# NEW INFORMATION FROM THE DISCOVERY
# OF AN ARCHAIC TILED ROOF IN IONIA

## (PLATE 27)

IN THE COURSE OF THE WORK of the German Archaeological Institute in Didyma, Turkey, an Archaic temenos was excavated in 1985 and 1986 on the Sacred Way between Miletos and Didyma. It dates from the second half of the 6th century B.C. (Fig. 1).[1]
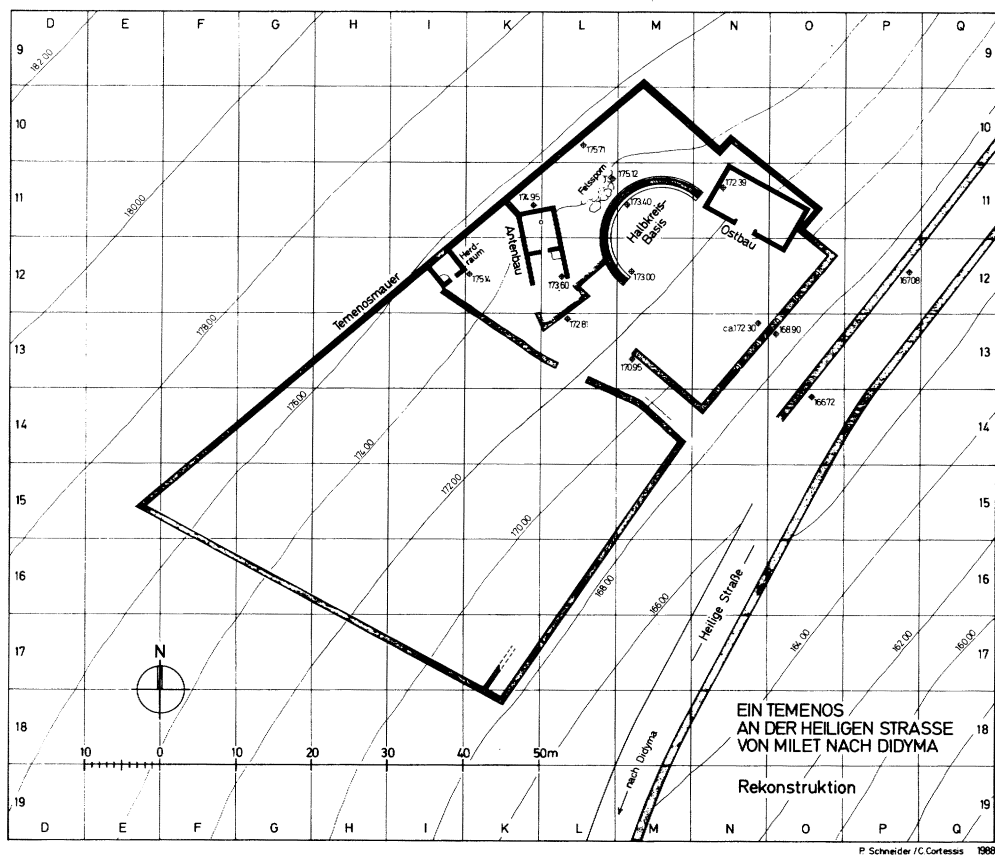


FIG. 1. Temenos on the Sacred Way to Didyma. Reconstruction of the ground plan
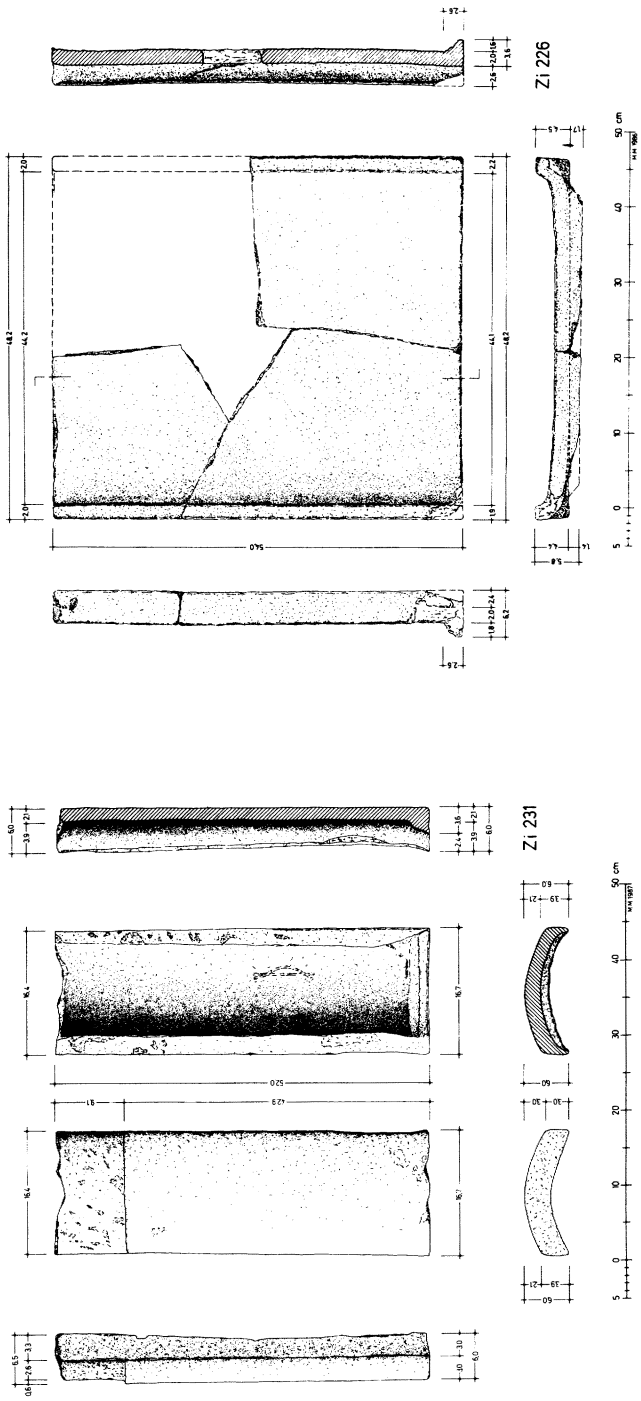(P. Schneider and C. Cortessis)

Fig. 2. Didyma, Sacred Way, temenos, "Ostbau", tile roof: left, cover tile; right, pan tile (P. Schneider and M. Maulbetsch)
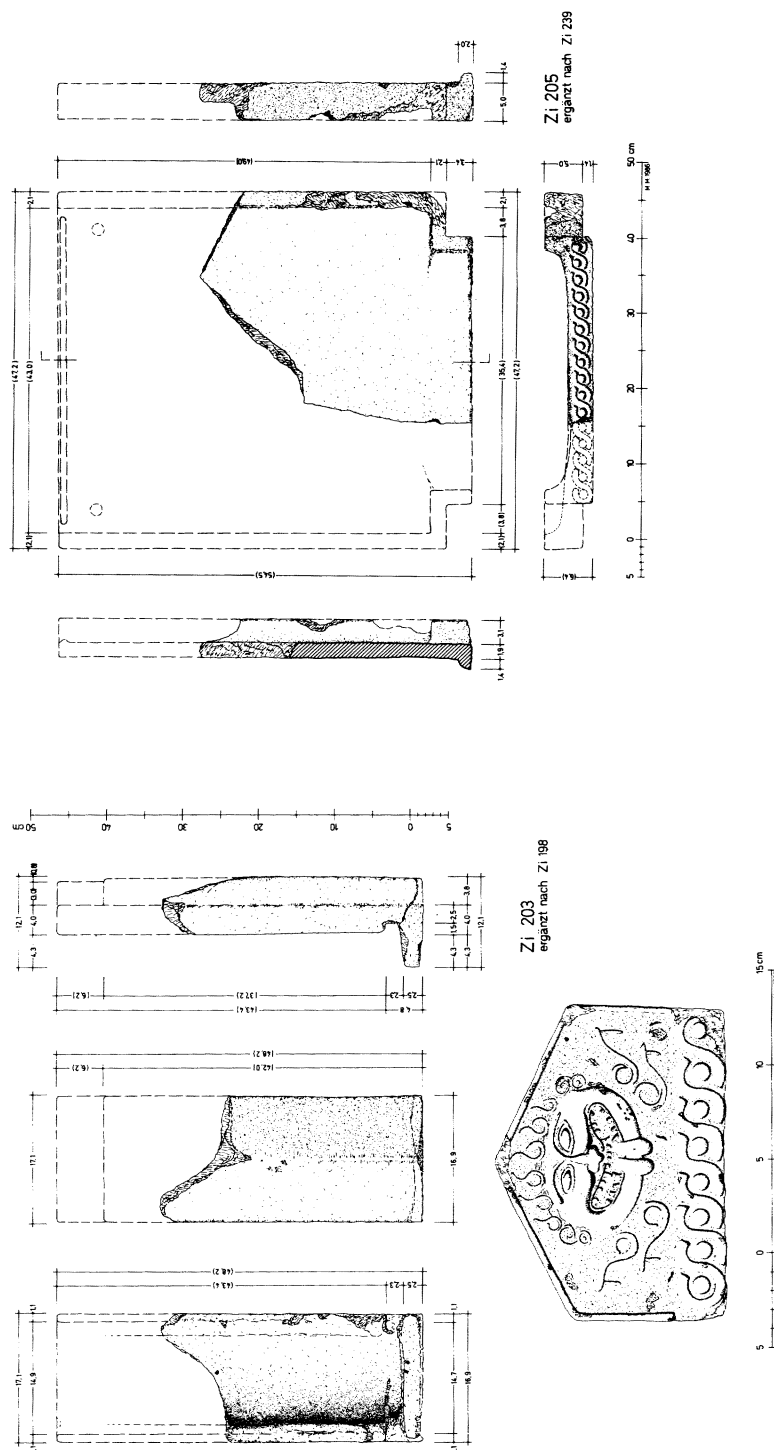
FIG. 3. Didyma, Sacred Way, temenos, "Ostbau", tile roof: left, antefix; right, eaves tile (P. Schneider and M. Maulbetsch)

An artificially filled terrace lies close to the Sacred Way, on a slope behind a huge retaining wall. It was probably a cult site or "theater of worship". Its northwest side is bordered by a 23-meter-long, semicircular base which carries enthroned marble figures. A second group of six winged female sphinxes stands on the terrace wall as if on a high pedestal; this wall defines the limit of the site beside the Sacred Way. On the summit above and behind the semicircular base emerges a spur-like block of rock on the central axis of the temenos.

In the northeast section of this terrace were discovered the ruins of an oikos (Fig. 1, "Ostbau"). By measuring the preserved foundations, we were able to determine the ground plan of this rectangular building, which is about 12.15 m. wide and 6.72 m. deep. Its wide, double-doored entrance opened onto the cult site.

About 8000 fragments of tiles were recovered from inside and around the building. Some tiles were still intact, and others could be restored. The large number of fragments makes possible not only observations on the construction, coloring, and manufacture of the tiles, but also an almost complete reconstruction of the roof.

The tiles are of a fired clay low in mica, which is reddish brown at the breaks. An intense brown-to-red or brown-to-black paint was applied to their exposed surfaces. All 8000 fragments were examined and classified into six different types of tiles which comprise the structural elements of the roof (Pl. 27:a). Judging by the fact that no ridge tiles of a hip roof were found and on the basis of two matching fragments of the raking sima, we come to the conclusion that the roof was double-sloped.[2]

The roof is a mixed type of flat "Corinthian" pan tiles and convex "Laconian" cover tiles (Fig. 2). The eaves tiles bear on their front side a painted relief guilloche, the antefixes a gorgoneion with four bearded snakes (Fig. 3). At a point about midway in their length, their pitched outline becomes convex, a change which accentuates their plasticity; the same is true of the ridge pan and cover tiles at the peak of the roof (Fig. 4).

Traces of spatula-like tools can be observed on the underside of almost all the tile fragments. The process of pressing the clay into a mold produced an uneven lower surface in contrast to the smooth upper sides. For the production of the plaques of the antefixes only one mold was necessary, as was confirmed by comparing all 33 examples of Gorgons found; they appear identical in every detail. The few variations are due to insufficiently filled matrices or to soiled material. The bottom edge of the guilloche is often incomplete, sometimes showing a diagonal cut which indicates that the matrix was not accurately filled.[3]

All the measurements of the tiles follow a strict metrological system, which is based on metrical units of inches and yards (24 Archaic Ionic inches = 1 Archaic Ionic yard =

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[2] Both fragments (Inv. No. Zi 393a, b) are badly disintegrated. They are lighter than any of the other tile fragments because they contain a different percentage of fired-clay temper. The raking sima can only be reconstructed on analogy with comparable simas: Le Roy, 1967, pl. 98 (Roofs 9, 10, 11, and 12).

[3] On analogy with the work of W. Rostoker and E. Gebhard, "The Reproduction of Rooftiles for the Archaic Temple of Poseidon at Isthmia, Greece," *JFA* 8, 1981, pp. 211–227. Carelessness during production, even of the ornamented antefixes, seems contradictory to the precise metrological design of the roof. The deviation from the intended "ideal form" of the tiles can be explained by the characteristics of the material and by the fact that the series of tiles was crafted by hand.
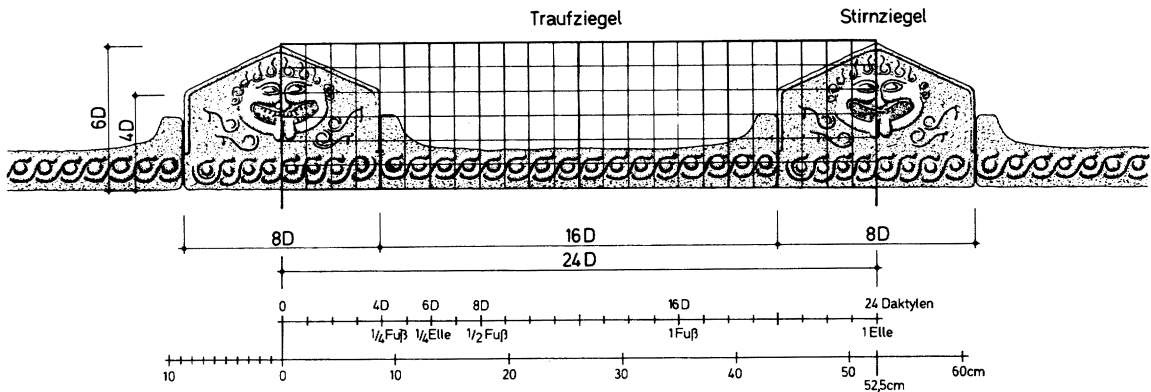
FIG. 4. Didyma, Sacred Way, temenos, "Ostbau", tile roof: left, ridge cover tile; right, ridge tile (P. Schneider and M. Maulbetsch)

Fɪɢ. 5.  Didyma, Sacred Way, temenos, "Ostbau", tile roof: metrological system of the eaves, detail
(P. Schneider)

52.5 cm.).[4] The module of this metrical system is the number 24.[5] The measurement for the
horizontal axis of the tile surface, 52.5 cm., corresponds to the length of an Ionic yard; the 24
elements of the braided ornament correspond to the 24 inches (Fig. 5). Furthermore, 16
braided units of the eaves tiles, which are two-thirds of the guilloche, are 16 inches equaling
one foot; one third equals the 8 units of the antefix (8 in. = ½ foot). The lateral height of the
antefixes is 4 inches, and the total height is 6 inches, which is three-quarters of the width.
The flat eaves tiles are 25 inches long, one inch over the yard grid, while on each side they
are an inch less (24 − 2 in. = 22 in.).

The total length of the lateral eaves of the building can be reconstructed through the
measurements of the foundations to which the small size of the overhanging geison tiles,
0.18 cm., should be added on each side: 12.15 m. (length of the building) + 2 × 0.18 m. (the
overhang of the roof) = 12.51 m. Although this figure depends on an assumption, it is suffici-
ently accurate to permit calculation of the number of rows of tiles. Dividing the length by the
measurement of the axis shows that the roof had 24 rows of tiles (24 × 0.525 m. = 12.60 m.).
The dimensions of the elements are identical to their number.[6]

The ornamented parts of the antefixes and of the eaves tiles are painted red or black. Of
the 33 Gorgon antefixes found, 10 are black and 19 red; 4 fragments lack any trace of color.
The ratio of red to black tiles is exactly 1:2. As this statistic covers more than 50% of all the

[4] Cf. H. Fränkel, *Dichtung und Philosophie des frühen Griechentums²*, Munich 1962, p. 314.

[5] Twenty-four is the product of 1 × 2 × 3 × 4. According to Pythagoras' theory, such series of numbers
with an inherent mathematical structure include their λόγος: ". . . ursprunglich offenbar das Zahlenbundel,
das in einem Ding steckt und das es möglich macht, seine Gestalt zu fassen und daher zu reproduzieren"
(K. von Fritz, *RE* XXIV, col. 199, *s.v.* Pythagoras).

[6] For the three terms "Mass", "Gewicht", and "Zahl" and the contribution of τέκτονες to this "Theorie-
bildung", see F. Preisshofen, "Zur Theoriebildung in Bauplanung und Bautheorie," *Diskussion zur ar-
chaeolog. Bauforschung, Berlin* 4 (n.d.), pp. 26–30. I remain indebted to F. Preissofen for many exciting
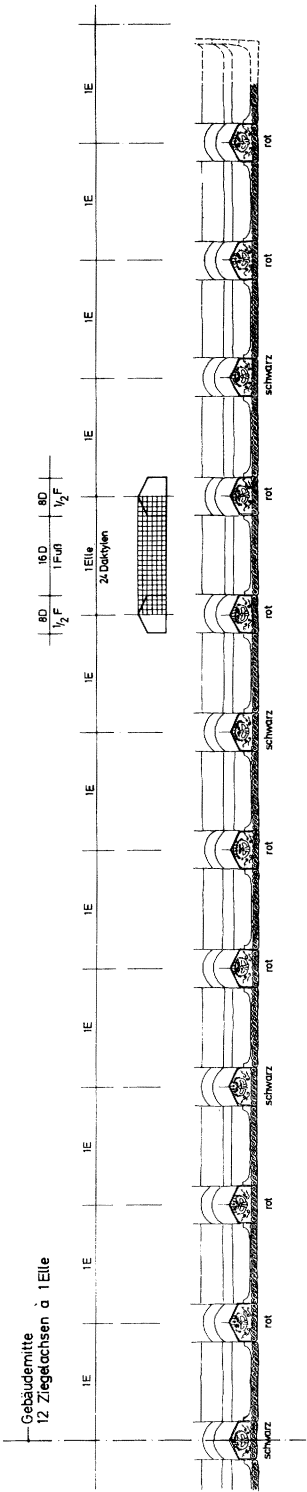discussions.

FIG. 6. Didyma, Sacred Way, temenos, "Ostbau", tile roof: metrological system and color scheme of the eaves (P. Schneider and C. Cortessis)

antefixes (the total number would have originally been 46), we can deduce that the color arrangement was a sequence of black/red/red (Fig. 6).

Even the preliminary results made it apparent that the lengths of some completely preserved cover tiles were not uniform. As more tiles were restored from fragments, it became clear that, among eighteen mended cover tiles, the lengths vary from 36.0 to 49.7 cm., i.e., by more than 13 cm., and that the lengths of the flanges on their back ends differ by 3.6 to 13.5 cm. (Fig. 7). In comparing these individual tiles, it becomes clear that the length of the exposed surfaces diminishes and the length of the flanges increases.[7] This variation must not be interpreted as resulting from carelessness during production or adjustments during the laying of the tiles. The intentional gradation of the length of exposed tile surfaces and flanges can be easily proven by tool marks. The surface of the flanges was increased by a sharp-edged tool following an inch-based system of measurements (Pl. 27:b).[8] The dimensions of these adjustments[9] can be precisely measured: they are 2.2 cm., 4.4 cm., or 6.6 cm., which are multiples of the inch.

There are seven different sizes of cover tiles (see Table). Only one example from among the eighteen mended tiles cannot be classified with certainty.

TABLE: Didyma, temenos on the Sacred Way, "Ostbau". Comparison of sizes of cover tiles of roof

| Inv. No. | Total length | Exposed surface length | Flange length |
|---|---|---|---|
| Zi 237, 225, 427, 262, (423) | 25 in. | 23 in. | 2 in. |
| Zi (423), 403, 559, 238 | 24 in. | 22 in. | 2 in. |
| Zi 233, 426 | 23 in. | 21 in. | 2 in. |
| Zi 464, 234, 235, 236 | 23 in. | 20 in. | 3 in. |
| Zi 231 | 23 in. | 19 in. | 4 in. |
| Zi 558, 232 | 23 in. | 18 in. | 5 in. |
| Zi 512 | 23 in. | 17 in. | (6 in.) |

The number of the rows of tiles from the eaves to the ridge of the roof can be determined from the dimensions of the foundations, which are 6.72 m. wide. If we assume that the roof overhung the walls on either side between 20 and 30 cm. in order to provide protection against rain for the mud brick, then the width of the roof should be 7.2 m. The tiles at the peak of the roof were made to fold over the ridge. If we measure the angle between their inclined sides and the horizontal, 34°, which corresponds to a gradient of 2:3, we can determine the inclination of the slopes with sufficient accuracy (Fig. 4). The fronts of these ridge tiles stood at an angle of 10° to the vertical axes so that they would meet the cover tiles at a right angle.

[7] Traces of working left on some examples show that the surfaces of the flanges were deliberately enlarged, probably after firing. That would mean that the cover tiles were manufactured the same size and adjusted later according to the length required.

[8] I would like to thank H. Kienast for his advice on the tool marks on the fragments.

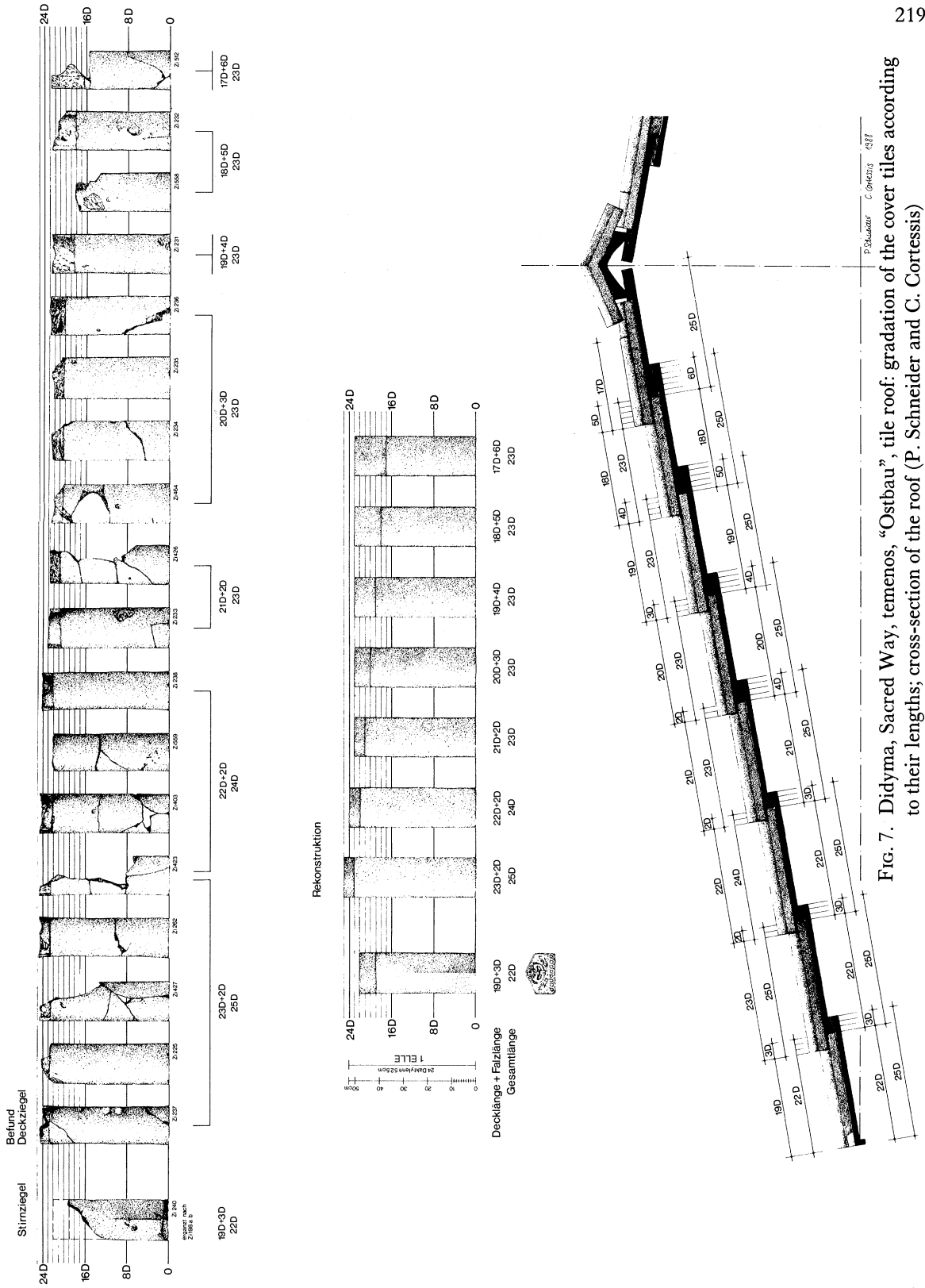[9] Zi 244, 401, 414, 433, 512, 518, 532, 711.

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FIG. 7. Didyma, Sacred Way, temenos, "Ostbau", tile roof: gradation of the cover tiles according to their lengths; cross-section of the roof (P. Schneider and C. Cortessis)

All this information permits us to conclude that the cover tiles were set 10° from the horizontal. The inclination of the roof should be 4° steeper than that of every individual tile, which would mean an angle of 14° and a gradient of 1:4.

If we arrange the cover tiles according to their lengths, combining them with the eaves and ridge tiles at the 14° angle, we can reconstruct the entire roof. Its width is now 7.30 m. (Fig. 7),[10] which corresponds perfectly to our calculated minimum width of 7.20 m. If another row of tiles whose exposed surface measures between 36 and 50 cm. were added, the roof would have an overlap of 66 to 100 cm.; in terms of construction, this length is very problematic. Leaving out a row would mean that the roof would be only 6.40 m. wide, certainly too small to fit the oikos. The exact inclination of the roof is irrelevant to the definition of the number of the rows.

The graduated arrangement of the cover tiles according to length carries over to the exposed surface of the pan tiles, because these interconnect with the upper ends of the cover tiles. The pan tiles themselves do not show any differentation in size: they are 22 inches wide and 25 inches long. Therefore the degree of overlapping on individual rows of tiles must be differently reconstructed.

In a preliminary cross-section of the roof incorporating the seven different sizes of tiles, we arranged them according to their lengths and in such a way that the smallest tiles were assigned to the upper rows and the largest to the lower. The result was surprisingly logical. Although in the first three rows the visible surface of the antefixes and cover tiles ranges from 22 inches to 25 inches, when combined with the individual measurements of their covered parts, the visible surface of the eaves and pan tiles remains the same: 22 inches each time. In the fourth and following rows the cover tiles, as they gradually become shorter and shorter, influence the dimensions of the pan tiles. This structurally and metrologically very complicated arrangement ends with the shortest cover tile that has the longest flange of six inches. Some latitude is obviously a necessity, since the final length of the roof is only determined during the process of laying the tiles on the rafters. The sequence in length of the cover tiles from the eaves to the ridge is 19 inches, 23, 22, 21, 20, 19, 18, 17; that of the pan tiles, 3 × 22, 2 × 21, then 20, 19, 18, and, last, 17 inches.

The visual impression of the gradually decreasing horizontal stripes which articulate the sloping roof, which an observer notices only after it has been drawn to his attention, makes the distance to the peak of the roof seem longer, and is accentuated by the plastically projecting line of the ridge tiles (Fig. 8). To achieve this effect must have been the intention of this arrangement. The spectator sees the surfaces and outlines of the roof from a disadvantageous angle in comparison to the rest of the building, which lies more or less within a suitable angle of view.[11] This distortion, therefore, which is due to "true" dimensions, is

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[10] The sum of the individual lengths of the tiles from the eaves to the ridge is 169 inches = 3.70 m. This dimension must be reduced by the inclination factor of the tiles and multiplied by two. This product is the width of the roof projected on the ground plan: 3.70 m. × cos10° × 2 = 3.64 m. × 2 = 7.28 m.

[11] Cf. Vitruvius (III.5.13). By this fact he explains the forward inclination of all architectural elements above the capitals.
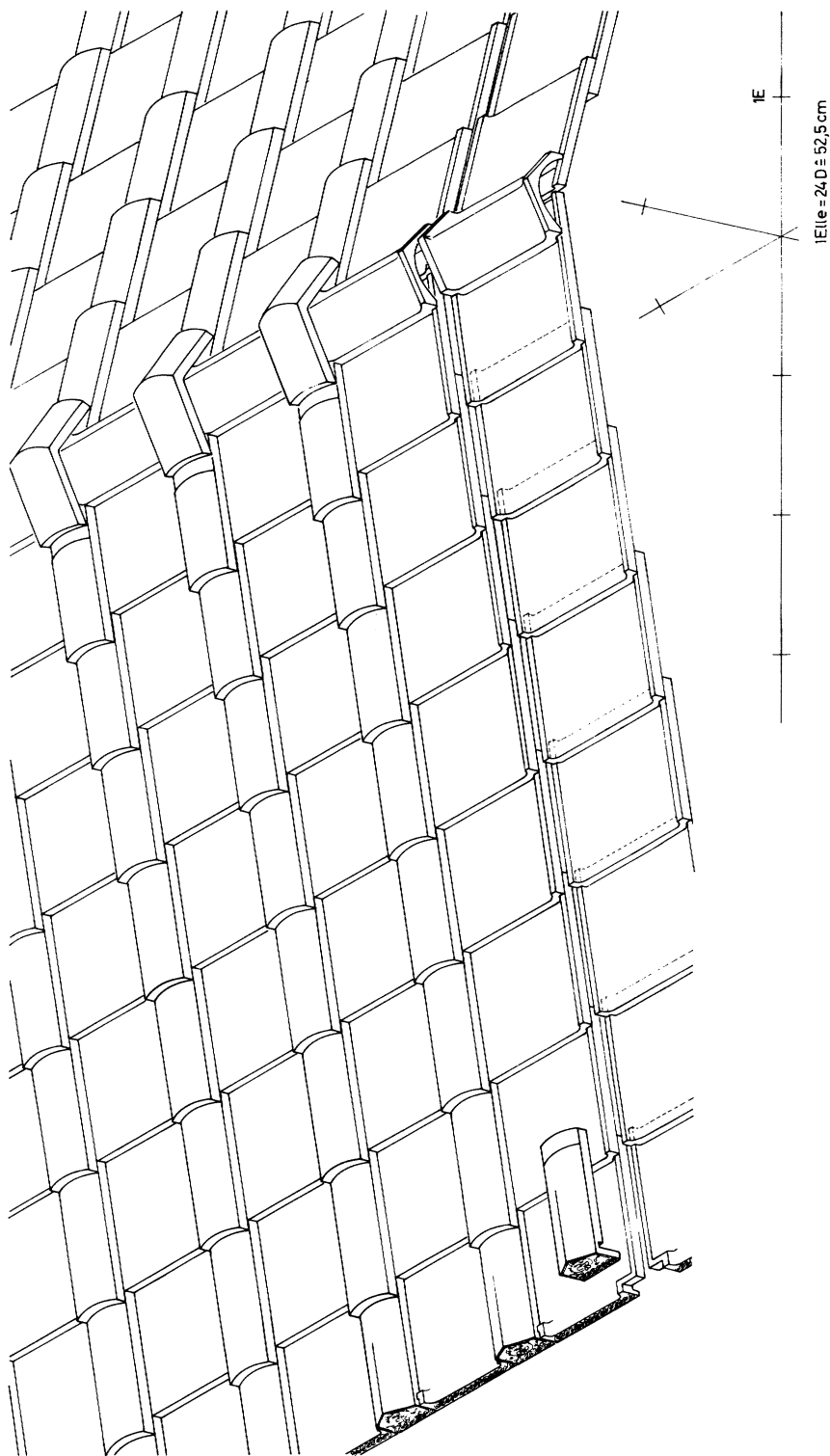
FIG. 8. Didyma, Sacred Way, temenos, "Ostbau", tile roof: reconstruction (P. Schneider and C. Cortessis)

corrected by using tiles of different length,[12] which gradually become shorter and shorter from the eaves to the ridge of the roof. In such a cross-section, no straight lines are produced, but instead a slightly oscillating curve results, like an interconnecting line of corresponding points (Fig. 7). This fine arrangement of tile lengths can be interpreted as an arithmetical definition of curves.[13] It is comparable to a staircase in which the height of each step remains the same while at the same time the width of each tread decreases upwards. Still, the first three rows of pan tiles form a straight line 3 × 22 inches, and as the cover lengths start to decrease (21, 20, 19, 18, . . . in.) it becomes a flat curve.

The resulting curvature of the cross-section was a matter of only a few centimeters and was probably not a noticeable feature of the roof. The conception and metrology of the roof, like its construction, plasticity, and colorfulness, testify to an extraordinary unity of form. The hitherto unknown differentiation of the plastic surfaces of an Archaic Ionian roof goes beyond the functional requirements of a roof. Although its form is based on a strictly rational metrical system, the roof approaches the quality of a free, organic structure. It is this law of order that characterizes every single element of an Archaic Ionian building.
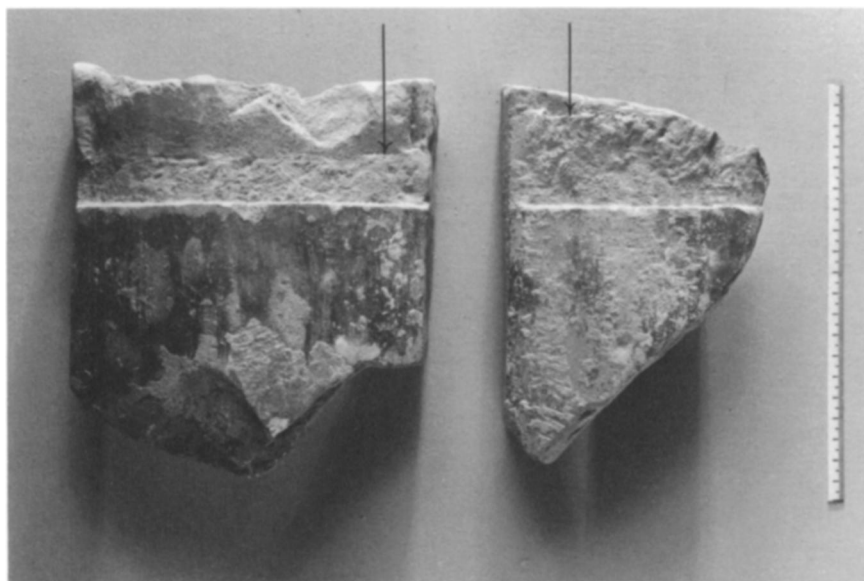
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[12] Cf. H. Büsing, "Optische Korrekturen und Propyläen-Fronten," *JdI* 99, 1984 (pp. 27–73), p. 31: "Den Korrekturen . . . fällt lediglich die Aufgabe zu, die idealiter konzipierte Form wirklich wahrnehmbar zu machen, so das sich dem Auge die unverfälschte eurythmia darbietet."

[13] Cf. A. Petronotis, *Zum Problem der Bauzeichnungen bei den Griechen*, Athens 1972, p. 6, note 27, with further bibliography. B. Gunn, "An Architect's Diagram of the Third Dynasty," *Annales du Service des Antiquités de l'Égypte* 26, 1926, p. 197, pl. 26.

PLATE 27
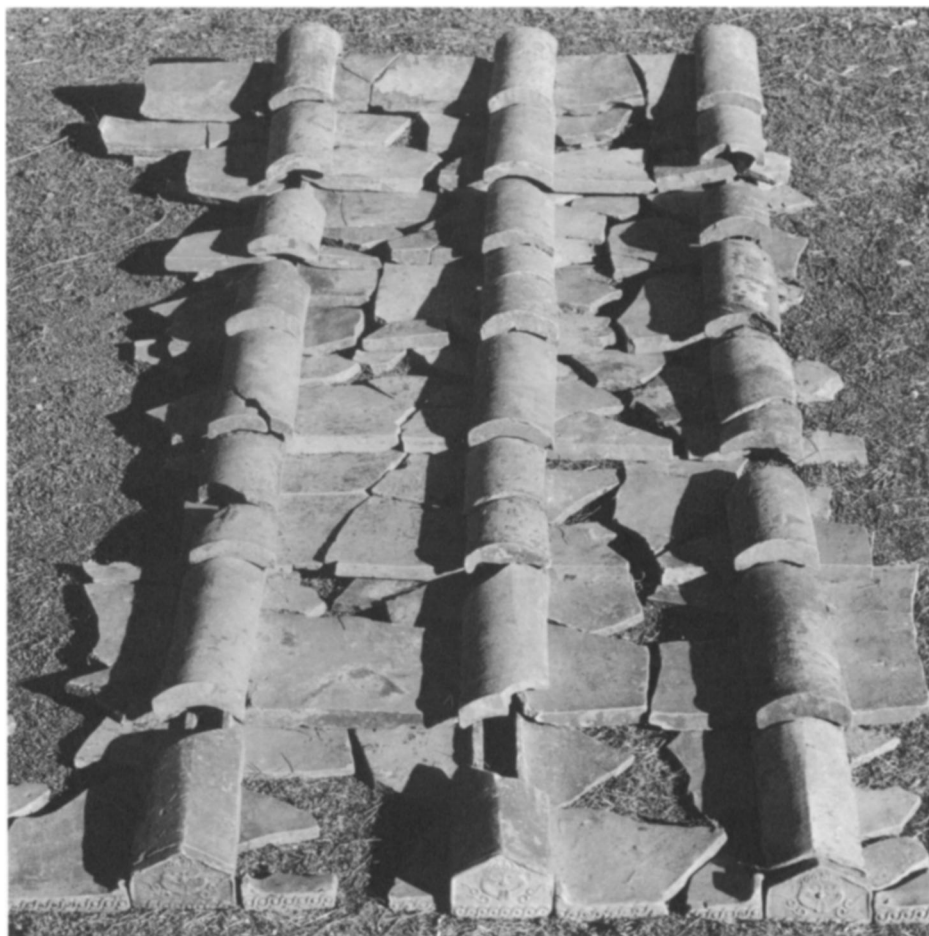


a. Preliminary reconstruction with the tile fragments in 1985. (Photograph W. Schiele)



b. Traces of working on the flanges of the cover tiles. (Photograph W. Schiele)

Didyma, Temenos on the Sacred Way, Tile Roof of the "Ostbau"

PETER SCHNEIDER: THE DISCOVERY OF AN ARCHAIC TILED ROOF IN IONIA