

THE SECOND TEMPLE OF HERA AT PAESTUM AND THE PRONAOS PROBLEM

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THE unusual proportions of the architrave and frieze of the pronaos and opisthodomos of the second temple of Hera ('Poseidon') at Paestum have long been known, and the design has been variously used as evidence for the original form of the Doric frieze¹ and for the unsophisticated design methods of Greek architects.² Full measurements of this entablature, on which to base explanations of its design, have not, however, been available.³ By the kindness of Prof. M. Napoli, Superintendent of Antiquities for the province of Salerno, I was enabled to take some of the necessary measurements in August 1973, and the first aim of this paper is to make them public.⁴ Standing on the abaci of the two antae and the two columns of the opisthodomos, I was able to measure the architrave and frieze which they carried, but the next course, the epikranitis, was unfortunately just beyond my reach; my rough measurement made its height 0.30 m, agreeing with that given by KP 29, fig. 28 for the corresponding moulded course behind the pteron frieze, which carried the other end of the ceiling beams. The dimensions of the various elements of the frieze and architrave of the opisthodomos are given in FIG. 1.

My second purpose is to consider briefly the relationship of the opisthodomos/pronaos order to the outer order of the second temple of Hera and to the problem of pronaos design in general. The height available for the opisthodomos columns, architrave and frieze is 0.80 m less than for the corresponding elements of the main pteron order, for the opisthodomos stylobate is set 0.50 m higher than the pteron stylobate, while the top of the frieze must come c. 0.30 m below the top of the pteron frieze, in order to allow for the epikranitis (cf. FIG. 2). It is therefore surprising to find that the opisthodomos columns repeat exactly the size and design of the pteron columns,⁵ so that the whole 0.80 m must be deducted from the entablature. Even here, however, the procedure is not consistent. The frieze is 0.359 m lower than the architrave, instead of being approximately equal to it, as in the pteron, and the triglyphs are c. 0.19 m narrower than the regulae, when they are normally exactly equal. Unless the architect intended this unparalleled arrangement (in which case it is strange that the design of the temple is in other respects so conventional), we must assume that there was either a failure to plan or a radical change of plan, which forced the architect to make the frieze as he did.

The triglyphs are one and a half times as high as they are wide ($T \times 1\frac{1}{2} = c. 0.885$;

¹ G. Perrot, C. Chipiez, *Histoire de l'art dans l'antiquité* 7 (1898) 382.

² Bundgaard 144-5. Bundgaard's interpretation is similar to that set out below. In addition to the standard abbreviations, the following are adopted here:

Bundgaard—J. A. Bundgaard, *Mnesicles, a Greek Architect at Work* (1957).

Dinsmoor—W. B. Dinsmoor, *The Architecture of Ancient Greece* (1950).

KP—R. Koldewey, O. Puchstein, *Die griechische Tempel in Unteritalien und Sicilien* (1899).

Krauss—F. Krauss, *Paestum, die griechische Tempel* (1943).

For parts of the Doric order, the following are used:

A = architrave height

D = lower column diameter (on arrises)

d = upper column diameter (on arrises)

F = frieze height

H = column height

I = axial intercolumniation

T = triglyph width

The subscripts W, L or Pr indicate that the part in question belongs to the pteron front, pteron flank or pronaos order.

³ Some of the dimensions are given by H. Labrousse, *Les temples de Paestum* (1877) and repeated by KP 27.

⁴ I am most grateful to Prof. Napoli not only for permission to measure the entablature, but also for generously allowing me to use the Soprintendenza's long ladder to reach it. I wish also to thank Dr F. Zancani Montuoro for advice and encouragement, and Mr. Finaldi and his men at Paestum for their kindness and help.

⁵ KP 27, Krauss 54.

COULTON J. J., *The second temple of Hera at Paestum and the pronaos problem*: JHS XCV 1975 13-24. | Accurate measurements of the various dimensions of the frieze and architrave of the opisthodomos of the second temple of Hera at Paestum permit an informed evaluation of the relationship of the opisthodomos-pronaos order to the order of the temple and to the problem of pronaos design in general. It is likely that architects of Doric temples of this period faced difficulties of design in the pronaos because the pronaos columns had to be designed and erected before the architrave and frieze could be designed in detail.

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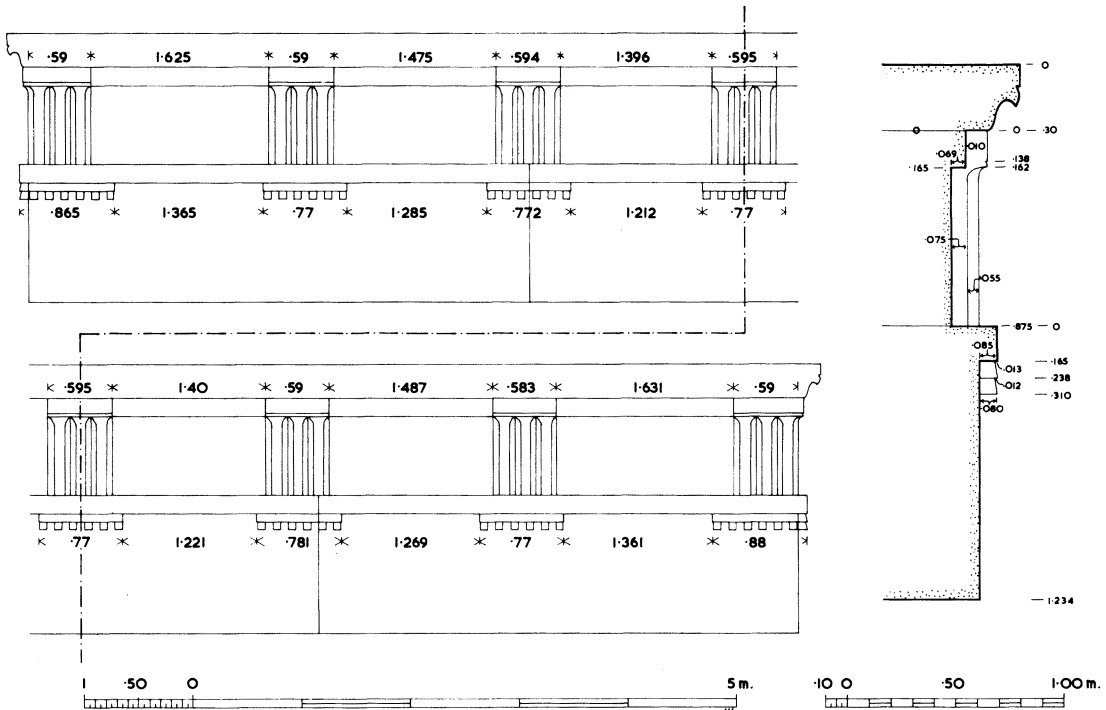


FIG. 1.—The opisthodos entablature of the second temple of Hera at Paestum: elevation and section.

$F = 0.875$ m); if they had the same proportions, but a width equal to the regulae, their height would have been *c.* 1.155 m, roughly equal to the height of the actual frieze and epikranitis together (*c.* 1.175 m). This would have made the frieze 0.079 m lower than the architrave (it is 0.055 m lower in the pteron),⁶ and the metopes would have been roughly square as usual (1.155×1.22 m; compare 1.433×1.35 m in the pteron). It rather looks therefore as if the architect, having repeated the pteron columns in the opisthodos, in spite of the 0.50 m difference in stylobate level, decided to divide the height available from the top of the capitals to the level of the top of the pteron frieze (where the horizontal ceiling beams were to be) almost equally between the architrave and frieze, but forgot to take into account the necessity for an epikranitis. The triglyphs were to be about one fifth of the opisthodos intercolumniation⁷ ($I/5 = 0.80$ m; $T = 0.77$ m), just as the pteron triglyphs were one fifth of the flank intercolumniations ($I_L/5 = 0.90$ m; $T = 0.90$ m), and the regulae were set out accordingly. When he realized his mistake, he had to reduce the frieze height by another 0.30 m, and in order to save the proportions of the triglyphs, he reduced their width to two thirds of the new frieze height. As usual, the metope was regarded as the elastic element, whose proportions could be altered to suit any special requirements.⁸ Indeed, even if there had been no change in the frieze height, the metopes would still have needed stretching near the corners, as the spacing of the regulae shows. There was no enlargement of the angle triglyphs.

⁶ Krauss 50 gives for the pteron $A = 1.488$ m, $F = 1.433$ m.

⁷ The intercolumniation of the opisthodos is 4.00 m (KP 27, Krauss 54, fig. 4), and the spacing of both regulae and triglyphs over the central span corresponds to this dimension. The pronaos intercolumniation, however, was increased to 4.146 m.

⁸ Compare the treatment of the metopes near the angles of the Stoa at Brauron (Ch. Bouras, *'H Anasτήλωσις τῆς στοᾶς τῆς Βραυρώνος* (1967) 59–61) and of the metopes of the Stoa of Antigonos at Delos (F. Courby, *Exploration archéologique de Délos* 5 (1912) 22–4); cf. also Bundgaard 115.

It might be objected that the reason for the unusual proportions of this entablature was a change of plan, rather than a failure to plan. The ceiling beams were perhaps originally intended to have their soffits well above the level of the cornice bed, and a decision to lower them at a late stage, when the opisthodomos architrave was already in place, meant that the architect was forced to lower the opisthodomos frieze accordingly.⁹ However, the height at which the ceiling beams were to run was already defined by mouldings along the top of the pteron frieze backers, so that this explanation requires that the pronaos and opisthodomos architraves should have been in place before the pteron frieze backers; most authorities believe that the construction of the pteron proceeded ahead of construction of the cella building.¹⁰ This does not necessarily mean that the pteron as a whole was always completed before the cella was begun (although that may sometimes have been the case). Furthermore, it is doubtful whether the ceiling beams at Paestum could ever have been envisaged as much as 0.80 m above the cornice bed, so that the opisthodomos order as a whole could hardly have been planned in detail with a height equal to that of the pteron order; the opisthodomos columns, repeating unchanged the dimensions of the pteron columns, must inevitably have been too large, and in fact both the architrave height and the triglyph width implied by the regulae are seriously out of proportion with the lower diameter of the columns, even without considering the actual frieze. Finally there is no evidence that the ceiling beams were ever set any higher than the cornice bed in the western colonies, so that the hypothetical intended higher ceiling level cannot be satisfactorily paralleled.¹¹ Nor is there any reason why, if a higher ceiling level had been intended, it should not have been put into effect, for the temple of Zeus at Olympia, virtually the same in size and date, shows that a higher ceiling level could be both aesthetically and structurally acceptable.

The suggestion that the architect of the second temple of Hera made a serious mistake in designing the pronaos order implies that there was some difficulty here for a Greek architect. It is in fact one of the few places in a peripteral temple where previous design work is required, in that the columns, architrave, frieze and epikranitis must together reach a predetermined height in relation to the pteron order. If the pronaos columns are made too high (as apparently here), the entablature must inevitably be made too low, while in the pteron the height of the columns does not control the height of the entablature physically, but only aesthetically. The other places where the possibilities open to an architect are similarly restricted physically by decisions already made are the handling of the angle contraction and the spacing of the front and flank columns. Thus a regular spacing of the frieze elements

⁹ Cf. W. H. Plommer, *Ancient and Classical Architecture* (1956) 142.

¹⁰ So Dinsmoor 170, Bundgaard 146–51, G. Roux, *L'Architecture de l'Argolide* (1961), 31, 108, 171–2; but cf. W. H. Plommer, *Ancient and Classical Architecture* (1956), 155. The fourth century temple of Apollo at Delphi is a problem here. For the accounts see *Fouilles de Delphes*, E. Bourguet, *Les Comptes du iv^e siècle* (1932), nos. 19–46 (cited below by inscription number only) and *RevArch* 1966, 249–96 (cited below as Roux). Roux 260–6 argues that the cella of the temple was built before the pteron, but the argument founders on the largely unknown state which the temple had reached in 356 B.C., when the Phokians occupied Delphi. Roux 264 shows good reason to believe that by then the colonnade was erected, but it seems likely that the entablature was also partly in place. Six architraves and the twelve frieze blocks to go with them were in the sanctuary in 359 B.C. (no. 19.28–30), and would hardly have been left unused

for three years; nor were these the only ones on the site before the war, for six architraves, fourteen frieze blocks and seven cornice blocks had to be replaced as damaged in 344/3 B.C. (no. 23 II 57–62). Furthermore if 140 dr. was paid, whether as supplement or as total, for setting the corner triglyphs of the pronaos (no. 25 IIB; cf. Roux 287–96), the 1 talent 5 minas and 20 staters paid for τὰς περιστάσις ἐργασίας in 343/2 B.C. (no. 19.97) would not cover the setting of the whole pteron entablature. We do know that the corner triglyphs of the pronaos and opisthodomos were quarried and set at about the same time as the corner cornice blocks of the pteron (no. 27 IA, III, no. 25 IIB), and since the ceiling level was probably established by the pteron architrave (cf. below, n.23), it is probable that construction of the pronaos was far enough behind that of the pteron for the purposes of this study.

¹¹ Cf. below p. 17.

cannot be achieved unless the angle intercolumniation has previously been contracted by the right amount,¹² and equal spacing of the front and flank columns depends on the choice of the correct proportions for the temple platform as a whole. In both cases Greek architects seem to have had some difficulty in finding the right answers. It was more than a century before they found a way of getting the front and flank intercolumniations equal,^{12a} and even longer before they managed (if indeed they ever did) to get the triglyph frieze consistently regular at the angles, yet both these are problems which should cause little trouble to an architect who designed his building in detail before construction started. It is therefore important to look at the way this third problem of design was handled in Greek architecture. Nevertheless, although the triglyph problem, and to a lesser extent the spacing of the front and flank columns, have received some attention from scholars,¹³ the problem of the pronaos order has been neglected. Koldewey and Puchstein remark on the restrictions imposed on the architect designing a pronaos order, in that both the height and the width of the façade are predetermined, and Bundgaard recognises it as fundamentally a problem of design method, but even they do not trace the way in which the design was handled.¹⁴ A full treatment of the problem would unnecessarily delay this paper, but the main lines of approach may be outlined.

Before the late sixth century B.C. we can study only the way in which the lower part of the pronaos was designed. In Sicily the earliest pronaos with columns is that of the temple of Apollo at Syracuse;¹⁵ the pronaos there is set 0.10 m higher than the pteron, and the lower diameter of the pronaos columns is apparently between that of the front and flank columns. Temples C and FS at Selinous have no pronaos columns, but Temple D has a substantial rise (0.78 m) from the pteron to the pronaos, and the pronaos columns are c. 0.33 m less in diameter than those of the pteron;¹⁶ it is likely that the pronaos columns were also lower, so as to compensate for the rise. In mainland Greece the temple of Hera at Olympia has the pronaos set only 0.06 m higher than the pteron, and the pronaos columns are not significantly smaller than those of the pteron.¹⁷ At Assos, the pronaos stylobate of the temple of Athena does not rise at all above the pteron, and the column diameter was apparently identical in both orders.¹⁸

From the late sixth century B.C. onwards, the situation becomes rather clearer. In mainland Greece, during the late sixth and earlier fifth centuries B.C., the pronaos is usually at a somewhat higher level than the pteron, but rarely more than c. 0.25 m; the ceiling is high up, with the epikranitis bed approximately level with the cornice bed, so that the pronaos order is little lower than that of the pteron. The difference is usually made good almost entirely in the height of the pronaos columns, both the height and the lower diameter of which are less than in the pteron. Thus the pronaos entablature can be made nearly the same height as that of the pteron. This arrangement can be seen in the temples of Aphaia at Aigina and Zeus at Olympia,¹⁹ but it is most obviously embodied in the Hephaisteion at Athens and other temples by the same architect. The trick of carrying the pronaos entablature across to join the rear of the pteron entablature means that the soffits of the two architraves must be at the same level, and in fact by setting the ceiling as high as possible, the two

¹² In simple cases the amount of contraction required equals $\frac{A \text{ width} - T}{2}$, but it is doubtful if that

formula was in fact used (*BSA* 69 (1974), 73-4, 83), and it does not allow for the possible inward tilt of the columns; but however the matter was managed, once the columns were in place, there was little that the architect could do to control the treatment of the angle.

^{12a} Bundgaard 128-9, n.255.

¹³ E.g. D. S. Robertson, *Greek and Roman Architecture* (2nd ed., 1943) 106-11; *BSA* 69 (1974) 61-86.

¹⁴ KP 209; Bundgaard 142-6.

¹⁵ KP pl. 7, *MonAnt* 41 (1951) 834-5.

¹⁶ KP pl. 13.

¹⁷ E. Curtius, F. Adler, *Olympia* 2 (1892) 32, pl. 18.

¹⁸ J. Bacon, F. Clark, R. Koldewey, *Investigations at Assos* 1881-3 (1902-21), 141, 157, fig. 3.

¹⁹ A. Furtwängler, *Aigina, das Heiligtum von Aphaia* (1906) 32-3, pl. 38; E. Curtius, F. Adler, *Olympia* 2 (1892) 9-10, pl. 10, 15.

orders are kept as similar to each other as possible.²⁰ In the Parthenon on the other hand the rise from pteron to pronaos is much greater than usual, *c.* 0.734 m, and the epikranitis top is barely higher than the cornice bed.²¹ Thus there is *c.* 1.03 m less height available for the pronaos columns, architrave and frieze, too much to be made good simply by adjusting the pronaos column height. The whole order was therefore redesigned, with columns *c.* 0.38 m lower than those of the pteron, and the architrave and frieze height each reduced by about 0.30 m; thus the pronaos entablature is considerably lighter than that of the pteron.²² In the temple of Apollo at Bassai the epikranitis top was also level with the pteron cornice bed, so that the whole pronaos order had again to be smaller than that of the pteron. In the fourth century the ceiling level was lowered again, so that the pronaos frieze top came level with the top of the pteron architrave, on top of which a course exactly corresponding to the epikranitis was set; even less height was thus available for the pronaos order and an entirely separate design for it became still more essential.²³

In terms of mainland Greek practice, it seems to have been Iktinos who lowered the ceiling level, rather than the Hephaisteion Architect who raised it. The reason was presumably to allow more space for the marble ceiling, a feature only then coming into use.^{23a} Earlier wooden ceilings seem to have required less space, so that the high ceiling level caused no problems, but the Hephaisteion Architect's determination to put his marble ceilings at the same high level repeatedly caused him difficulties with the roof, even though the coffering was very shallow.²⁴ Certainly the marble ceiling over the east and west pteron of the Parthenon, which had the ceiling beams at the lower level, used all the space available at the eaves (although a shallower ceiling at a higher level would presumably have been structurally possible, since the span is less than that over the east pteron of the Hephaisteion). Over the north and south pteron, however, the ceiling beams were omitted, leaving only the coffer slabs, set at the same height as those of the east and west ceilings; there was thus a free face of 0.88 m above the north and south sides of the Panathenaic frieze, which were probably carved *in situ*.^{24a} The same combination of front and rear ceilings consisting of beams and coffer slabs with side ceilings consisting of coffer slabs only was used again in the temple of Apollo at Bassai and the temple of Athena at Tegea; but in these temples, which had no sculptured frieze on the long sides of the cella building, the coffer slabs of the side ceilings come at the level of the ceiling beam soffits of the front and rear ceilings. The advantages of the low pronaos order are apparent in the temple at Tegea, where the very deep coffering of the front and rear ceilings takes almost all the space available at the eaves.²⁵

²⁰ BSA 45 (1950) 66–112. In the Hephaisteion and at Rhamnous the rise from pteron to pronaos is kept small, but at Sounion it is 0.335 m, all of which is absorbed in the pronaos columns.

²¹ F. C. Penrose, *Investigation of the Principles of Athenian Architecture* (2nd ed., 1888) pl. 7–8, 14, 16.

²² In the pteron $A = I \times 5/16$ ($4.296 \times \frac{5}{16} = 1.343$; $A = 1.349$ m); in the pronaos $A = I \times \frac{1}{4}$ ($4.189 \times \frac{1}{4} = 1.047$; $A = 1.044$ m). Cf. also Bundgaard 142–6.

²³ A ceiling at this level is first found in the east porch of the Propylaia at Athens (the west porch had a ceiling as high as those of the Hephaisteion Architect); the reason for the low east ceiling was perhaps a desire to leave a relieving opening above the central doorway (W. H. Plommer, *Ancient and Classical Architecture* (1956), 140; but cf. also Bundgaard 159–60). In the fourth century however, this became the normal level, and is found in the Tholos at Delphi, the temple of Asklepios and the Tholos at Epidauros, the

temples at Tegea and Nemea, the Philippeion at Olympia, etc.

^{23a} Martin's alternative explanation (R. Martin, *Recherches sur l'agora grecque* (1951), 452–3) is based on the assumption that the horizontal and sloping beams of early Greek roofs were jointed together so as to resist a lateral thrust; there seems no good evidence for this assumption.

²⁴ A. T. Hodge, *The Woodwork of Greek Roofs* (1960), 106–15; on wooden ceilings see *ibid.* 35, 101–5.

^{24a} B. Ashmole, *Architect and Sculptor in Classical Greece* (1972), 141–2.

²⁵ No special explanation is required for the ceiling height at Tegea, since it was normal for the period whether there were sculptured pronaos metopes or not. The deep coffer slabs of the front and rear ceilings are self-supporting over the long span, overlapping only the mouldings of the ceiling beams which seem to carry them.

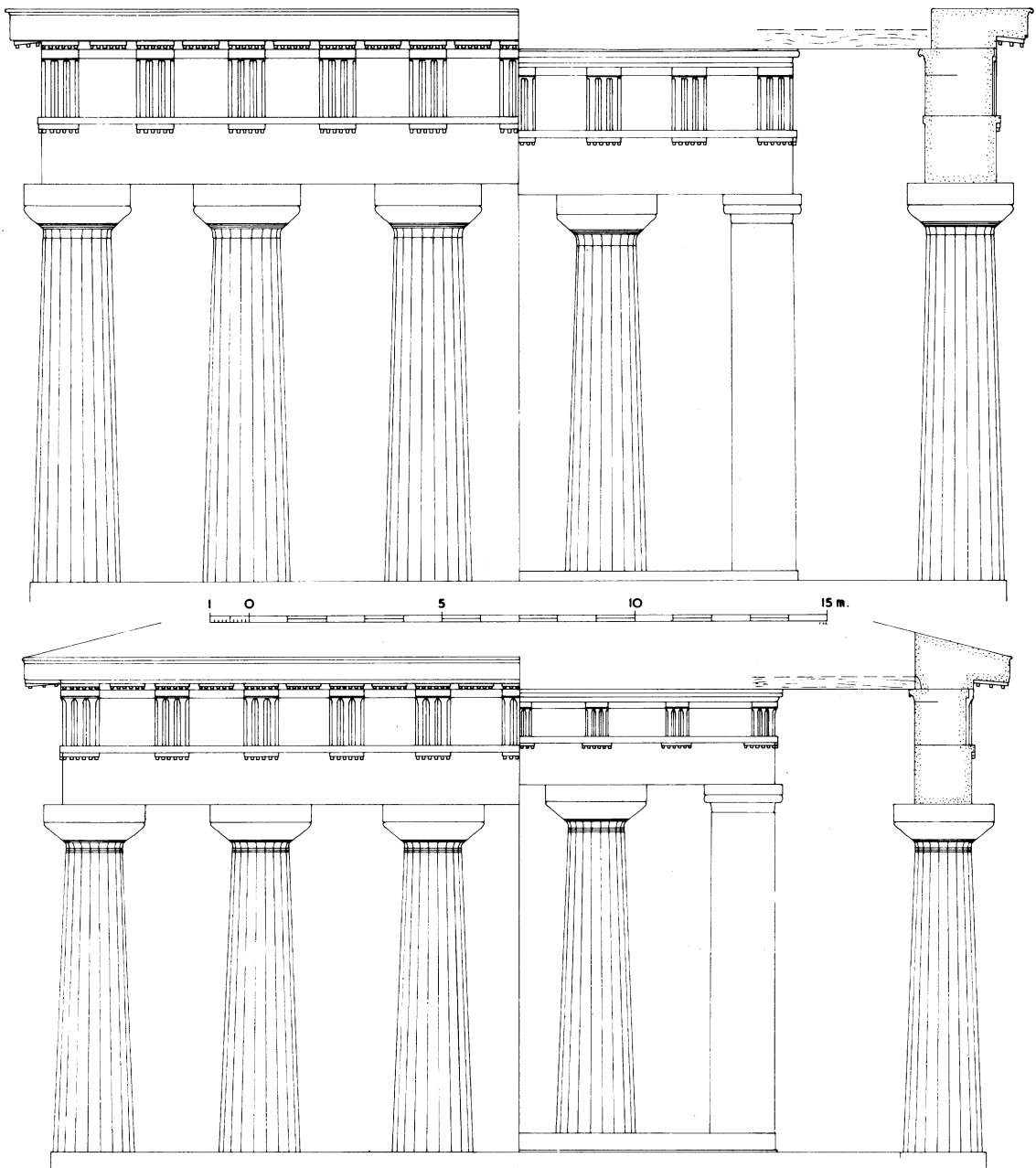


FIG. 2.—Pteron and pronaos orders compared: Temple ER at Selinous (above) and the second temple of Hera at Paestum (below).

In Sicily it seems to have been normal from quite early in the fifth century for the epikranitis to be level with the pteron frieze top; indeed there is no evidence for any other arrangement.²⁶ Since the pronaos is usually set at a somewhat higher level than the pteron, the pronaos order must normally have been significantly smaller than the pteron order, and certainly the pronaos columns normally have a smaller lower diameter. In Temple ER

²⁶ Ceiling beams at this level are certain in Temple ER at Selinous, the temple of 'Concord' at Akragas and the temple at Segesta. They were

certainly no higher than this in Temples D, FS and GT at Selinous.

(Hera) at Selinous we can follow the whole design (FIG. 2). The opisthodomos is set 0.24 m higher than the pteron, the epikranitis is about 0.55 m high,²⁷ and the difference of c. 0.79 m between the two orders is spread over the three main constituent elements. The columns of the pronaos are c. 0.52 m (5%) lower, the architrave 0.11 m (6.4%) lower and the frieze 0.158 m (9%) lower than the corresponding elements of the pteron, so that the various proportional relationships within the two orders do not differ very much.²⁸

In the second temple of Hera at Paestum the ceiling is set at the same height as in the Sicilian temples, but instead of having smaller columns as in Temple ER, its porches simply repeat the pteron columns, thus upsetting the whole proportional scheme (*cf.* FIG. 2 and Table 1). The mistake can probably be explained by reference to the other temples at

TABLE 1

	Selinous, ER			Paestum, Hera II		
	Pteron	Pronaos	Pronaos Pteron	Pteron	Pronaos	Pronaos Pteron
	(m)	(m)		(m)	(m)	
I _L	4.712	4.43	0.942	4.503	4.00	0.888
H	c. 10.15	9.63	0.949	8.88	8.88	1.00
D _L	2.268	2.05	0.904	2.04	2.06	1.01
A	1.74	1.63	0.937	1.488	1.234	0.831
F	1.72	1.562	0.91	1.433	0.875	0.61
T	0.95	0.90	0.947	0.90	(0.77)	(0.856)
					0.59	0.655
H/D	4.47	4.7		4.35	4.31	
H/I _L	2.055	2.175		1.971	2.22	
A/F	1.011	0.96		0.965	1.41	
F/T	1.81	1.74		1.59	(1.14)	
					1.485	
I _L /T	4.96	4.92		5.0	(5.20)	
					6.78	

(Figures in brackets refer to the triglyph width implied by the regulae.)

Paestum. In the temple of Athena ('Ceres') there are two moulded courses between the pteron frieze and cornice; the lower of these, which might be regarded as a crown moulding for the frieze, carried the ceiling beams, and the epikranitis corresponded to its moulded inner face. There was a rise of 0.31 m from the pteron to the pronaos,²⁹ so that the pronaos order could not simply repeat the design of the pteron; but in this case the pronaos was given Ionic columns, and so it could not be used as a model for the second temple of Hera.

²⁷ KP fig. 112 shows a block with a hawksbeak moulding at the back and front; its height is 0.67 m, but its bed width of 1.23 m shows that it was not the epikranitis above the pronaos frieze (*cf.* KP 129 and fig. 111), the height of which is therefore not directly known. The figure of 0.55 m is based on the following calculation:

	Pteron	Rise	Pronaos
H	10.15		9.63
A	1.74		1.628
F	1.72		1.562
	13.61 m	less	13.060 m = 0.55 m

In the temple of 'Concord' at Akragas the course carrying the wall crown moulding is also taller than the epikranitis proper above the pronaos frieze.

²⁸ The arrangement was probably similar in the temple of 'Concord' at Akragas, but full and accurate

figures are not available. The pteron column height is 6.70 m (Dinsmoor 339), the architrave and frieze 1.09 m and 1.295 m (KP fig. 152), so that the ceiling beams would have been 9.085 m above the pteron stylobate. There is a rise of 0.34 m from pteron to pronaos (KP pl. 25); the pronaos column height corresponds to the orthostates (1.11 m high) and 10 wall courses, while the pronaos entablature (including epikranitis) corresponds to four wall courses. The height of the lower wall courses is c. 0.517 m (KP 175), but the upper five or so courses appear to be higher, c. 0.54–5 m. The total height of the pronaos order should therefore be 0.34 + c. 6.32 + c. 2.20 = 8.86 m, that is about 0.20 m short of the required ceiling height. It would appear from photographs that the pronaos frieze was equal in height to its architrave, not higher, as in the pteron, so that there was no reduction of the pteron order by a constant factor.

²⁹ KP 20, fig. 17, pl. 3; Krauss 39.

The first temple of Hera ('Basilica') therefore provided the most convenient indication of how to tackle the problem. The rise from pteron stylobate to pronaos was there only 0.15 m, and the architect repeated the design of the outer columns, except for making them correspondingly lower.³⁰ What happened at the top of the pronaos façade is not certain; the ceiling beams must have come above the top of the frieze proper, but it is quite likely that there were two moulded courses between the pteron frieze and cornice here, as in the temple of Athena,³¹ and that the epikranitis similarly corresponded to the lower of these. That would mean that the architrave and frieze of the pronaos could be precisely the same as those of the pteron; the pronaos order could thus be regarded as virtually repeating that of the pteron to reach a ceiling height at the level of the frieze top/cornice bed. Perhaps therefore the architect of the second temple of Hera thought he would simply follow his predecessor's example in repeating the design of the pteron columns in the pronaos; but he failed to take into account the problems caused by the greater differences between the pteron and pronaos stylobate levels, and by his rejection of the two moulded courses as uncanonical.

We thus find three relationships between the pteron and pronaos orders:

a) the epikranitis bed is level with the pteron frieze top (mainland Greece in the late sixth century (and perhaps earlier?) and the early fifth century; the Hephaisteion Architect).

b) the epikranitis top is level with the pteron frieze top (Sicily from the early fifth century (and perhaps earlier?); the Parthenon and Bassai; and, with more or less strictness and probability, the temples at Paestum).

c) the epikranitis bed is level with the pteron architrave top (mainland Greece in the fourth century).

All three are easily visualised, although not always precisely realised.^{31a} The first arrangement, which keeps the difference in height between the two orders as small as possible, is an attempt to avoid or localise the problem. Almost all the difference is deducted from the column height, yet the pronaos intercolumniation is normally less than that of the pteron, and so the whole order should theoretically be smaller to match.

With the other two arrangements the problem must be faced more directly, for a new design has to be made for a smaller pronaos order. It is noticeable, however, that the pronaos order never repeats the proportions of the pteron exactly, nor does it differ from the pteron order in a consistent way. We never get the glaring makeshifts of the second temple of Hera at Paestum, but even in the fourth century it appears that the architect of the temple of Zeus at Nemea was in some difficulty, as we can see by comparing its pronaos with that of the temple of Athena at Tegea, a very similar temple with the same ceiling height (FIG. 3).³²

³⁰ The height of the pteron columns was 6.454 m, that of the pronaos columns 6.323 m (F. Krauss in *Festschrift für Carl Weickert* (1955), 104). The difference of 0.121 m means that the architrave soffit of the pronaos would be at almost exactly the same level as that of the pteron. The cella floor of the same temple is set 0.375 m higher than that of the pronaos, and it is an interesting reflection on this architect's design methods that, instead of designing slightly smaller columns to reach the same ceiling level, he made the cella columns exactly like those of the pronaos, but since less height was required, he set them on a course below the floor, at the same level as the pronaos, and built up the floor round them.

³¹ The capitals of the two temples are also unusual and similar to each other; and without the crown

moulding the frieze of the first temple of Hera would be remarkably low in relation to its architrave.

^{31a} The epikranitis bed is 0.12 m below the pteron frieze top in the temple of Zeus at Olympia; the epikranitis top is 0.058 m above the pteron frieze top in the Parthenon; the epikranitis bed is 0.021 m below the pteron architrave top in the Tholos at Delphi.

³² The figures are from C. Dugas, J. Berchmans, M. Clemmensen, *Le Sanctuaire d'Aléa Athéna à Tégée* (1924) and B. H. Hill, C. K. Williams, *The Temple of Zeus at Nemea* (1966). The lower diameter of the pronaos columns at Tegea is unknown, so that the comparison there is made in terms of the upper diameter.

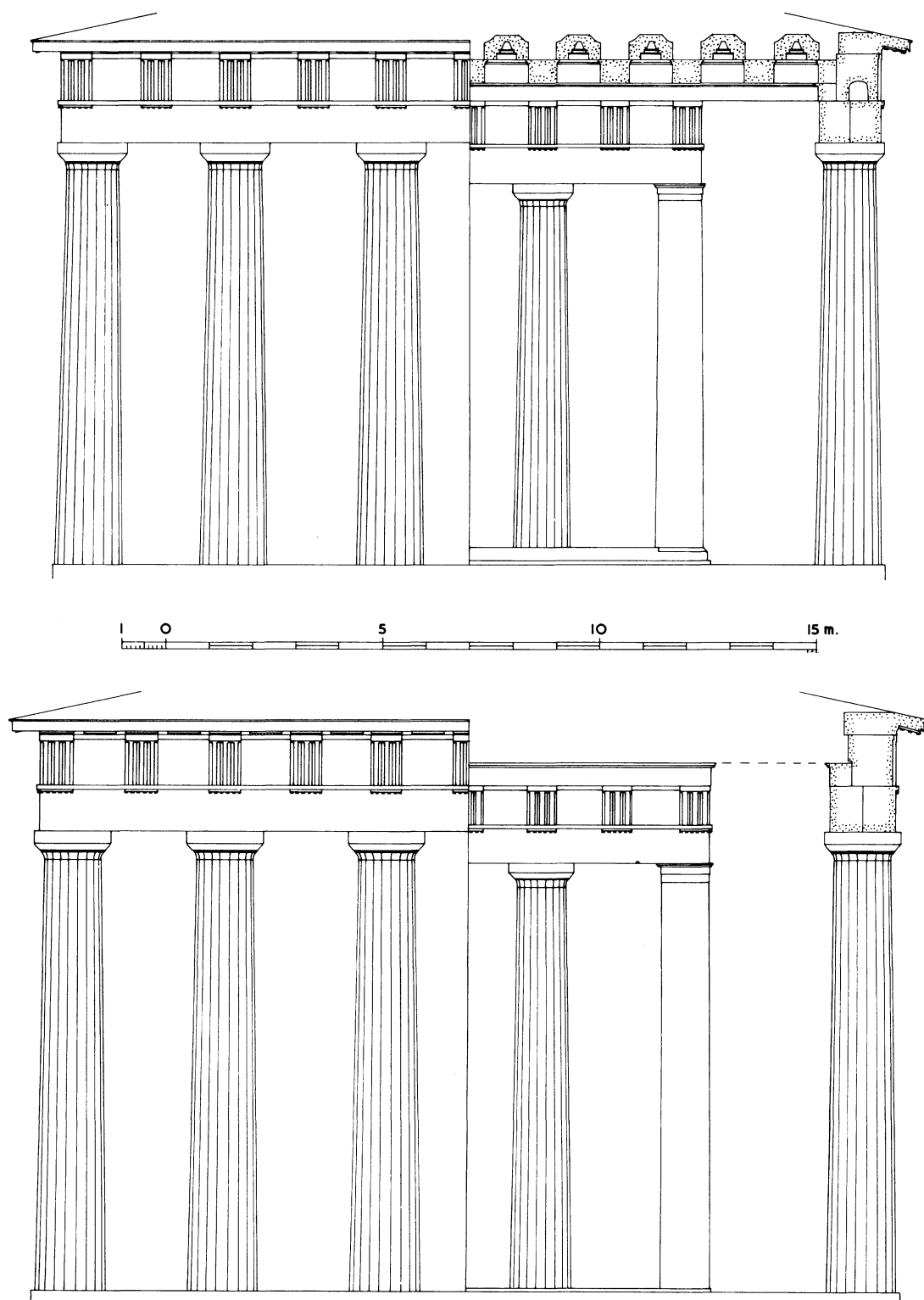


FIG. 3.—Pteron and pronaos orders compared: the temple of Athena at Tegea (above) and the temple of Zeus at Nemea (below).

At Tegea the pronaos column diameter and height are reduced considerably more strongly than the intercolumniation and entablature, but the ratio of column height to diameter and the proportional relationships within the entablature are very much the same in the pronaos as in the pteron. At Nemea, on the other hand, the proportional relationships within the entablature of the two orders are markedly different, as Table 2 shows. In particular, the frieze is surprisingly low, as in the second temple of Hera at Paestum; the difference between the architrave height and frieze is much less in the pronaos than in the pteron and, more noticeable, the triglyphs are unusually squat, with a height of only about one and a quarter times the width, instead of the normal one and a half times (as in the pteron). In addition, the metopes are not uniform across the façade; those nearest the corners are stretched from a normal 1.025 m to 1.132 m, very much as implied by the opisthodomos architrave of the second temple of Hera. At Tegea, on the other hand, as also in Temple ER at Selinous, the metopes nearest the corners are the same width as all the others.^{32a}

TABLE 2

	Tegea, Athena			Nemea, Zeus		
	Pteron	Pronaos	Pronaos Pteron	Pteron	Pronaos	Pronaos Pteron
	(m)	(m)		(m)	(m)	
I	3.613	3.364	0.932	3.745	3.432	0.916
H	9.474	c.8.176	0.863	10.325	c.9.55	0.925
D(d)	(1.209)	(1.052)	(0.871)	1.628	c.1.404	0.864
A	0.968	0.884	0.913	1.0335	0.858	0.831
F	1.088	0.993	0.913	1.1505	0.88	0.765
T	0.71	0.66	0.93	0.73	0.685	0.938
H/D(d)	(7.85)	(7.77)		6.35	6.8	
H/I	2.625	2.43		2.76	2.78	
A/F	0.89	0.89		0.898	0.976	
F/T	1.533	1.502		1.58	1.285	
I/T	5.09	5.1		5.14	5.01	

(Figures in brackets refer to the upper column diameter.)

In most fifth century temples (and some others) both the epikranitis and the step from pteron to pronaos might give some degree of freedom in designing the pronaos order, for neither seems to have been rigidly linked to the general system of proportions. At Nemea and Tegea, however, the pronaos frieze top was made level with the top of the pteron architrave, so that only the step height could give the architect any freedom, and in fact some variation in proportions from pteron to pronaos was inevitable. For in peripteral temples the external width of the cella building was normally made equal to three intercolumniations of the front colonnade; at the same time, if the pronaos frieze was to have uniform triglyphs and metopes, the cella width would also have to be equal to between $3\frac{1}{3}$ and $3\frac{1}{5}$ pronaos intercolumniations, and thus the ratio of pronaos to pteron intercolumniation should be between $3:3\frac{1}{3} = 9:10$ and $3:3\frac{1}{5} = 15:16$.³³ At Nemea the pronaos intercolumniation is

^{32a} Both temples had sculptured pronaos metopes, which obviously made it more important to work out accurately the spacing of the pronaos frieze (*cf.* the regular pronaos frieze of the temple of Zeus at Olympia, which also had sculptured metopes); but any small differences between design and execution could still be taken up by the system of slotting the metope slabs into grooves in the triglyphs. For the design scheme of the friezes at Tegea and Nemea see below, n.33.

³³ The three front intercolumniations sometimes correspond to the cella width over the toichobate, sometimes to the width over the antae, sometimes to

the width over the walls. The cella width over the walls should be barely more than the 'proper' pronaos frieze length of $3\frac{1}{5}$ pronaos intercolumniations (if $T = I/5$, as is usual), so that if this dimension is equal to three front intercolumniations, the pronaos intercolumniation would be a little less than $\frac{15}{16}$ that of the pteron. On the other hand the width over the toichobate, the pronaos stylobate, might be $3\frac{1}{3}$ pronaos intercolumniations (*cf.* the stylobate width of many temples, *BSA* 69 (1974) 73-8, 83-4), so that if that dimension is equal to three front intercolumniations, the pronaos intercolumniation would be $\frac{9}{10}$ that of the pteron.

0.9155 ($c. \frac{11}{12}$) of the pteron intercolumniation, but with the pronaos frieze top at the same level as the pteron architrave top, the height available for the pronaos columns, architrave and frieze was only 0.91 ($c. \frac{10}{11}$) of the height of those of the pteron, even before allowing for any rise from pteron to pronaos. Although there was thus bound to be some conflict of proportions, however, a much more normal result could have been achieved by reducing the widths of all pteron elements by a twelfth for the pronaos, and their heights by a tenth.³⁴

As we have seen, that was not done, and in general we find neither an exact repetition of the pteron proportions in the pronaos (even where conditions would allow it), nor a consistent system of differentiating the pronaos order from the pteron³⁵ (as our comparison of the two pairs of temples shows). It might be argued that this inconsistency was due to the architects experimenting in the design of the pronaos; experimentation there may have been, in the sense of uncertainty in the handling of a difficult area in temple design, but as Bundgaard pointed out, the pronaos is a most unsatisfactory field for coherent experiments in the evolution of a new scheme of forms and proportions.³⁶ For the pronaos order carries neither a normal Doric cornice nor a pediment; at the same time the architect's freedom is restricted as regards both the width and the height of the design, and he cannot even get far enough away to appreciate properly the effect of what he has done. A small temple or treasury would be a much more appropriate field to choose for experiments.

It would seem therefore that the difficulty of design really was felt by Greek architects. Yet as with the problem of column spacing and the triglyph problem, there should be no difficulty if the architect uses accurate preliminary drawings to work out the design in full before construction starts. The difficulty arises when the architect has to design and erect the pronaos columns before their architrave and frieze can be designed in detail; for then the architrave and frieze height must not only be suited to the intercolumniation and column height (both by now fixed), but must also, when added to the column height, reach a given level in relation to the pteron order. The problem will arise even more acutely if the height which the pronaos order is to reach is not yet accurately defined, because the pronaos columns are to be erected before the pteron order has reached ceiling level.

If this problem of planning was indeed a real one, we must be careful about talking of changes in plan, for what appear to be changes in plan will in most cases be rather a gradual definition of the design as the building takes shape; and because of that we cannot regard an architect as fully responsible for the design of a building unless he oversees its construction. On the other hand it does not follow that Greek architects were not interested in the aes-

At Nemea, it is the width over the walls that is equal to three front intercolumniations ($I_W \times 3 = 11.235$ m, cella width over walls = 11.229 m), but instead of making the pronaos intercolumniation $1/3\frac{1}{2}$ of that width, the architect made it $1/3\frac{1}{3}$ of the cella width over the toichobate, which is only 0.19 m greater ($I_{Pr} \times 3\frac{1}{3} = 11.44$ m, cella width over toichobate = $c. 11.42$ m). The central intercolumniation is therefore too small to allow uniform frieze elements. At Tegea, the procedure is much the same ($I_W \times 3 = 10.839$ m, cella width over walls = 10.80 m; $I_{Pr} \times 3\frac{1}{3} = 11.21$ m, cella width over toichobate = 11.16 m), but because the toichobate projects further beyond the cella walls, the width over the walls is only a little more than $3\frac{1}{3} I_{Pr}$, and so the effect is more satisfactory.

³⁴ This would give the following dimensions and proportions for the pronaos (*cf.* Table 2): Rise = 0.106 m, $I = 3.432$ m, $H = 9.29$ m, $D = 1.49$ m, $A = 0.929$ m, $F = 1.035$ m, $T = 0.669$ m; $H/D =$

6.24, $H/I = 2.70$, $A/F = 0.898$, $F/T = 1.55$, $I/T = 5.13$. The low pronaos frieze may be partly due to a desire to equate it with two more or less normal wall courses (so also perhaps in the Parthenon (Bundgaard 146), but the scheme at Tegea shows that such a difficulty was not insuperable.

³⁵ Vitruvius (*De Arch.* 4.4.2) says that pronaos columns should be more slender than those of the pteron. In many Doric temples the pronaos columns are indeed more slender (in the temple of Aphaia at Aigina, Temple ER at Selinus, the temple of Zeus at Olympia, the Parthenon, the temple of Apollo at Bassai, the Great Temple of Apollo at Delos, the temple of Zeus at Nemea and probably the temple of 'Concord' at Akragas (but *cf.* note 26 above)), but this was apparently not true of the temple of Athena at Tegea. Reduction of the lower diameter to produce a more slender column need not affect the other proportions of the order.

³⁶ Bundgaard 143-4.

thetic aspect of their temples.³⁷ Pytheos certainly was,³⁸ and the lack of a formal procedure of preliminary design is usually regarded as no bar to a sculptor's aesthetic interest in his statues. A Greek architect, knowing the rules of proportion used in, say, the Hephaisteion, and knowing what he did and did not like about it, could consciously modify the rules to produce specific changes where he wanted them—provided that he did not try to change too much at once. It is surely casting no slur on Greek architects, but rather the reverse, to suggest that they created such sophisticated and satisfactory buildings without the equipment and techniques for planning which we regard as indispensable.

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³⁷ I disagree, therefore, with Bundgaard's conclusion (Bundgaard 184–5). Temple building can never have been a sufficiently commonplace activity to be indulged in without conscious thought, and

rules of proportion do not change themselves automatically.

³⁸ Vitruvius 4.3.1.