South door and the South East window gave access to the platform.

**Rectangular tower.** Stretches of the North West circuit wall (the same wall bonds to the half-round tower) and foundations of several other rectangular towers are preserved at the site. The masonry is trapezoidal-to-polygonal. The best preserved of these towers measures 5.7m x c. 5.8d internally in the ground-floor chamber. The tower walls are double-wall construction, 1.45m. A door enters the back of the tower from ground level.

The Paravola towers do not fit tidily into either the first- or the second-generation series. Wall thickness and window size at the half-round tower conform to first-generation specifications, but the ratio of floor-space area to windows (c. 11.0m² per window) is more typical of large second-generation towers (e.g. Herakleia 18: ratio of 11.1; Herakleia 62: ratio of 10.25). The ground-storey wall thickness of the rectangular tower is also typical of second-generation towers. Several solutions to the apparent conundrum are possible: we might suppose that the Paravola circuit was built in c. 340-325 on the cusp of the first- and second-generations, or that it is the product of peculiar regional tastes in tower construction.

But it is important to keep in mind that only the first part of the history of Greek fenestrated towers has been sketched out above. There are towers and wall-apertures at other sites in the Greek world that do not fit neatly into either the first- or second-generation series; notable examples are to be found at the Pamphylian towns of Side and Perga. These two sites are probably to be dated to the mid-to-late 3rd century and may represent a distinct "third-generation" of tower architecture, with its own unique characteristics. Thus, while the first/second-generation typology may help to solve some chronological riddles, it is not a panacea. The puzzle of the chronology of the Paravola towers will probably only be solved by extending the typology. There is much work yet to be done.

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Bibliography


BOMMELIÉ, Sebastiaan, DOORN, Peter K., et all., 1987: Aetolia and the Aetolians: towards the interdisciplinary study of a Greek region (= Studia Aetolica I; Utrecht).

BUCKLER, John, 1980: The Theban Hegemony (Cambridge, Mass.).

BUCKLER, John, 1989: Philip II and the Sacred War (= Mnemosyne Suppl. 109, Leiden).


LAWRENCE, A.W., 1979: Greek Aims in Fortification (Oxford).

LAWRENCE, A.W., 1962: Greek Architecture (Harmondsworth).


WINTER, Frederick E., 1971: Greek Fortifications (= Phoenix Supplement 9, Toronto).


Plate 59  [Ober] Herakleia, Tower 59; inside North face.
Plate 60  [Ober] Herakleia, Tower 62; inside.
Plate 61  [Ober] Iasos.

Plate 62  [Ober] Iasos.
Plate 63  [Ober] Tithorea.
Plate 68  [Ober] Boukation.
Plate 69  [Ober] Boukation.