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A Rereading of the Interior Elevation of Hadrian's Rotunda

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The Pantheon, in particular the interior of the Rotunda, has posed a paradox: unrestrained praise for its overall effect; severe criticism for its interior elevation. The criticisms were rooted in a Renaissance perception of Roman imperial architecture, a perception based too heavily on a Vitruvian view of Hellenistic trabeate architectural design, largely irrelevant to the Rotunda. This view of the critiques of San Gallo the Younger, Michelangelo, Desgodetz, and Viollet-le-Duc leads one to the Roman aims of the Roman architect who designed this interior. I wish to show how the Hadrianic state of the Rotunda may be taken as a projection of the Roman idea of the templum mundi.

In this paper my aim is to read the interior elevation of Hadrian's Rotunda as a Roman design. While the sheer volume of space enclosed by the Rotunda has long been admired, architects from the 16th century on have found much to criticize in the design of its elevation. These criticisms were naturally embedded in a Renaissance view of ancient architecture narrowly focused, in the treatises of Serlio and his followers, on the classic orders, a term unknown to Vitruvius and Alberti. Looking through this 16th-century screen at the second-century interior elevation of the Rotunda, early critics of the building saw a failure to align solids and voids, floor to dome, and a failure to establish a consistent scale, floor to dome. These criticisms are factually true: solids do not align and the scale shifts abruptly from level to level. The criticisms remain unaccounted for or unresolved, obstructing not our reaction to the grandeur of this interior, but our understanding of its Roman character. Several centuries of professional criticism have not provided an analysis of this interior elevation as the product of a Roman design, at once coherent and Hadrianic.[1]

There can be no question about a single design governing its structure. Brick stamps retrieved from integral and critical parts of the structure have proved that Hadrian's Rotunda was built from foundation to oculus in one extensive building campaign between 119 and c. 126/8.[2] Unity of construction of this complex Roman structure suggests a basic, single design for its Roman interior elevation. The problem is to see the Roman elevation of the Rotunda with Roman, rather than Renaissance, eyes.

From the mid-18th century, visitors to the Pantheon have not seen its unviolated Roman interior. In 1746–1748, as part

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Abbreviations:

- BAV = Biblioteca Apostolica Vaticana, The Vatican
- ENSBA = Ecole Nationale Supérieur des Beaux Arts, Paris
- FU = Fototeca Unione, American Academy, Rome
- ICCD = Istituto Centrale per il Catalogo e la Documentazione, Rome
- NGA = National Gallery of Art, Washington, D.C.
- SML = Soprintendenza ai Monumenti e Bene Culturali di Lazio, Rome
- UMd = University of Maryland, School of Architecture

1. T. Buddensieg, "Criticism and Praise of the Pantheon in the Middle Ages and the Renaissance," in *Classical Influences in European Culture, A.D. 500–1500,* ed. R. R. Bolgar, Cambridge, 1971, 259–267; idem, "Criticism of Ancient Architecture in the Sixteenth and Seventeenth Centuries," in *Classical Influences on European Culture, A.D. 1500-1700,* ed. R. R. Bolgar, Cambridge, 1976, 335–348. M. Boatwright, *Hadrian and the City of Rome,* Princeton, 1987, 43–48, provides a description, at once succinct and comprehensive, of the structure in its Hadrianic context, without entering upon the criticisms of its design. P. Davies, D. Hemsoll, and M. Jones, "The Pantheon: Triumph of Rome or Triumph of Compromise?," *Art History,* X, 1987, 133–153, deal chiefly with problems of the Portico and Rotunda, except for a brief addendum, 152–153, in which they propose a hypothetical "original" design in order to solve problems in the design of the interior elevation. For an 18th-century statement of these problems, cf. R. Venuti, *Descrizione topographica delle antichità di Roma,* second enlarged edition, Rome, 1803 (first ed. 1763) Reprint, Rome, 1977, Part II, 114–153.

2. Beginning date for the Pantheon is usually given as 118, the accession year of Hadrian. However, Hadrian, then in Antioch, did not arrive in Rome before 119. Construction of the Pantheon most likely did not precede his arrival. W.-D. Heilmeyer, "Apollodorus von Damaskus, der Architekt des Pantheon," *Jahrbuch des Deutschen Archäologischen Instituts,* XC, 1975, 316–347, on the basis of a few brick stamps from the structure earlier than 117, argued that construction began in 114. He falsely assumed that a brick was used as soon as stamped. He also failed to note that bricks of earlier date appear higher in the structure than those of later date: cf. H. Bloch, *I bolli laterizi e la storia edilizia romana,* Rome, 1938, 103, for a brick stamp of 114 taken from the exterior of the Rotunda above the first cornice; cf. L. Beltrami, *Notizie degli scavi, n. s.,* 1892, 89, for one of 123 taken from a semicylindrical chamber about one meter above the pavement.

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of Benedict XIV's urban preparations for the Holy Year of 1750, Paolo Posi removed the original marble placage in the attic zone above the Corinthian order of the lateral exedras and installed the present funereal set of heavily pedimented windows and panels whose concept, dimensions, and proportions have nothing to do with anything Roman. The pre-Posi state of the attic had fortunately been amply recorded by professional observers in detailed descriptions, measured drawings, engravings, watercolors, and oils, culminating in Pannini's well-known painting of the interior of the Pantheon of about 1740 (Fig. 1). While many sheets of marble placage had been removed by Pannini's time,[3] nothing suggests that the overall design had been affected. On the basis of this rich but scattered archive of drawings and descriptions of the Pantheon, soprintendente Alberto Terenzio was able to install, in the course of restorations carried out between 1929 and 1934, a portion of the original placage in the southwest sector of the attic zone (Fig. 2).[4] This restoration, though limited in extent, enables us to gauge the effect *in situ* of the original attic, otherwise known only in drawings or paintings. The placage replaced by Posi had been attributed early on to Septimius Severus, rather than to Hadrian, but only on stylistic and aesthetic grounds.[5] Echos of this 18th-century judgment recur in later studies,[6] but, so far as I know, no substantive archaeological or historical evidence has been adduced to support it.[7] There seems to be no reason to doubt the Hadrianic date of the pre-Posi placage in the attic zone.

If we take as Hadrianic the interior of the Rotunda as drawn and painted by architects and artists, from San Gallo the Younger and Raphael to Francesco Piranesi and Giovanni Pannini, the basis of 16th-century criticisms immediately appears. Many professional critics, Renaissance and post-Renaissance, felt that this elevation could not be the product of a single, coherent Roman design because they noticed that the columns and voids of the Corinthian order of the exedras do not align with pilasters and windows in the attic, nor with the "ribs" and coffers of the dome. These misalignments, some of them slight and apparently casual, violated a basic tenet of multistory trabeate architecture, whether ancient or Renaissance, that is, the axial alignment of structural supports, whether real or apparent.

To architects of Serlio's generation and later, misalignments of this nature counted as egregious errors in an otherwise admirable building. But since the Rotunda is arcuate, not trabeate, in both concept and structure, trabeate forms in the practical Roman view of design and construction must conform to arcuate necessities. The imperial Roman architect amply demonstrated his command of traditional trabeate forms in the magnificent Corinthian order of the lateral exedras, which has always invited praise rather than criticism. The brunt of criticism, as we shall see, fell on the Corinthian pilasters in the attic zone. These are, of course, nonstructural thin sheets of marble in the placage screening a complex vaulting system. The criticisms we shall investigate assumed that the architect should have maintained the logic of ancient, multistory trabeate architecture in this placage.

I

Two unequal cornices divide this elevation into three unequal parts: coffered dome, windowed attic, Corinthian exedras. These parts differ sharply in height, function, and scale. They are layered horizontally without regard to a systematic vertical alignment of solids or voids. Yet they successfully define a volume of space immediately perceived as indivisible, grand, and dramatic. The grandeur and unity of the space enclosed derives fundamentally from three factors: unprecedented dimensions, simple geometry, and the broad shaft of light descending from the oculus. The Rotunda inherits the great breadth of its interior from its precise superposition upon the open court of the first Pantheon on this site, built by Agrippa in 25 BC.[8] The exterior pavement of that court lies 3.15 m. below the present floor. The Rotunda covered an open public court with a one-room building; this achievement accounts in great measure for its grandeur.

The simplicity of its geometry is well known: a hemisphere held at the height of its radius by a cylinder of equal diameter (Fig. 3). We should remember, however, that this geometry is visually stated only by the upper cornice, an uninterrupted circle marking the common circumference of drum and dome. This cornice gives linear definition to the void enclosed, not to the mass of the drum and dome, whose structures, complex and hidden, interpenetrate above the level of this cornice. The idea of a sphere and cylinder contained within the Rotunda is stated in linear outline, like the illustration to a geometer's theorem. The third element contributing to the impact of this interior is neither static nor linear: the broad cone of sunlight which im-

3. Biblioteca Apostolica Vaticana (hereafter BAV), Chigi P VI g, fol. 102v, inventories the loss of c. 2500 square palmi, much of it from the attic. These losses had apparently been made good in painted stucco.

4. A. Terenzio, "La restauration du Pantheon de Rome," *Museion,* XX, 1932, 52–57. Terenzio's drawings and promised monograph have not been published. For a description of the attic, see K. de Fine Licht, *The Rotunda in Rome,* Copenhagen, 1968, 114–118.

5. Venuti, *Descrizione topografica,* 131. Fine Licht, *The Rotunda,* 118, 190, rejects the attribution to Severus.

6. R. Lanciani, *Dissertazioni archeologiche,* I, Rome, 1882, 12; Fine Licht, *Rotunda,* 289, note 44, lists others, to which may be added C. E. Isabelle, *Les édifices circulaires e les domes,* Paris, 1855, 41; and J. Dell, "Das Pantheon in Rom," *Zeitschrift für bildenden Kunst,* nf IV, 1893, 273–277.

7. Minor areas restored under Septimius Severus are identified by Fine Licht, 190, with notes 46 and 47.

8. W. Loerke, "Georges Chedanne and the Pantheon: a Beaux Arts Contribution to the History of Roman Architecture," in *Modulus, The University of Virginia School of Architecture Review,* 1982, 52.

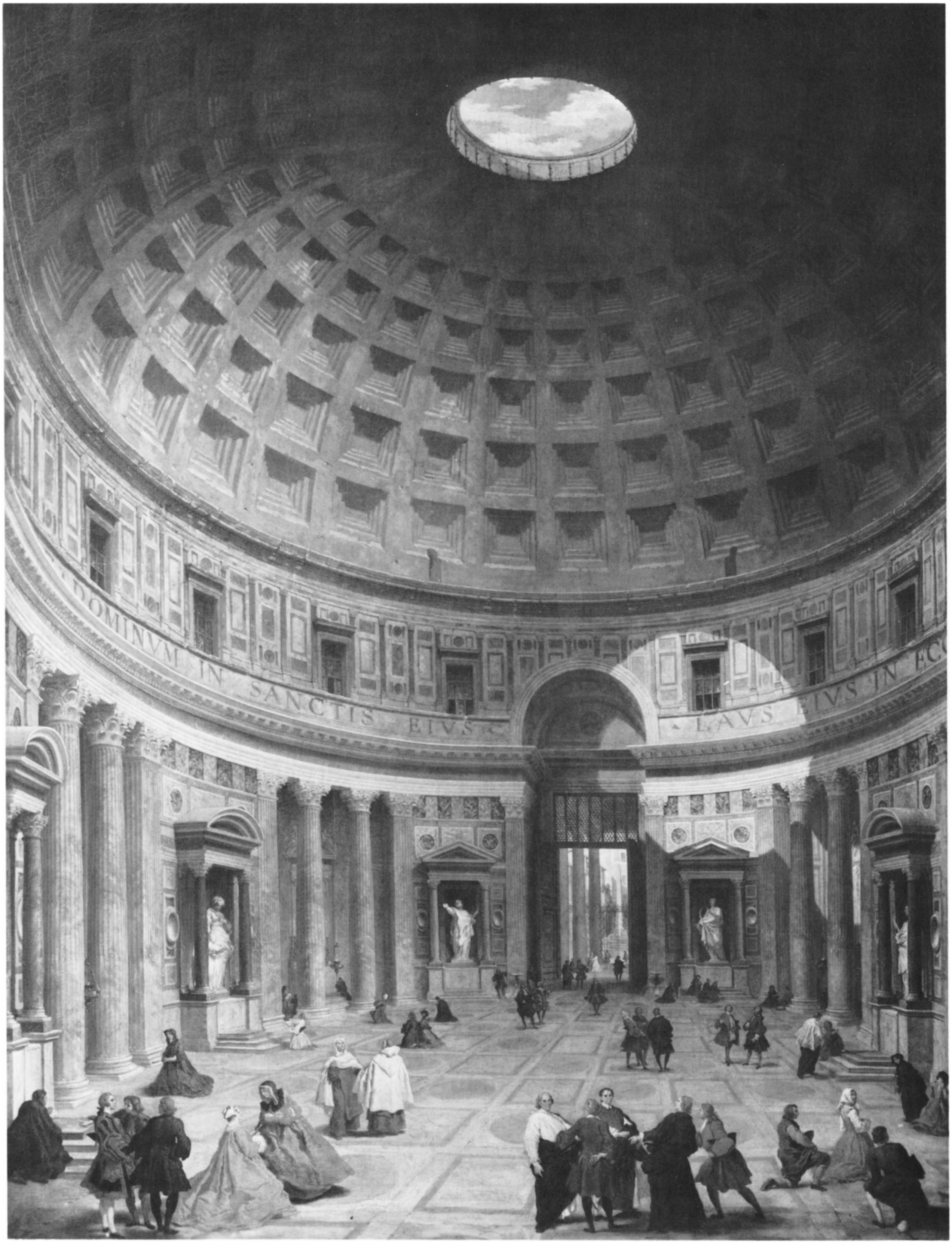

Fig. 1. Giovanni Pannini, interior of the Pantheon, c. 1740. Oil on canvas, National Gallery of Art, Washington, Kress Collection (photo: NGA).

Fig. 2. Pantheon, 119–c. 126, view into Rotunda (photo: SML).

prints, along an elliptical path, the circle of the oculus upon the periphery of this interior, admitting not only light, but also a display of the sun's apparent motion, marking both hourly and seasonal progress.

The overall success of this grand design posed a paradox for a number of architects of the Renaissance and later. How could a Roman architect, whose wit and ingenuity conceived and erected this structure of unprecedented span, make so many mistakes in the design of his interior elevation? An impressive list of architects described serious flaws in its design. They expressed their critique verbally in sharp statements or visually in "corrective" drawings.[9] Four of these, two Italian and two French, will expose the central issues to be resolved.

II

For Antonio da San Gallo the Younger, to center a rib (more accurately, a rib-like form) in the dome above a window in the attic and above the central intercolumniation of diagonal exedras—to place a solid above a void (Fig. 2)—was a "fatal error" ("cosa pernitiosisima").[10] He wrongly claimed that if the number of vertical rows of coffers were increased from 28 to 48, solids would appear above solids and voids above voids. Yet many ribs would still dangle over voids, particularly at apse and entry where there are no screening columns. In addition, his "solution" would cut the size of the coffers nearly in half, with disastrous results to the scale of the interior. Yet the rib above diagonal exedras which drew his criticism holds one of the keys to the Roman design of this interior.

Michelangelo restricted his praise of the interior of the Rotunda ("un disegno angelico e non humano") to the Corinthian order of the exedras ("dalla prima cornicione in giú").[11] He was careful to exclude the attic and the coffered dome. On another occasion he spoke of "tre maniere" in the Rotunda,[12] clearly implying that its elevation and the abrupt attachment of the portico cannot be the product of a single, coherent design. In the interior, he must have been objecting to the abrupt shifts in scale as attic was stacked on exedras and coffered dome upon attic. Mere stacking he could hardly object to, since he did the same in the Medici Chapel and in his design for the exterior of St. Peter's dome.[13] His laconic critique, however, identifies another key to the Roman design: the attic placage, out of scale with both the Corinthian order below it and the coffers above it.

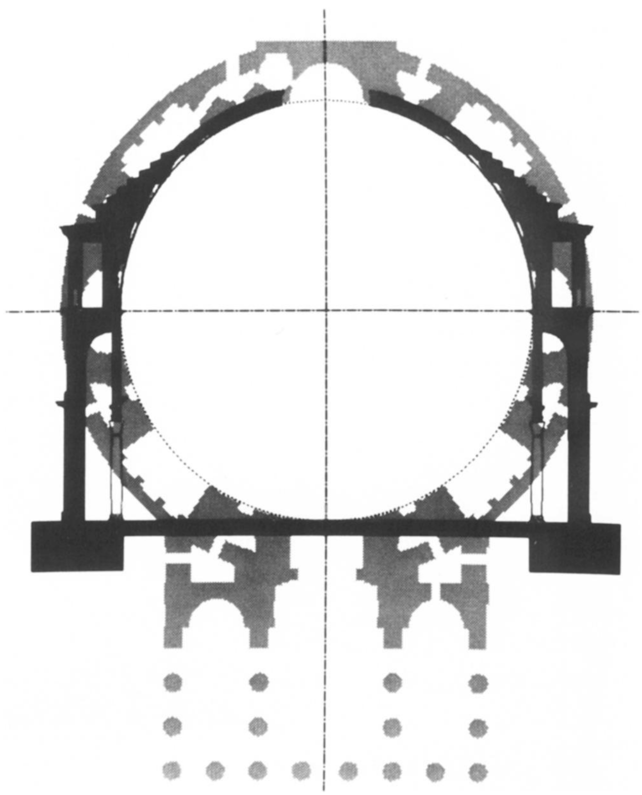

Fig. 3. Pantheon, section superposed on ground plan (photo: UMd).

In 1671, the young Desgodetz presented a devastating critique of the attic: "In the attic, the pilasters do not project from the wall and are only distinguished by the different color of the marble. They are so poorly proportioned with the entablature and pedestal that one can scarcely call it an order, this badly ordered assembly of parts. They are not at all fit for an attic, which ought not to have the essential parts of an order. This part should not be called an attic, unless one supposes that once there was one in this place, and that pilasters, an architrave, and a frieze were later added there."[14]

On the basic point that the placage does not represent an attic, Desgodetz was correct. The entablature is a replica, about one-half size of the one crowning the Corinthian order below. The porphyry pilasters, short and thin, create the impression of an order in miniature. Had the pedestal been omitted, the 9 m. height of this zone could have accommodated an order about three-fourths the size of the one in the exedras. Hellenistic and Roman basilicas, civic fountains, libraries, and stage fronts exhibit many examples of second-story structural orders, well

9. Buddensieg, "Pantheon"; and Davies-Hemsoll-Jones, "Pantheon."

10. A. Bartoli, *Monumenti antichi di Roma nei disegni degli Uffizi di Firenze,* Rome, 1914–1922, III, fig. 414; VI, 76–77.

11. The remark appears in an archaeological report made to Pope Urban VIII by Cipriano Cipriani (BAV, Barb. lat. 4309, fol. 11) published by Carlo Fea, *Miscellanea filologica critica e antiquaria,* II, Rome, 1836, 241, and quoted by R. Lanciani, *Dissertazione,* 1.

12. G. Vasari, *Le vite de' piu eccellenti pittori scultori ed architettori,* ed. G. Milanesi, Florence, 1906, IV, 511–512.

13. In the Medici Chapel no vertical element connects the three zones of architectural forms. For the dome of St. Peter's, cf. H. A. Millon and C. H. Smyth, *Michelangelo Architect,* Milan, 1988, 101–102, plates 19, 20.

14. A. Desgodetz, *Les Edifices antiques de Rome,* Paris, 1779 (2d ed.), 211, plates VI and XVII.

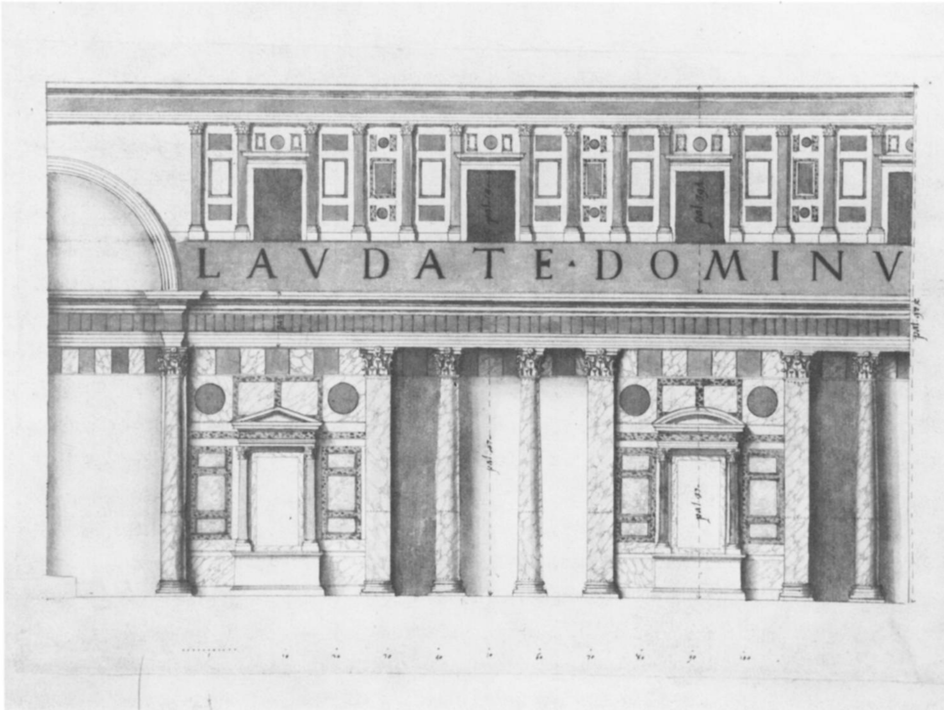

Fig. 4. BAV, Chigi, P VII, 9, 110, Rotunda, Corinthian order and attic, wash drawing (photo: BAV).

proportioned to their first-story supports.[15] It would be fatuous to assume that Hadrian's architect was unaware of this tradition. If he did not choose to represent in this space such a structural order, he must have been aiming at an effect that a conventional second-story order would not have achieved. Desgodetz's own understanding of an ancient attic would rest on those above triumphal arches or on the one crowning the wall of the Forum Transitorium. The basic pattern of these attics consists of framed, horizontal rectangles, not of columns or pilasters spaced as if they were an order. Desgodetz's critique of the attic makes us reexamine the one he saw (Fig. 4) and look for its architectural source.

It was left to Viollet-le-Duc to question the aesthetic function of any attic in the Rotunda. In 1860, he observed that the "construction of this hall and its decoration form two distinct parts," that the "marble decoration . . . is merely a screen-work of columns set against and in no way contributing to the strength of the edifice."[16] "In my opinion," he continued, "the lower order which cuts the recesses [i.e., the exedras] at two thirds of their height, the attic which masks their arching, and that division into two zones of a homogenous piece of construction rising from the floor to the springing of the cupola, lessen the effect of this beautiful composition instead of adding to its grandeur."[17] This grandeur, of course, remained visible only at apse and entry.

More than any of his predecessors, Viollet-le-Duc specified the clash in scale between attic placage and coffered dome (Fig. 1). "One need not be a builder," he wrote, "to feel that they [the coffers] belong to the general structure of the design; while the part below, upon which they seem to rest, is merely an immense wainscot of marble set up against the interior surface of the cylinder." Beneath these coffers, "so impressive, so distinct and so grand in scale, what effect could be produced by that repetition of panels in marble, of slightly projecting pilasters, of capitals of columns, whose height scarcely equaled half the diameter of the roses which must have adorned the back panels of the coffers?" He targeted both the Corinthian order and the attic placage in his final thrust: "In a hall whose members are all on a large scale, I can understand a wainscot of marble or wood which, by its height and delicacy of detail, should recall at the base the size of the human figure; but I cannot understand a wainscot 80 feet [sic] high."[18]

Clearly Viollet-le-Duc would solve problems of disparate scales in the Rotunda by massive surgery. Had the surgery been per-

15. H. Lauter, *Die Architektur des Hellenismus,* Darmstadt, 1986, 121–124, plates 3b, 24, 30b, 48. For the Stoa of Attalos, Athens, cf. J. Travlos, *Bildlexikon zur Topographie des antiken Athen,* Tübingen, 1971, 505–519.

16. *E. Viollet-le-Duc, Discourses on Architecture,* transl. B. Bucknall, New York (2d ed.), 1959, 113. Viollet-le-Duc ignored the observation made by Leclere, Prix de Rome 1813, that the screening columns carried arches spanning the exedras radially. For Leclere, see n. 23.

17. Ibid., 115.

formed, the structure would have lost much: hierarchic distinction between apse and lateral niches; cylindrical definition of the central void; the Corinthian order, which establishes in this vast interior the grand yet human scale of an imperial forum with its statuary. In short, loss of its Roman character.

Taken as a whole, these professional critiques betray a desire to redesign the interior elevation to fit the Procrustean bed of classical architectural theory, which began to sweep Europe in the 16th century. San Gallo recognized that the interior elevation denied structural logic, floor to oculus. Desgodetz showed that the placage of the attic did not represent a traditional Roman attic. Michelangelo and Viollet-le-Duc recognized the disturbing juxtaposition of disparate scales. One could conclude from these 16th- to 19th-century observations that the Rotunda was a master work of Roman engineering, clad in a downright defective marble dress on the interior.

Of the four basic components of Hadrian's Rotunda—structure of the drum, Corinthian order, attic placage, coffered dome—the first two escaped the criticisms sketched above. The defects of the last two—failure to align superposed solids, and abrupt shifts in scale—counted as failures to respect the praiseworthy Corinthian order. The attic, indeed, suffered the ultimate in criticism when it was deleted in 1746–1747. In Germany in the 1960s discussion of these matters shifted to false issues of secular versus sacred space,[19] and of Italic space and structure versus a Hellenistic aesthetic of ornament,[20] issues which have nothing to do with architectural decisions made in Hadrian's Rome. To recover the rationale of the Roman design of this interior remains a desideratum.[21]

III

An analysis of the Rotunda should begin with a consideration of its great size. Its inner diameter (43.8 m.) had been determined by Agrippa's architect in 25 BC when he laid out the open court of the original Pantheon sanctuary on this site. This open court survived in Domitian's restoration of Agrippa's Pantheon after the great fire of AD 80.[22] It had been associated with the Pantheon for more than 130 years when Hadrian determined to cover it with the present Rotunda, a fire-proof building. The interior elevation of the Rotunda may be regarded as the architect's commentary on this well-known open court, which was his task to convert into the largest and most unusual cella then known. The volume enclosed is so large that this interior elevation is better defined as an "interior façade." This definition is less an oxymoron than might be thought when we recall that the Corinthian order of the exedras, 12.7 m. in height from floor to top of cornice (the height of a four-story building), takes up only two-sevenths of the total distance from floor to oculus. To see the exedras and attic of the drum as a circular façade fronting an open space is to place us in the position of the architect in 119. We gain a Roman vantage point from which to assess this design. We shall focus on the architect's handling of the attic.

The attic is the smallest of the three elements comprising this interior elevation. If we were to divide the total height (43.8 m.) into 24 units, 12 would define the dome, 5 the attic and 7 the Corinthian order. The height of the attic was determined by the vaults spanning the exedras. In 1813, the French Prix de Rome architect Leclere showed how the placage in this space relates, in its vertical articulation, to the arcuate system behind it.[23] His section drawing includes placage as well as arches and vaults (Fig. 5). Studied with the frontal view provided in Chedanne's *Etude Générale* (Fig. 6), we can see how the double set of shallow relieving arches spanning intercolumniations of the exedras are precisely screened by the pedestal represented in the attic placage. The string course of the pedestal marks the crowns of these arches and the base of the windows.

Above this point in the attic three elements come into play: the conoid vaults, three bricks thick, spanning the breadth of the exedras; the radial arches, which spring above each screening column and span the depth of the exedras; and the windows admitting light into the exedras directly from the oculus. Clearly the position, breadth, and height of the windows was precisely determined by the arcuate system: the base must lie above the arches screened by the pedestal; the breadth must fit between the radial arches springing above each screening column; the horizontal tops must stay clear of the intrados of the conoid vaults spanning the exedras (Figs. 5 and 6). The blind windows midway between the open ones, and on axis with the aediculas between the exedras, would naturally maintain the same dimensions, though structural restrictions were not so severe.

Between the windows runs a shallow pedestal upon which the pilasters are placed (Figs. 2 and 4). Not indicated in Leclere's

18. Ibid.

19. H. Kahler, "Das Pantheon in Rom," *Meilensteine europäischer Kunst,* ed. E. Steingraber, Munich, 1965, 72; idem, "The Pantheon as Sacral Art," *Bucknell Review,* XV, 1967, 41–48.

20. G. Kaschnitz von Weinberg, *Römische Kunst,* Reinbek bei Hamburg, 1963, 89; K. Schefold, *Römische Kunst als religiöses Phänomen,* Reinbek bei Hamburg, 1964, 79, 81f.

21. For a comprehensive treatment of the entire structure, cf. W. MacDonald, *The Architecture of the Roman Empire,* I, New Haven, 1965, 94–121.

22. Two pavements were discovered beneath the floor of the Rotunda in 1892/93: (1) a stratum of tufa and chalk, 30 cm. thick, the bed of a marble paving, lying 2.15 m. below the present floor; (2) a layer of tufa, 1.20 m. thick, lying one meter below the above. Undisturbed alluvial clay was found below the lower pavement. The lower pavement must be Agrippa's; the upper belongs to Domitian's restoration of the sanctuary in the mid 80s. For a summary review of these strata, cf. Fine Licht, *Rotunda,* 172–173.

23. A. Leclere's analytical drawings of the Pantheon were published by C. Isabelle, *Les Edifices,* plates 14bis, 15, 18; also by H. d'Espouy, *Monuments antiques relevés et restaurés par les architectes pensionnaires de l'Academie de France à Rome,* II, Paris, 1910, plates 134–139.

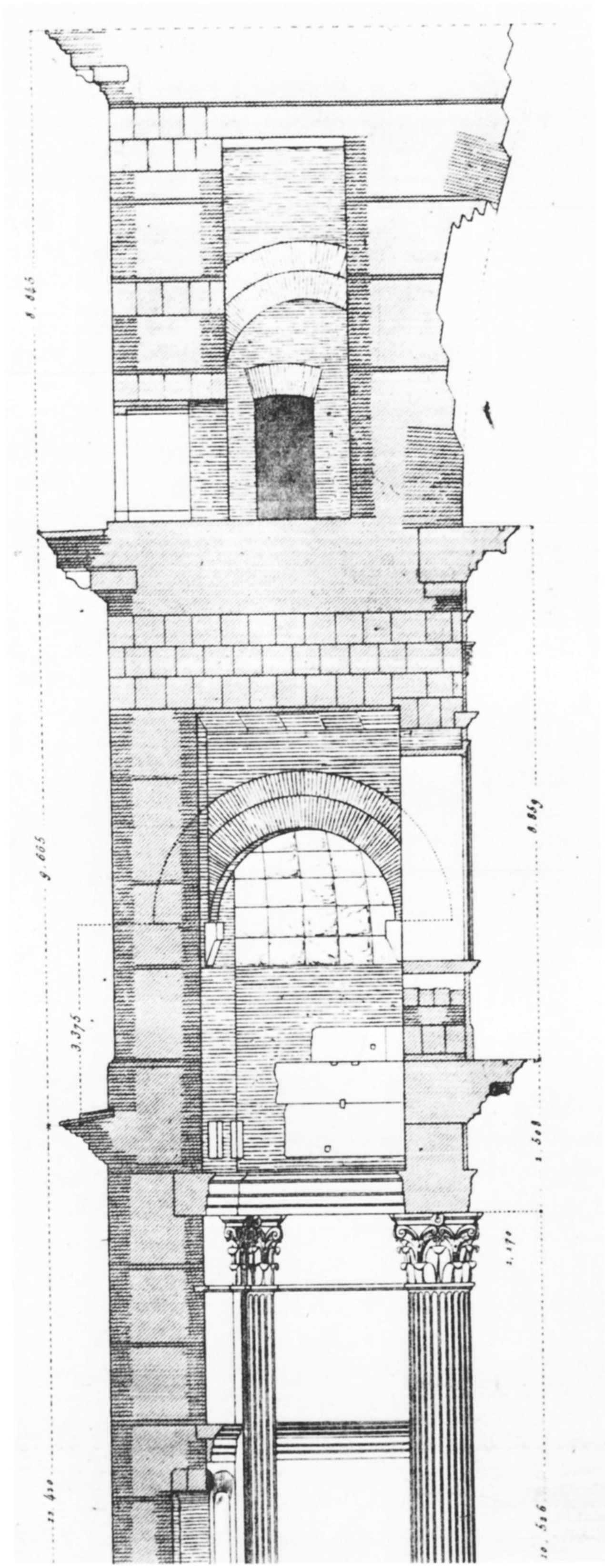

Fig. 5. A. Leclere, Pantheon, section through exedra, detail drawing (after C. Isabelle, *Les Edifices circulaires et les domes,* Paris, 1855).

drawing, this pedestal is at the level of the impost block of the radial arches spanning the depth of the exedra. The thin slabs of the shafts, of the capitals, and of the architrave are set against the face of the conoid vaults. Leclere shows in section how these units reach the crown of the great vault (Fig. 5). Here the builders leveled off the masonry of the drum with a bed of concrete, whose thickness matches the porphyry placage of the frieze. On this bed, clear of arches and vaults, the builders were in a position to lay in the blocks of the projecting cornice.

Such appears to be the relation between the placage of the attic and the structural system behind it. Some elements were fixed by the structure: the position and size of the windows; and the position of the projecting cornice, whose blocks must lie in a plane above the crowns of the conoid vaults. Between these fixed points the entire placage was a matter of free choice for the architect. He had to cover the double set of relieving arches, but he need not have done so with the representation of a pedestal, which cost him one-fourth of the total height available. He had to cover the faces of the great vaults, but he need not have done so with sets of four pilasters between the windows. He could have installed a placage pleasing to Desgodetz. He chose, however, to ignore two types of attic design well known in antiquity and to the Renaissance: the attic of triumphal arches and the attic of continuous barrel vaults. Since he was designing neither for a triumphal arch nor for a continuous barrel vault, we can scarcely fault his decision to ignore these common examples. Instead, he followed a third type, well known to his contemporaries, but probably not to his Renaissance critics.

IV

The ancestry of the attic in Roman architecture can be found not in Vitruvius, but in Hellenistic practice. At Palestrina a low wall rises above a columnar order to mask annular barrel vaults spanning colonnades of the hemicycles in the sanctuary of Fortuna (Fig. 7).[24] The height of this wall equals the radius of the vault to be masked, plus its thickness. This wall is articulated by colonnettes aligned above the columns of the colonnade. The need for this mask arose from the desire to hide the rough, convex exterior surface of the vault behind a formal, vertical dress in marble or stucco. This type of attic appeared also in the flanking colonnades of the Forum of Augustus, where caryatids, each aligned above a column, punctuated a series of rectangular panels.[25] Since no barrel vault, apparently, covered these excep-

24. F. Fasolo and G. Gullini, *Il Santuario della Fortuna Primigenia a Palestrina,* Rome, 1953, 130, fig. 195; 135, fig. 203; plates XVIII, 1; XX, 1; XXIII, 6, 7. Cf. Macdonald, *Architecture of the Roman Empire,* plates 8, 9, 10b.

25. P. Zanker, *Forum Angustum, Das Bildprogram,* Tübingen, 1969, 7, figs. 4, 5, 25. Dates of construction of the temple of Mars Ultor (vowed 42 BC, dedicated 2 BC) and of the colonnades of the forum are

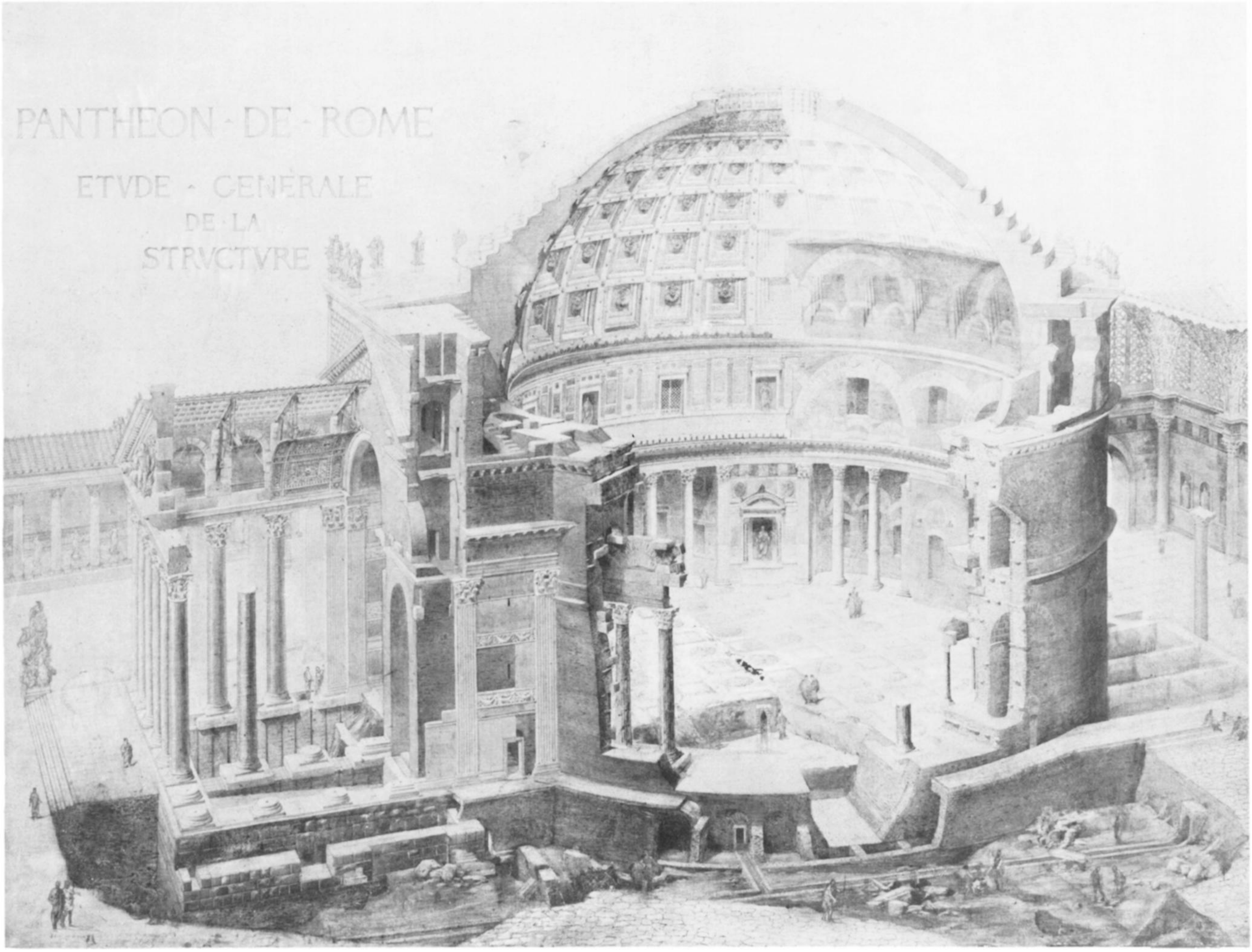

Fig. 6. G. Chedanne, Pantheon, *Etude Générale de la Structure,* wash drawing (Cliche ENSBA).

tionally broad colonnades, the desire to install caryatids or "Victories" may well have motivated the presence of an attic. Attics of triumphal arches were the likely sources of inspiration. Pliny tells us that Diogenes of Athens placed caryatids "on the columns" ("in columnis") in Agrippa's Pantheon, no doubt in the attic of a colonnade, as in Augustus's Forum (Fig. 8).[26] That Vitruvius says nothing about attics, which he could have seen in Palestrina, is to be expected, since he says little about arches, less about domes, and nothing about the problem of integrating trabeate "orders" with arcuate structures.

Hadrian's attic placage owes its appearance and character to a factor not yet mentioned. While the size, scale, and position of its elements (pedestal, windows, pilasters, entablature) were largely controlled by the arcuate system in this level, the use of various marbles of differing colors diminished, or made ambivalent, the structural statements of these elements. A frieze of red porphyry between white marble architrave and cornice does not immediately suggest a unified entablature. Rather, it seems to detach the cornice from its entablature. Red porphyry shafts of the pilasters link white marble base to white marble capital without immediately suggesting a single tectonic support.[27] Their architectural force would have been further diminished if Desgodetz is right in saying that they were set flush with the surface of the background placage.[28] Terenzio's restoration "corrects" this Hadrianic "error," if such it was, by allowing a slight

not known with precision. The temple was still unfinished in 19 BC. Both temple and forum quite likely date after the completion of Agrippa's Pantheon in 25 BC, cf. V. Kockel, "Beobachtungen zum Tempel des Mars Ultor and zum Forum des Augustus," *Mitteilungen des Deutschen Archäologischen Instituts, Römische Abteilung,* XC, 1983, 439–443. That these caryatids were replicas of those of the Erechtheion is clear from extant remains discovered in 1930 (G. Giglioli, "Le copie romane delle 'Caryatidi' dell' Eretteo nelle 'Porticus' del Foro di Augusto, *Römische Mitteilungen,* LXII, 1965, 155–159, plates 54–60).

26. Pliny, *Natural History,* xxxvi, 38.

27. For an analysis of the use of color in the Pantheon, cf. G. Mansuelli, "Il problema di spazio e colore prima dell'età bizantina," *Corsi di cultura sull'arte ravennate e bizantina,* XVI, 1969, 273–280.

28. The Chigi drawing (Fig. 5) shows these shafts projecting.

Fig. 7. Palestrina, Sanctuary of Fortuna, Terrace of Hemicycles (photo: FU).

projection to the shafts, as well as to the bases and capitals (Fig. 9). In any case, architectural elements are treated frankly as decor (we think of Pliny's verb *decoravit* to characterize the work of Diogenes in Agrippa's Pantheon). Instead of a serious statement of weight and support at this critical juncture of drum and dome, the architect goes out of his way to emphasize that his attic cannot support his dome. In this middle zone of the Rotunda, we have not a structurally scaled formal order, nor an image of a traditional attic, but a painter's illusion of a gallery or miniature colonnade, such as we might find in Pompeiian painting, Third Style (Fig. 10).[29]

The architect of the Pantheon was not the first to place a gallery or miniature colonnade directly beneath a ceiling. In the Samnite House at Herculaneum, c. 120–100 BC, an open colonnade crowns one wall of the atrium, while the motif is continued as a blind colonnade on the other three walls with adossed half columns.[30] For an example in public architecture, we may cite the miniature colonnade in the Hellenistic Hieron in the sanctuary of the Great Gods on Samothrace. This colonnade, depicted in stucco immediately below the coffered ceiling, presented a complete Doric order in a space 1.18 m. high (Fig. 11).[31] The height of this space was determined by the top two stone courses of the wall, which, on the exterior, formed the Doric architrave (0.64 m. high) and frieze (0.74 m. high) of the building. Thus, a complete Doric order was represented in miniature in a space equal to that of a normal architrave and frieze. These incompatible scales, on opposite sides of the same wall, are apparent in a section drawing, but not to the eye of the visitor.[32] On the interior, however, the miniature colonnade is abruptly and obviously out of scale with the boldly stated ashlar pattern of the wall.

29. For fictive loggias in Pompeiian painting, Third Style, cf. D. Scagliarini, "Spazio e decorazione nella pittura pompeiana," *Palladio*, XXIII–XXV, 1974–1976, 3–44, especially 11ff. For further examples, cf. F. L. Bastet and Mariette de Vos, *Proposta per una classificazione del terzo stile pompeiano* (Archeologische Studien van het Nederlands Instituut te Rome, IV), 's Gravenhage, 1979, plate XL.

30. A. Maiuri, *Ercolano, I nuovi scavi*, I, Rome, 1958, 197–206, figs. 157–159; II, plate 18.

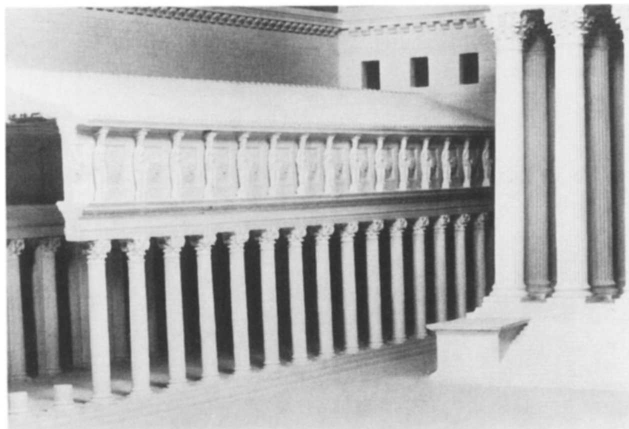

Fig. 8. Forum of Augustus, Rome, 32-2 BC (after P. Zanker, *Forum Augustum, Das Bildprogramm*, Tübingen, 1969).

The pattern on the interior surface of the wall was entirely carried out in stucco, lined and drafted to repeat the exterior pattern of marble blocks, paneled with beveled edges. The pattern consisted of the nine courses above orthostates, six of them stretchers, laid in pairs and each c. 0.56 m. high. These blocks are half the thickness of the wall, being backed by limestone blocks of equal size. The remaining three courses are marble binders, c. 0.27 m. high, which pass through the wall, separating each pair of stretchers and crowning the topmost one with a stringcourse. To cover the contrast on the interior between marble and limestone, the surface was fully stuccoed. This pattern of two high courses alternating with one low course was as prominent in stucco on the interior as it was in marble on the exterior. Since the height of the columns in the miniature colonnade did not exceed the height of one stretcher and one binder course, the clash in scale was obvious. The columns were aligned with alternate beams of the ceiling, but not with vertical joints in the ashlar courses.[33]

31. Phyllis Lehmann, *Samothrace, The Hieron*, Princeton, 1969, III, plate CV (longitudinal section).

32. Ibid., plate CIV.

33. Lehmann, *Hieron*, I, 39–45 for description of exterior wall; 138–140 and 204–207 for description of wall decoration of the cella.

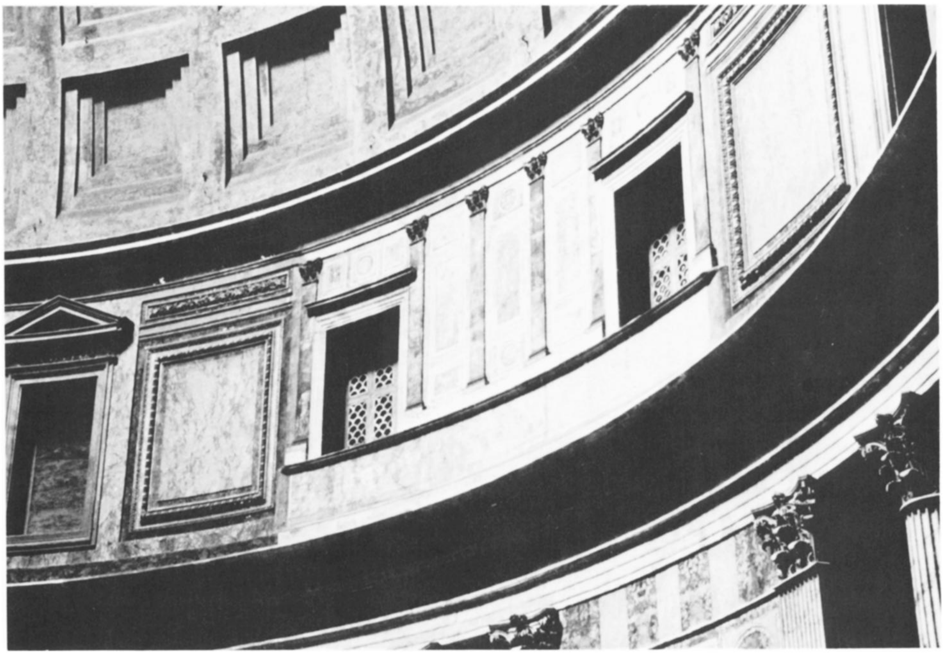

Fig. 9. Pantheon, Rotunda, attic placage restored by Terenzio.

Phyllis Lehman pointed out other Hellenistic examples of decorative colonnades and galleries in heroa and in the frescoes of houses on Delos.[34] The façades of Macedonian tombs provide further examples of small, if not miniature, colonnades above regular orders. Ph. Petsas's reconstruction of the façade of the Great Tomb at Lefcadia (late fourth century BC) exhibits an Ionic colonnade above a painted frieze, continuous and figured, below which is a complete Doric order. The six Ionic columns above align with nothing below.[35] On Thasos, the façade of Pythippos, late fourth century BC, exhibits a small scale Ionic colonnade above, but not aligned with, a full-size Doric order (Fig. 12). These Hellenistic upper galleries and colonnades, in stucco or fresco, form the typological background to Hadrian's placage in the attic zone of the Rotunda. They exhibit the same disregard for vertical alignment and for consistent scale; their context is Hellenistic wall decoration, not Hellenistic structure. They represent architectural forms cut free from architectural theory and from tectonic demands. Renaissance architects and critics could not have encountered this decorative colonnade *in situ* in the field anymore than they, or we, could find it in

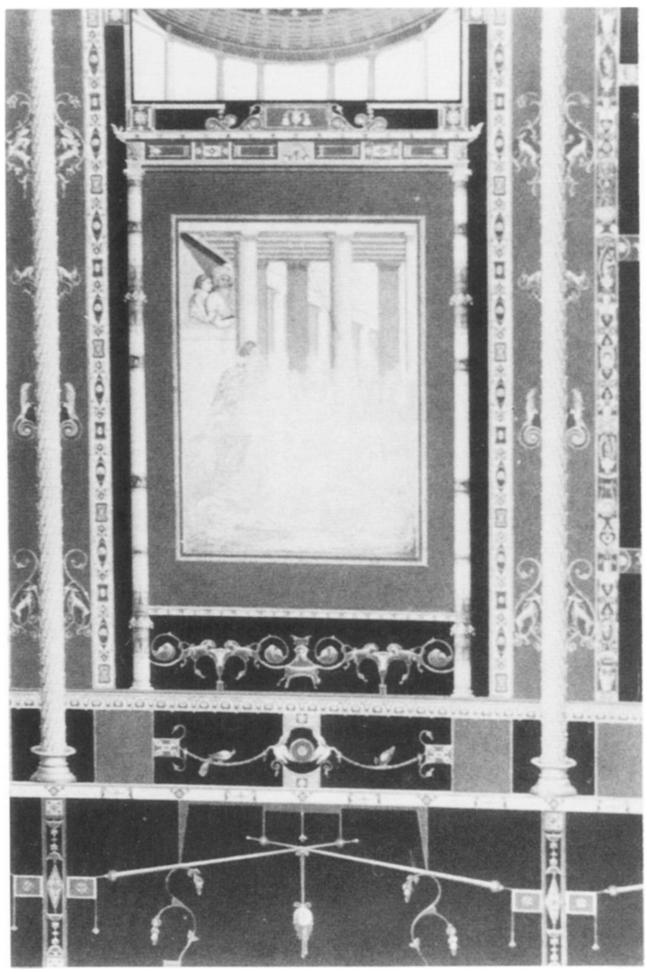

Fig. 10. Pompeii, House of L. Caecilius Jucundus, fresco, right wall of tablinum, c. AD 40–50 (after K. Schefold, *Pompeiianische Malerei,* Basel, 1952, pl. 32).

34. Ibid., figs. 163, 164, 168 for comparanda at Delos and in the Arsinoeion at Samothrace. For the Hellenistic principle of stucco decoration imitating wall structure, cf. M. Bulard, *Peintures murales et mosaïques de Delos,* Paris, 1908 (Monuments et Memoires, Fondation Piot, 14), 116–132 with plate 6a. Further on Samothrace, cf. A. Frazer, "Macedonia and Samothrace: Two Architectural Late Bloomers," *Macedonia and Greece in Late Classical and Early Hellenistic Times* (Studies in the History of Art 10, National Gallery of Art), Washington, 1982, 191–203, especially 195ff.

35. Stella Miller, "Macedonian Tombs: Their Architecture and Architectural Decoration" (as in Frazer, n. 34), 153–171, fig. 3.

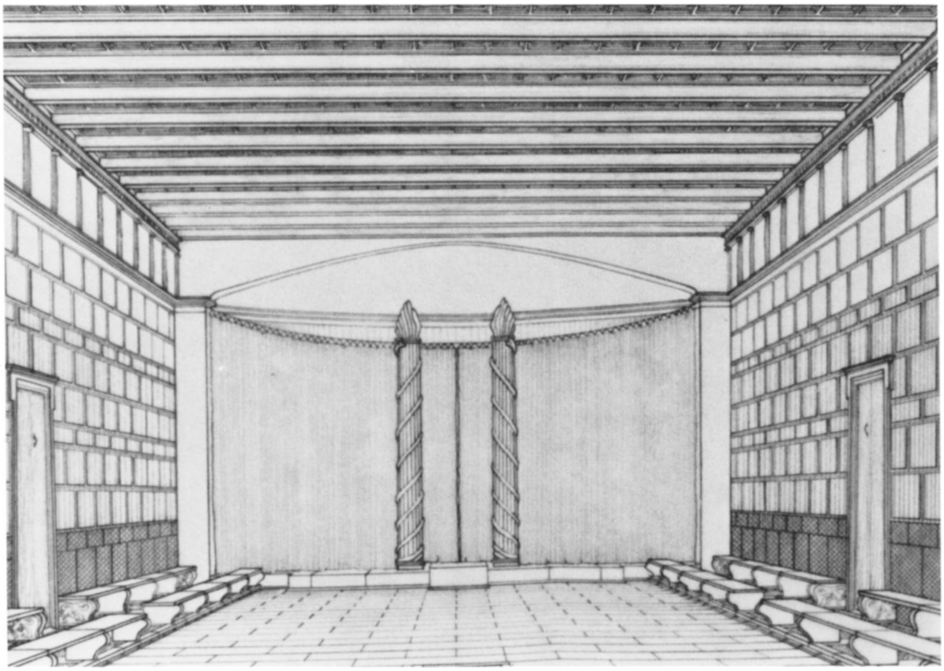

Fig. 11. Samothrace, Hieron, restoration drawing of interior wall (after Phyllis Lehmann, *Samothrace, The Hieron,* Princeton, 1969, III, pl. CV).

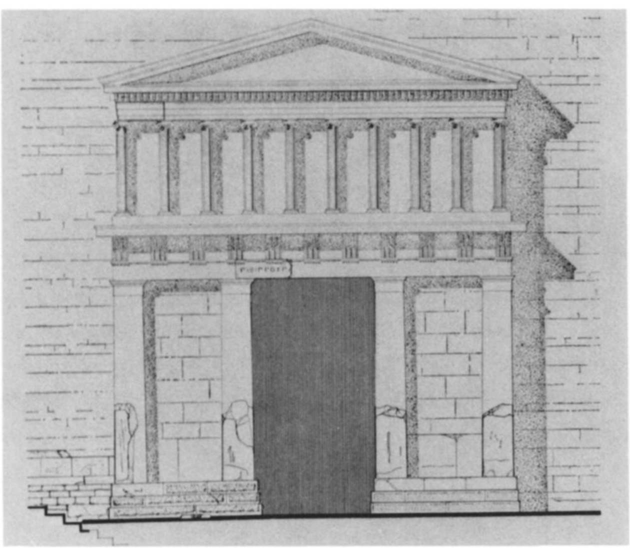

Fig. 12. Thasos, Gate of Zeus and Hera, with late 4th-century BC façade of Pythippos (after *Revue Archeologique,* 1968, 171. fig. 1).

Vitruvius. His conservative view of Hellenistic trabeate architecture avoided discussion of creative variants.

A colonnade, by definition, is open, inviting us to look not merely at it, but through it. When it crowns a wall, we expect to see the sky through it, as is still possible for one standing in the atrium of the Samnite House in Herculaneum. Pompeiian frescoes often represent sky beyond these upper colonnades. In the Rotunda, the decorative colonnade provides a light ambience at the top of a circular wall. Positioned immediately under the coffered dome, it makes no structural statement adequate to its position. I believe we may take this as a serious strategem of the architect, by means of which he could obliterate even the notion of support precisely at the juncture of drum and dome. The great size of the bottom row of coffers has nothing to do with the entablature or pilasters of this colonnade. The dome thus appears to rise from a structure located well behind the interior façade of the Rotunda.

The inner surface of the dome, except for a broad band around the oculus, is articulated into five horizontal rows of coffers divided vertically by 28 ribs. Both the number and the position of these ribs, as well as their juncture with the upper set of vaults in the drum, have been the subject of inconclusive controversy for several centuries.[36] A Roman reading of the dome is still a desideratum.

V

The bricks forming the ribs of this dome were not laid radially, as in a typical Roman brick arch, whose soffit presents a smooth continuous curve. Rather they were placed against the curving false-work in nearly horizontal planes, as in other massive Roman vaults.[37] The horizontality of their beds can be observed in the rib exposed in the upper part of Figure 13. Indeed, the bricks appear to have been shaped to create a ragged

36. Beginning in the 16th century with San Gallo (above n. 10). For Fine Licht, *Rotunda,* 1968, 196, the "28 coffers has up to now escaped any satisfactory geometrical explanation."

37. G. Lugli, *I monumenti antichi di Roma e suburbio,* III, Rome, 1938, 680.

Fig. 13. Pantheon, upper coffers of dome, detail (photo: SML).

soffit, permitting better purchase for the intonaco. Whatever use the brick ribs served during construction, perhaps in shaping the coffers, they delivered no diagonal thrust. Once the building cured, these ribs were part of the dead weight, all thrust in the structure being vertical. This aspect of Roman construction gave the architect considerable freedom in the placement of these 28 ribs.

The size of the bottom row of coffers clearly bears no relation to the scale of the fictive gallery in the attic zone. As Viollet-le-Duc observed more than a century ago, "The compartments of the cupola . . . indubitably belonging to the structure of the Roman building . . . by their imposing character overpower the decoration below."[38] He was right to relate the coffers to the structure, for the breadth of two coffers in the bottom range, including the intervening rib, measures 8.72 m., which compares fairly closely with the clear diameter of the exedras, 8.95 m. This relationship can be seen above diagonal exedras, where one rib falls on its axis, while adjacent ribs strike close to the spring of its vault. If we wish to associate the rib-coffer pattern with exedras, the four diagonal exedras account for 12 of the 28 ribs. The other 16 ribs we can associate with the four axial exedras, where, in each case, two ribs strike the shoulders of the vault as they frame a coffer centered on axis, while two ribs define adjacent coffers (Fig. 14). That the scale of the coffers expresses the scale of the structure is further apparent from the congruence of these measurements: diameter of oculus, 8.95 m.; height of attic zone, 8.95 m.; span of exedras, 8.95 m.; lower breadth of two coffers with intervening rib in bottom range, 8.72 m.

In addition to these approximate relationships, a congruence can be noted between the coffers and the marble pattern in the floor. This is apparent in the bands of white marble which align with columns screening the east and west exedras (Fig. 15). Above these columns rise the ribs in the dome which flank the axial coffers. Adjacent bands in the floor align with adjacent ribs in the dome. Comparable alignments are observable on the north-south axis. These alignments are also approximate, but suggest that the squares in the floor pattern are close in size to coffers in the bottom range. If we draw the axes of ribs centered above diagonal exedras down to the floor, these lines will strike

38. Viollet-le-Duc, *Discourses,* 115.

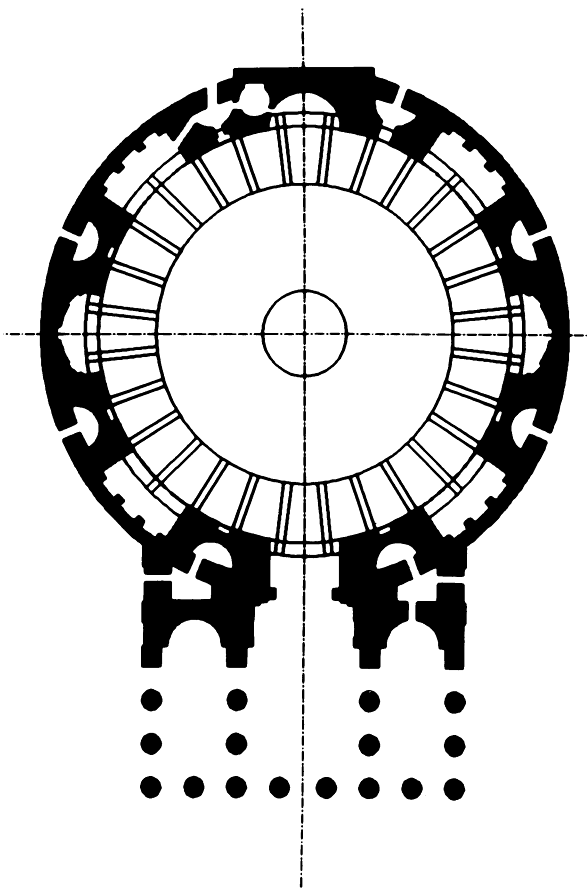

Fig. 14. Pantheon, ground plan with rib pattern superposed (photo: UMd).

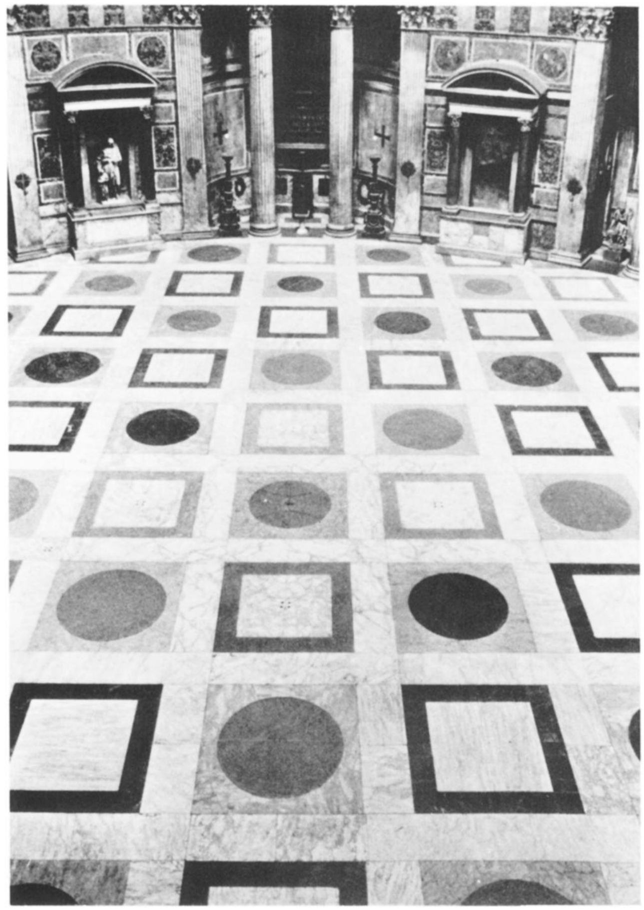

Fig. 15. Pantheon, floor of Rotunda.

the corners of an ideal square inscribed within the circle of the Rotunda. If we draw this circle through the axes of all screening columns, the sides of this square will run through seven squares in the floor, corresponding to seven coffers lying between these diagonal ribs in the dome (Fig. 16). Moreover, there are five files of squares in the floor from center to sides of the inscribed square, just as there are five ranges of coffers in the dome.

This congruence between floor and dome suggests that we should read the 28 vertical rows of coffers as four groups of seven, defined by the diagonal ribs. Read in this fashion, coffers in the dome and the marble pattern of the floor appear to be similarly scaled decorative elements related to the basic geometry of the building. To the extent that we read all three levels in the Rotunda horizontally, we diminish awareness of vertical misalignments, while enhancing our perception of a harmony between the horizontal rhythms of solids and voids at ground level and in the attic. As Bernini appears to have recognized, the pilaster-window rhythm in the attic (4-1-4-1, etc.) matches, in smaller scale, the exedra-aedicula rhythm below (four columns-aedicula-four columns, etc.).[39]

The size of the coffers derives from their number: 28 in each of the five ranges. This number does not appear to derive from the geometry of the ground plan. Fine Licht has observed that if we rotate the inscribed square 45 degrees and then again 22½ degrees, the radii of the resultant 16-sided polygon define the axes of all voids reserved in the drum: eight exedras and eight smaller semicylindrical voids between them (Fig. 17).[40] It would have been a simple matter to bisect the angles of these 16 radii and thereby define on the ground, for the benefit of the carpenters building the false work, the axes of 32 ribs, eight to a quadrant (Fig. 18).[41] Instead, we have 28 ribs, seven to a quad-

39. T. Marder, "Bernini and Alexander VII: Criticism and Praise of the Pantheon in the 17th Century," *Art Bulletin,* forthcoming. I am grateful to Tod Marder for the opportunity to read this article in typescript.

40. Fine Licht, *Rotunda,* 196, fig. 202.

41. J. Dell, "Pantheon" (as in n. 6), 277, felt that the "original" design had called for 32 coffers. H. Saalman, in an unclear note, "The Pantheon Coffers: Pattern and Number," *Architectura,* XVIII, 1988, 122, dismisses without explanation Dell's point. Saalman postulated a choice between 20 and 36 coffers, 20 yielding coffers too high, as well as wide (c. 6 m. square), 36 yielding coffers too low, as well as narrow (c. 3 m. square); hence, 28, which creates coffers c. 4 m. square in the bottom range. But 32 would produce a coffer c. 3.63 m. square, about $^{11}/_{12}$ths the size of the present set. It seems unlikely that the Roman architect would have flipped this kind of coin in making his decision.

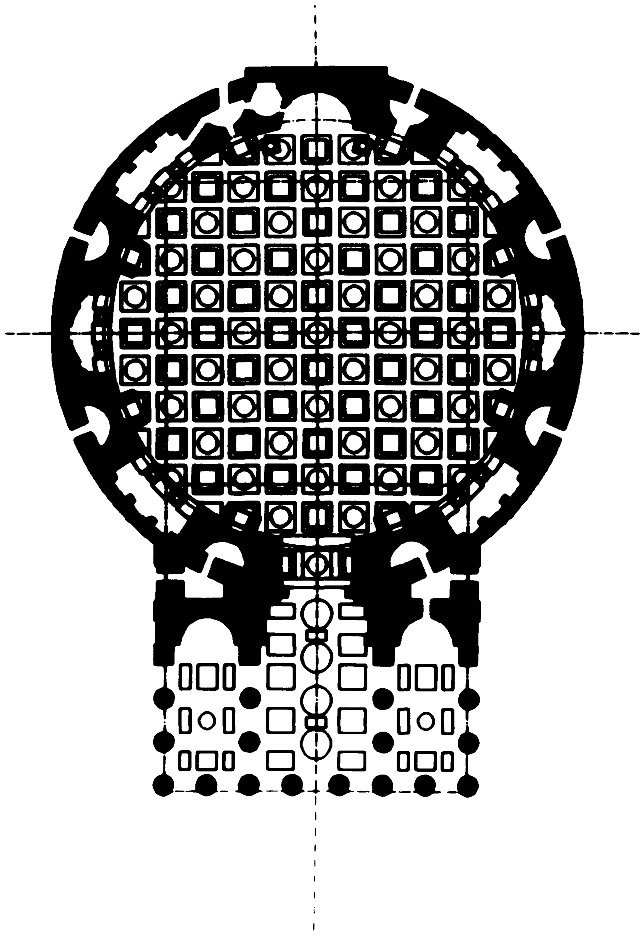

Fig. 16. Pantheon, ground plan with inscribed square (photo: UMd).

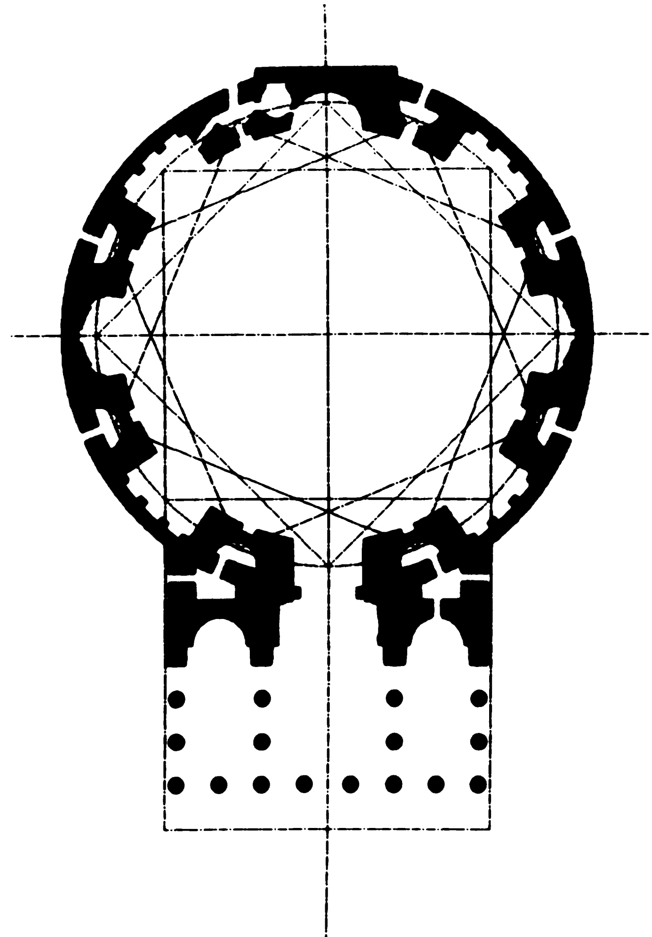

Fig. 17. Pantheon, ground plan with inscribed square, rotated 45 and 22½ degrees (photo: UMd).

rant. With 32 ribs, the size of each would not have been much smaller than the present 28 (angular width of 11.25 degrees versus 12.875 degrees), but in that case a rib, or the center of a coffer, would have fallen on each cardinal and diagonal axis. The present system disposes a rib above each diagonal axis and a coffer above each cardinal axis. This expresses the geometry of the ideal square and maintains a vertical alignment of voids on the major axes. We might now think we have reached a sufficient reason for articulating the lower part of the dome into 28 ribs and coffers. This would be true if the expression of an ideal geometry were alone responsible for the design. But the structure of the drum rises above the spring of the dome. In this upper structure are repeated the eight large vaults of the exedras and the eight smaller vaults between them. Since the exterior brick faces of these vaults have been visible for centuries on the exterior of the drum (Fig. 19), students of the building have long wondered how 28 ribs could fit, at their bases, into this upper set of 16 vaults.

The problem, however, appeared more complex than it actually was. To begin with, the inner brick faces of the great vaults above exedras rise vertically against the ideal cylindrical plane of the inner face of the drum. The crowns of these brick faces reach to the the midpoint of the second range of coffers, at the base of the back panel (Fig. 6).

At this point, the curve of the inner face of the dome has brought the recessions of the coffers sufficiently forward to free them from contact with these vaults. This can be seen in Figures 20 and 21, where a deep cut in the lower part of a coffer in the second range reveals the face of this vault, behind the recessed framing. Ribs and coffers above this point have no contact with vaults. The only places where juncture between ribs, recessed framing of coffers, vaults, and arches occurs, lie in the bottom half of the bottom range of coffers. And here the problem exists chiefly in those coffers which are located directly above the six lateral exedras.

The great vaults above lateral exedras embrace within their spans three relieving arches, whose crowns reach the base of the inner panel of coffers in the bottom row (Fig. 6). These arches correspond in position to those in the attic zone masked by the parapet. The bricks of these arches pass through ribs and recessed frames of the coffers. The bricks have been held back to accommodate these recessions. Of the three coffers shown

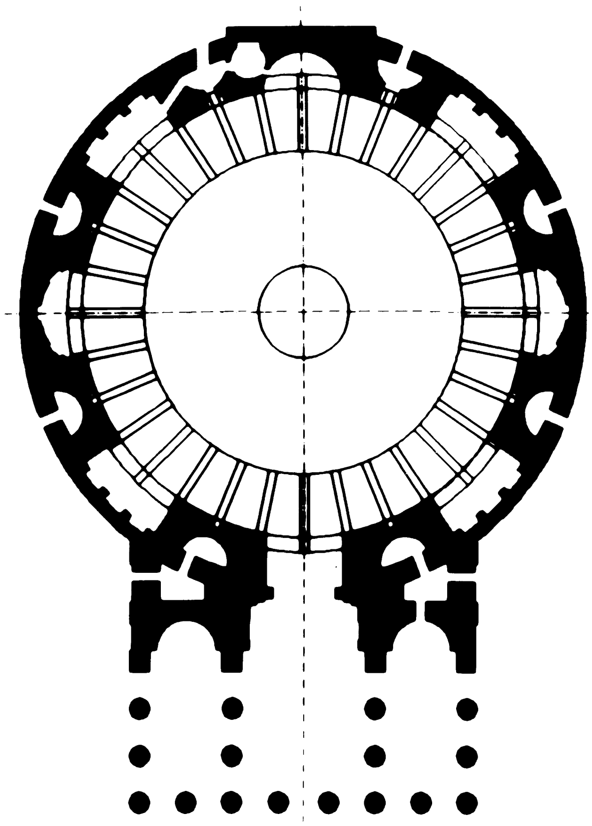

Fig. 18. Pantheon, ground plan with 32 ribs superposed (photo: UMd).

in Figure 20, the two on the left are directly above a diagonal exedra and must contend with three arches; the one on the right has no such problem. Bricklayers working above the east and west exedras also had to mesh, in a different pattern, the bricks of two ribs and three arches, bricks of the arches again giving way to recessed frames of coffers. So far as I know, the juncture between the bases of the eight great vaults above exedras and the bases of those ribs which coincide with them has not been observed, or at least reported. Since their spring points lie about at the level of the crowns of the triple relieving arches just mentioned (Fig. 6), they would pose less of a problem. The eight lesser vaults, whose brick faces appear on the exterior between the eight great vaults, probably posed no problem of juncture to the workmen. These vaults shield only the eight semicylindrical voids in the drum. Their inner faces would lie well behind the coffers of the second range. Nothing in this system of arches and vaults demanded 28 ribs or precluded 32 or more ribs. With free choice before the architect, we may seek elsewhere for his decision to have five ranges of coffers divided by 28 ribs.

The search for significance in the number 28 has uncovered two distinct ancient possibilities. The first of these notes that 28 is a perfect number, the second in a very limited set of numbers that are the sum of all their integers. The first in this set is six ($6 = 1 + 2 + 3$). The second is 28 ($28 = 1 + 2 + 4 + 7 + 14$). Next in this series are 496 and 8,128, perfect

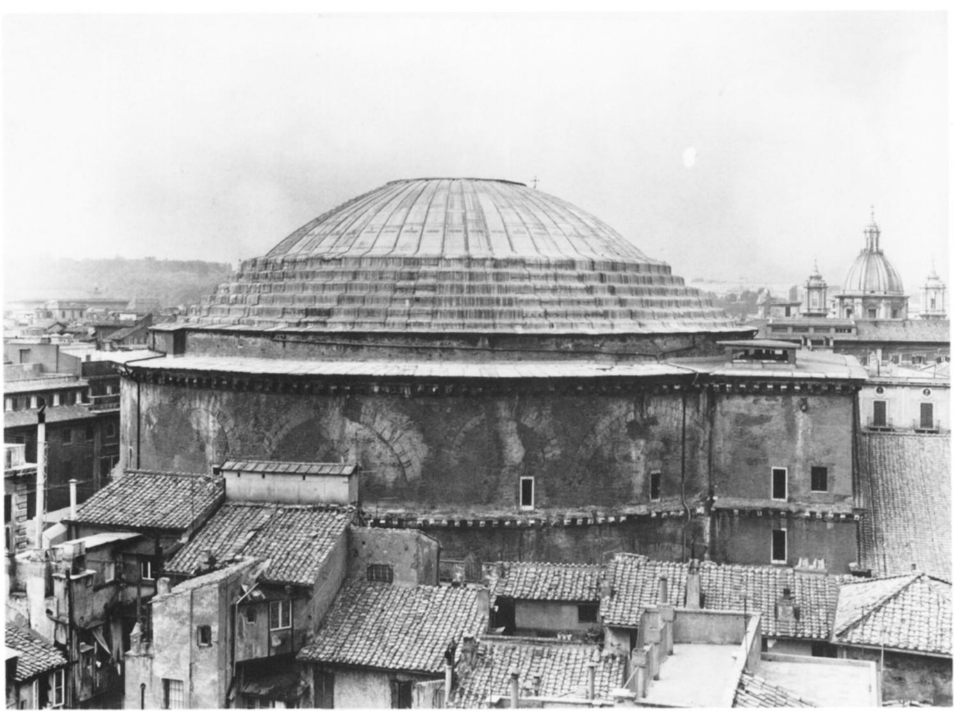

Fig. 19. Pantheon, exterior of Rotunda (photo: ICCD).

Fig. 20. Pantheon, interior of Rotunda, lower coffers (photo: SML).

numbers which had been identified by Nicomachus of Gerasa (fl. AD 100), the neo-Pythagorean author of a popular introduction to arithmetic.[42] While neo-Pythagoreans and others[43] could indeed see deep theological and cosmic meaning in certain numbers, it is difficult to see why this abstract, arithmetical aspect of the number 28 should play a role in the Pantheon, particularly since the numerical series established by its ground plan (4-8-16) leads rather to 32 than to 28.

The second significance of 28 was undoubtedly far more widely known in the ancient world: the number of days required for the moon to orbit the earth. Ancient astronomers were well aware of the irregular periodicity of the moon, the various ways its orbit could be timed, the difficulty of achieving precision in this matter, and the further difficulty of fitting these results into the calendar of a solar year.[44] As measured against a star, the moon requires 27 days, 7¾ hours to complete its orbit; Pliny (*Nat. Hist.* II, 44) reports this datum, a sidereal month, fairly accurately as 27⅓ days, while Vitruvius (IX, 1.5) gives it as 27 days and about an hour. In any case, the orbit is completed early on the twenty-eighth day. At IX, 2.3, Vitruvius summarizes Aristarchus of Samos (c. 270 BC), who calculated the duration

42. J. Bertier, *Nicomaque de Gerase, introduction arithmétique,* Paris, 1978, 75f.

43. T. Heath, *A History of Greek Mathematics,* Oxford, 1921, 74f; B. L. van der Warden, *Science Awakening,* I, Princeton, 1985, 4th ed., 97f.

44. Cf. Ptolemy, *Almagest,* IV (*Ptolemäus, Handbuch der Astronomie,* I, transl. K. Manitius, Leipzig, 1963, 191–253).

Fig. 21. Pantheon, detail of Figure 20 (photo: SML).

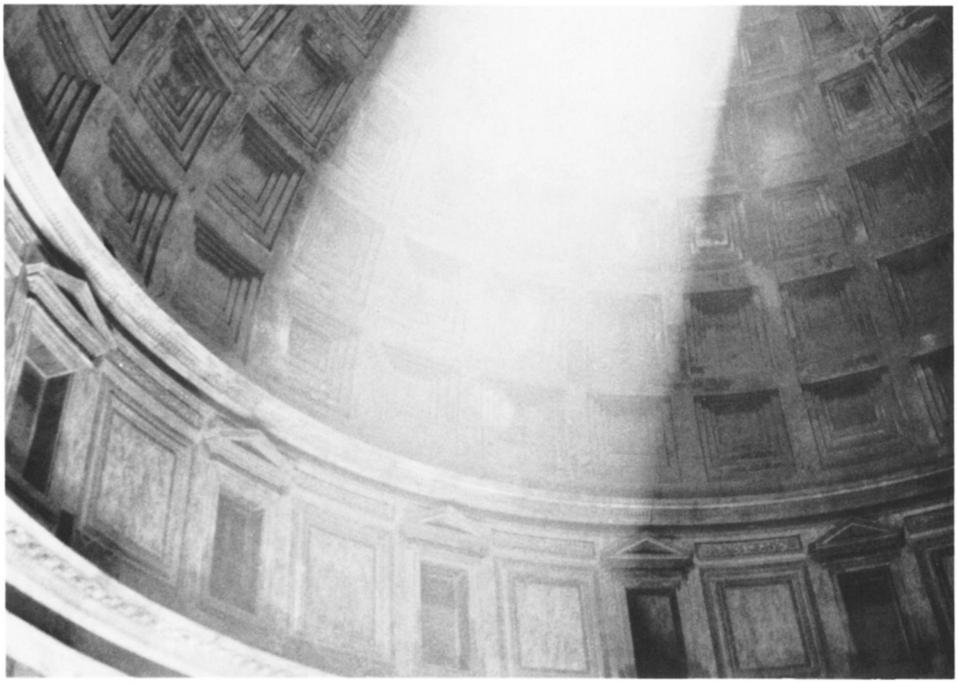

Fig. 22. Pantheon, Rotunda, shaft of light.

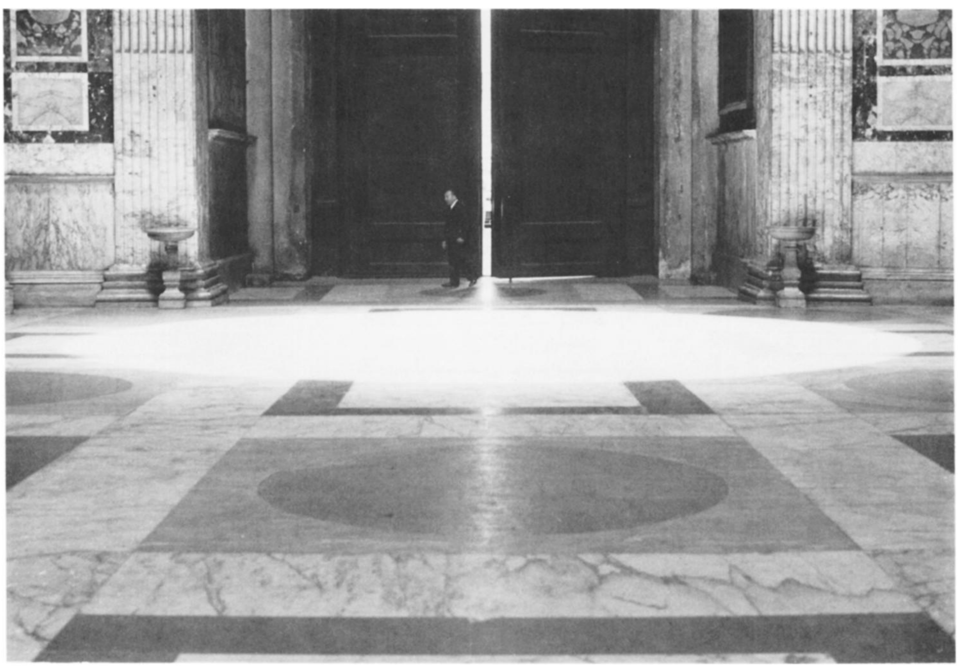

Fig. 23. Pantheon, Rotunda, circle of light crossing axis.

of the moon's orbit by observing its phases (the synodal month). This, the common method of reckoning the month, identifies the four phases of the moon (new moon, first quarter, full moon, last quarter) with the four axial positions on its orbit. According to this system, the moon passes through each quadrant of its orbit in seven and a fraction days. Vitruvius reports Aristarchus as stating that the moon completes its orbit on the twenty-eighth day.[45] We can all articulate the moon's orbit into four quadrants by observing and timing its four phases. The only means we have of visually controlling the 28 coffers, that is, of

45. *Vitruve: De L'Architecture,* Livre IX, ed. J. Soubiron, Paris, 1969, 16f.

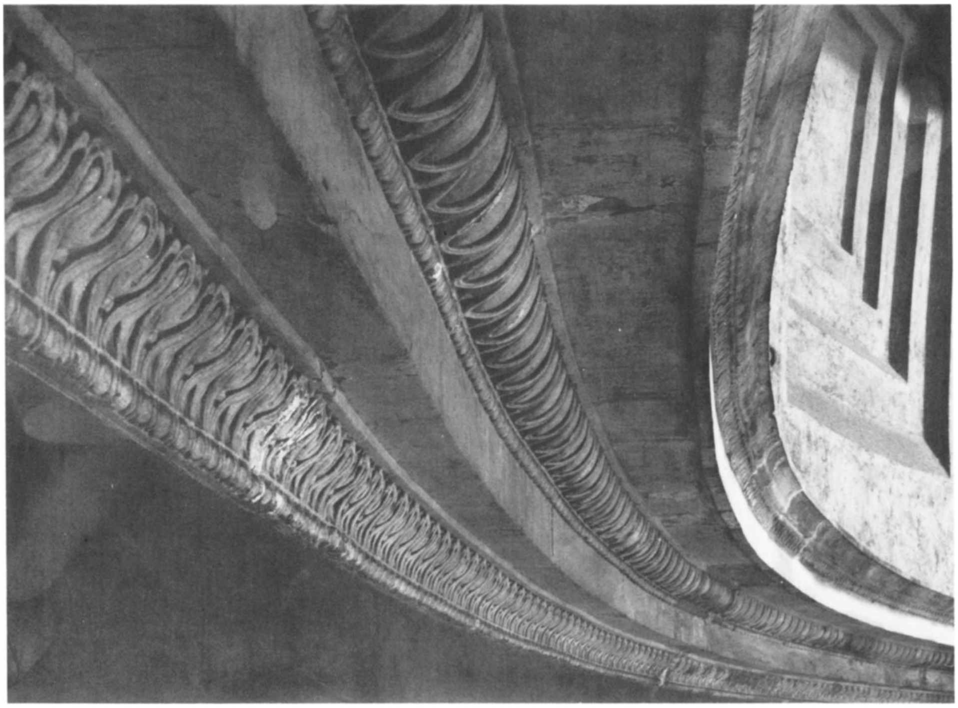

Fig. 24. Pantheon, Rotunda, detail of upper cornice and coffer (photo: ICCD).

Fig. 25. Pantheon, Rotunda, coffers of dome (photo: SML).

subdividing them and relating them to the structure below, is to observe the coincidence of a rib with an axis. The four ribs above diagonal axes alone coincide with a significant axis.

Twenty-eight coffers in a horizontal row circling the Rotunda: 28 days for the moon to circle the earth. Coincidence or intended reference? The possibility that the number of coffers might be meant to suggest the duration of the moon's orbit arises from two factors. First, the fact that the number 28 for the ribs and coffers does not derive from the ground plan. The ground plan would more easily, sensibly, and theoretically yield

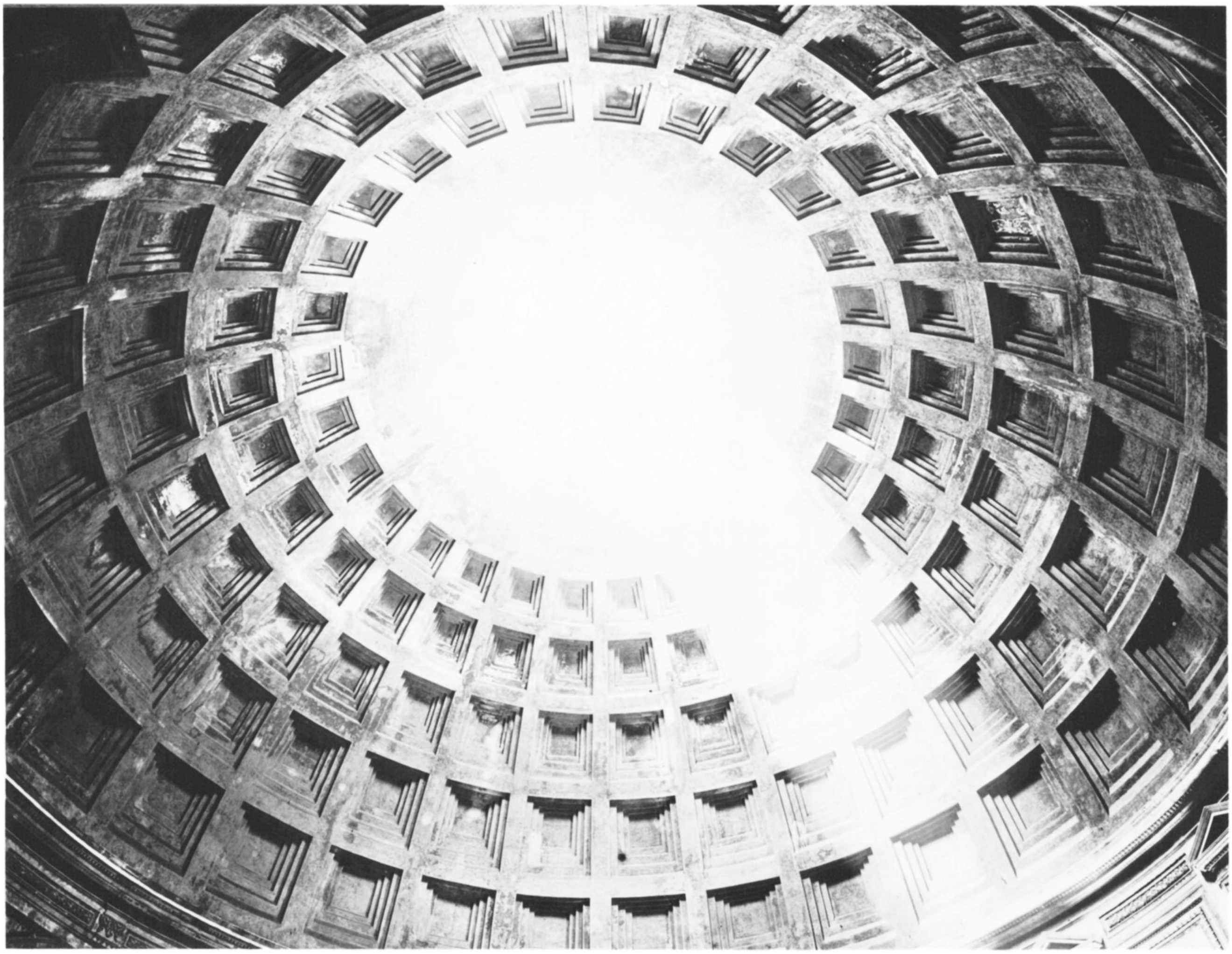

Fig. 26. Pantheon, Rotunda, dome (photo: ICCD).

32. The second factor is the fact that the major visual experience in the Rotunda, apparent to anyone immediately upon entry, whether or not he knows anything about Roman temples, Roman religion, or Roman history, is the single shaft of sunlight slowly moving through the space. The Rotunda isolates the sun's motion. It has always offered its visitors a palpable experience of celestial motion. In this context, it is not unreasonable to see in the 28 ribs and coffers a reference to the moon, particularly since this number seems to bear no connection with the structure.

We must now ask if our rereading of the "grammar" of the interior elevation of the Rotunda can lead us to a coherent reading of its impressive architectural rhetoric.

VI

Three scales inhabit the Rotunda: the familiar trabeate scale of an imperial Corinthian colonnade, with its spaces for statuary suggesting a human scale of great dignity; the light, nonstructural scale of a decorative, fictive, and apparently distant gallery; the massive scale of the coffers, related to hidden structure but not to attic placage or Corinthian order. The architect asks us to read each level independently as discrete horizontal layers. We may observe a congruence between the patterns of the coffers in the dome and the marble pattern of the floor, but no architectural element runs without a break from floor to oculus. That role is reserved for the moving cone of light, descending from the oculus and imprinting its circular image upon coffers, attic, exedras and floor (Figs. 22 and 23). It does this in an elliptical sweep set low in the summer and high in the winter. Only one element runs without interruption in a horizontal plane: the upper cornice (Fig. 24). The shaft of sunlight and the cornice alone define the unity of the void; coffers, attic, and exedra make dramatic its scale.

Unlike conventional temples,[46] the Pantheon faces north.[47] This accounts for the first contrast in the building: the façade

46. Temples with deep cellas and a single cult image generally face the sun, in order to light the image. East or southeast was favored, for

and portico never receive full sunlight and are always darker than the interior cella, well lit by its 30-foot oculus. Turning its back to the sun, the Rotunda presented to the Roman citizen a daily display of cosmic motion in the context of "all the gods." Celestial motion, from the time of Aristotle, was considered the fifth element of the universe. It differed in its nature from the other four: it was a self-moving, spherical body without lightness (like air and fire), without weight (like earth and water), uncreated, eternal, more divine than the other elements. For some it was the outer sphere of the stars, the generator of all spherical motion in the heavens.[48]

The cosmic finger of light in the Rotunda was a tiny fragment of the moving radius of the sun's orbit, for those who followed the common view and Ptolemy, or of the earth's orbit, for those who followed Aristarchos of Samos.[49] In either case, this shaft is the true focal point of this structure. Apse and exedras, withdrawn into the mass of the drum, are secondary. The dedicated statues of "many gods," which Dio saw there,[50] became perforce veiled spectators of celestial motion.

To convey the celestial scale of this constructed cosmos, the architect broke the human scale of a trabeate order with a nonstructural, pictorial gallery. He denied structure at the base of a heavy dome. He lightened the dome by recessing huge coffers, whose back panels are pushed so deeply (0.73 m.) into the mass of the dome as to detach them from the radial and horizontal bands which frame them. These bands, nearly equal in width, read more readily as grid than as structure. The bottom surface of each recession is pitched up to catch light from the oculus, while recessions at the top are sharply cut back, remaining always in shadow. The bottom surfaces of the recessions in each coffer are so broad as to create a plane, receding along our line of sight and raising the back panels above the midpoint of the coffer (Figs. 25 and 26). These perspectival effects, as well as the diagonal shadow patterns created on certain days, expand the sense of space behind the bright grid defining the concave surface of the dome. The five ranges of coffers recall the five circles marked on ancient celestial globes: two arctic, two tropics, and the equator.[51] Globes with constellations drawn on them were well known in ancient Greece and left their mark in art and poetry.[52] But a major breakthrough in these matters was achieved by Archimedes when he invented a contrivance of interlocking rings which, by a simple turning device, set into motion on their miniature orbits globes representing the sun, moon, and five planets.[53] Celestial motion could be seen and grasped in Archimedes's mechanical "microcosmos." The architect of the Rotunda did his best to assure us that we are

Fig. 27. Pantheon, interior Rotunda.

this permitted the sun's rays to enter the long cellas at dawn. Doxiadis, "Tempelorientierung," *Paulys Realenzyklopädie der klassichen Altertumswissenshaft,* Suppl. VII, 1940, 1,283–1,293, points out the distinction between ancient theory and practice in orienting temples. The Greeks had no theory; the Romans had one but did not always observe it. Of possible Etruscan origin, this theory linked axes of temples with sectors of the sky, and would favor a north-south orientation; but temples in the Roman Forum face all directions, since they are generally backed against adjacent hills. In general, the Roman augur displayed his skill at city planning in orienting temples, whatever archaic phrases he uttered at the sacred moment.

47. Actually c. 355 degrees. Agrippa had picked up this north-south axis from the Saepta Julia, the voting precinct on the east flank of his Pantheon sanctuary, which had been inaugurated as a templum in Republican times. This axis also governed the Baths of Nero, on the west flank of the Pantheon forecourt, and the Stadium of Domitian (Piazza Navona) immediately west of the baths.

48. For Aristotle's role in formulating this doctrine, cf. *Aristote, du ciel,* ed. and transl. P. Moreaux, Paris, 1966, xxxiv–1x, and 3–12. For a survey of the ancient notion of the fifth primal element cf. "Quinta essentia," *Paulys Realenzyklopädie,* XXIV, 1,171–1,263 (P. Moreaux).

49. T. Heath, *Aristarchus of Samos,* Oxford, 1913, 301–310.

50. Dio Cassius, LIII, 27, 2–4 (*Dio's Roman History,* VI, transl. E. C. Cary, New York, 1917, 262–264).

51. *Manilius Astronomica,* transl. G. P. Goold, Cambridge, 1978. Bk. I, 563–602 describes these circles and their positions; cf. Preface, xvi–xxxiv, for the astronomical background of the poem. Plutarch, "De Defectu Oraculorum," includes the five zones of the earth and the orbits of five planets among significant "fives" in the universe: *Plutarch, Moralia,* V, transl. F. C. Babbitt, Cambridge, 1936, 453.

52. G. Thiele, *Antike Himmelsbilder,* Berlin, 1898, 17–44.

53. Cicero, *De Re Publica,* I, xiv, relates the story of Archimedes's orrery and its removal to Rome by Marcellus (*Cicero, De Re Publica,* transl. C. W. Walker, New York, 1928). Ptolemy, *Almagest,* VIII, 3, gives directions for constructing celestial globes.

looking not at the heavy tonnage of an immense vault, but at the upper half of a celestial globe.

The architect's vigorous decisions about scale, sharply reducing it from exedras to attic and dramatically increasing it from attic to dome, and his inventive perspectival effects in the coffers, go far to persuade us that this dome-globe of the Rotunda has a circumference greater than that of the circular façade immediately below it (Fig. 27). The dome belongs to another and larger world, the Roman *templum mundi.*[54]

54. The concept of the *templum mundi,* that is, the cosmos as a celestial temple, was widespread: Varro, *De lingua latina,* VII, 6 (*Varro, On the Latin Language,* transl. R. G. Kent, I, Cambridge, 1938, 273); Manilius, *Astronomica,* I, 20–25 and 518–531; *Dio Chrysostom,* 36th Discourse, sec. 36 (c. AD 100), transl. J. W. Cohoon and H. L. Crosby, III, Cambridge, 1940, 453. The classic study is by A. Festugiére, *La révélation de Hermes Trismegistes, II. Le Dieu cosmique,* Paris, 1949. 233ff.