THE PANTHEON: TRIUMPH OF ROME OR TRIUMPH OF COMPROMISE?

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It is paradoxical that a building as universally admired as the Pantheon (plate 1) should have been the subject of so much criticism.[1] Time and again, commentators have qualified their praise of the Pantheon with expressions of dissatisfaction or bewilderment over particular aspects of its design, especially the awkward and incoherent meeting of the building's three constituent parts – rotunda, transitional block and portico (plates 2 and 8). What is most perplexing here is the striking lack of harmony and unity, all the more so given the grandeur and magnificence of the Pantheon's overall conception.

This incongruity had already begun to concern Renaissance architects, even if they did not make their criticisms explicit. For example, Serlio wrote that the Pantheon was 'the most beautiful, the most whole, and the best considered of Rome's ancient buildings', but illustrated the façade with its proportions adjusted and the upper of the two pediments omitted (plate 3).[2] Others, however, looked for likely reasons to explain what they saw as problematic. Michelangelo speculated that the portico and rotunda were designed by different architects (of differing ability), while Palladio thought that Agrippa had added the portico to a building of even earlier – indeed Republican – date.[3]

Subsequent authors agreed that the different parts of the Pantheon were built at different times, even though they disputed the details of its history. Desgodetz interpreted the façade inscriptions to mean that the Pantheon dated from the time of Agrippa, but that the portico was later rebuilt by the emperors 'Severus and M. Aurelius'.[4] Carlo Fontana returned to Palladio's idea and illustrated the façade he imagined had existed before the addition of the portico (plate 4).[5] Milizia, on the other hand, thought that the rotunda alone was built first, the transitional block second, and the portico last (by Agrippa).[6]

Until quite recently, the disparities between the portico, transitional block and rotunda continued to preoccupy commentators, who persisted in assigning them different dates. Scholars like Beltrami realized that the rotunda and transitional block were actually Hadrianic, but nevertheless believed that the

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portico belonged to a later period.[7] Durm agreed, and supplied a fanciful reconstruction of the Hadrianic façade, giving it an unusual attic storey (plate 5).[8] Alternatively, Lanciani wondered if the columns of an Agrippan portico had been retained in the Hadrianic rebuilding, whereas Cozzo still insisted on an Agrippan rotunda (once entered at the back!), supposing all the rest to be a Severan addition.[9]

Theories of this kind had to be abandoned once studies of the building's fabric, and in particular of the brick stamps, proved conclusively that it was constructed in its entirety within a few years of Hadrian's accession in AD 117.[10] Since then, the vexing issue that once provoked so much discussion and controversy has been ingeniously evaded. Authors have argued that any incongruity would have been scarcely noticeable from in front of the portico, and have emphasized the difficulties associated with a design of such novelty, which brings together elements of such diverse form and function.[11] It has even been suggested that the building attempts to unite a typically Roman concrete rotunda with a columnar portico specifically Greek in its inspiration, and that the designer was actually the philhellenic emperor Hadrian himself, so that any ineptitude could be attributed to his understandable inexperience as an architect.[12] Other critics have deemed the supposed design problems to be insignificant, or else have brought into question the modern ability to understand the aesthetic intentions of Roman architects and so recognize what might have appeared faults to their eyes.[13]

Where recent commentators agree is that if the Pantheon was built at one time, then it must have been built as it was intended to be. Yet it would appear over-hasty to thus dismiss so much earlier opinion as misguided in attempting to account for the Pantheon's defects. Associated with the awkward joining together of the rotunda, transitional block and portico there are a number of specific design inconsistencies and conflicts, all of which we contend form part of the same puzzle.

1 The pedimented portico has a gabled roof which intrudes into the second pediment applied to the taller transitional block (plate 2 and fig. 4).

2 The entablature of the portico terminates abruptly on reaching the rotunda, while the lowest cornice of the rotunda terminates at the transitional block (plate 6 and figs 4 and 6).

In addition, there are several other puzzling aspects of the Pantheon's design, which, as we will argue, also seem to be related to the joining together of the portico, transitional block and rotunda. These include the following:

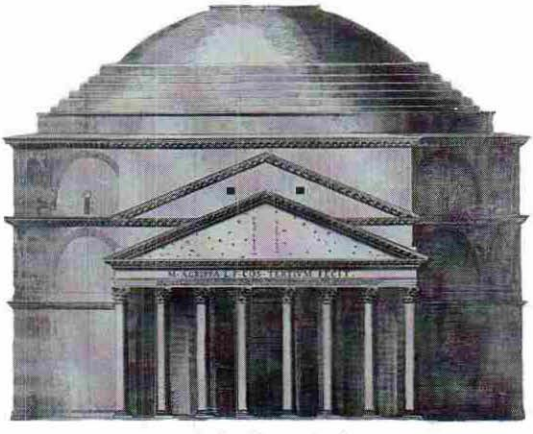
3 The portico pediment is exceptionally tall in relation to the height of the order (plate 2 and fig. 4) as compared with porticoes of other Roman buildings.[14]

4 The cornice modillions of the portico pediment are smaller and are spaced at shorter intervals than those of the other pediment, despite it being virtually identical in size (fig. 4).[15]

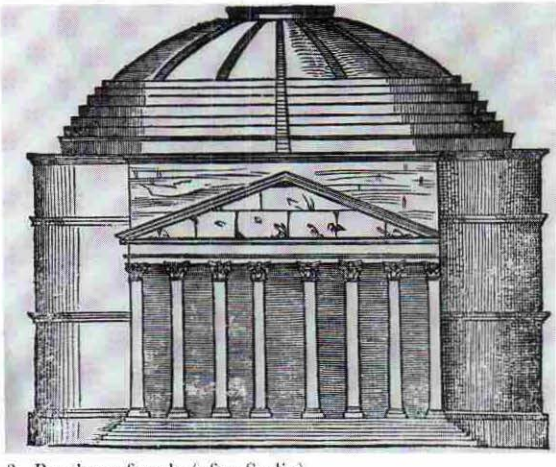
5 The portico columns, 5 Roman feet in diameter and separated by intercolumniations of 10¼ ft (fig. 2), are spaced further apart than is usual during the Imperial period.[16]

6 The *antae*, or pilaster-faced pillars, where the portico meets the

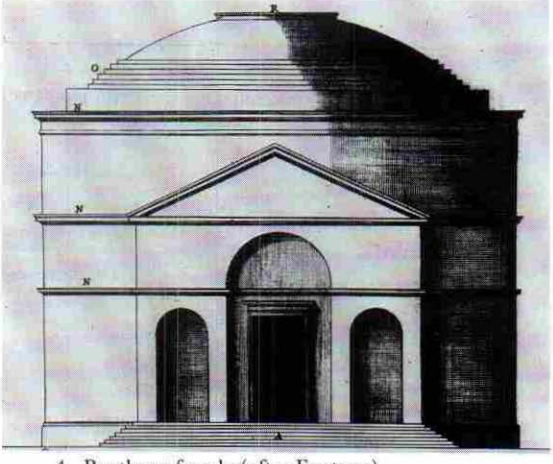
1. The Pantheon from today's piazza



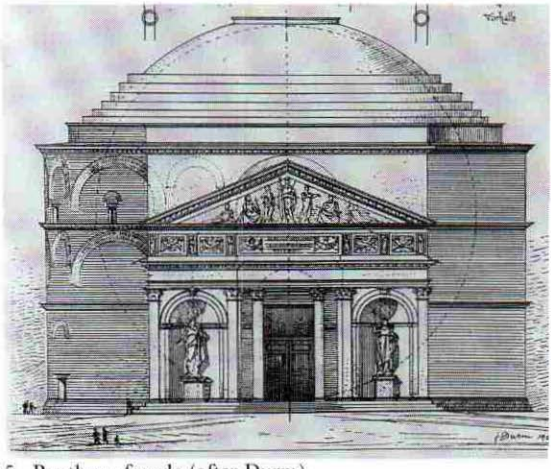
2. Pantheon façade (after Desgodetz)



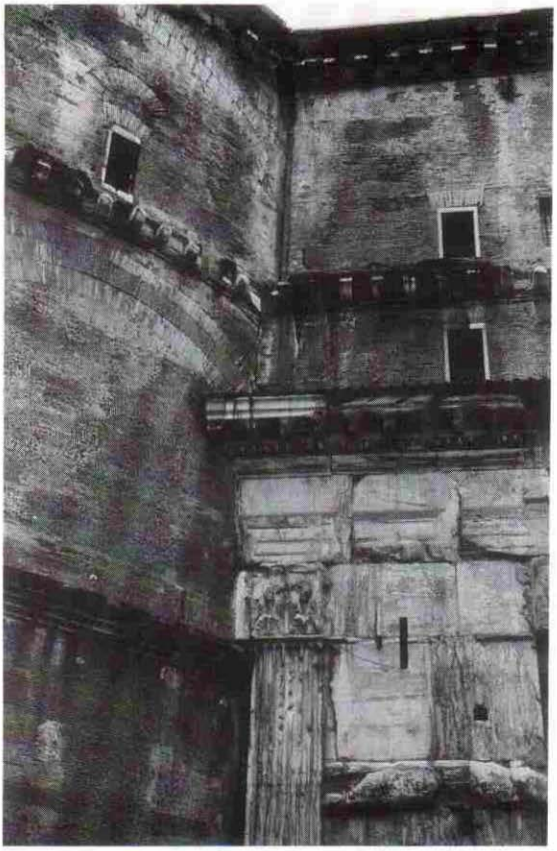
3. Pantheon façade (after Serlio)



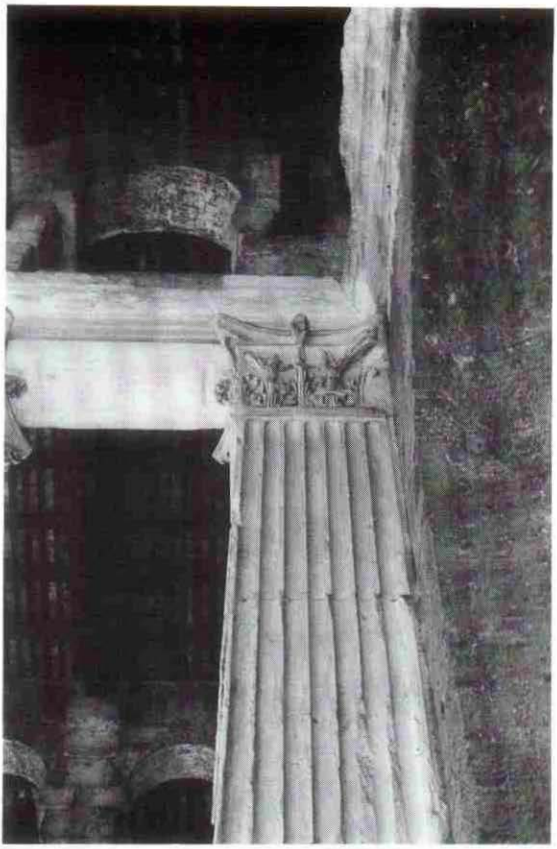
4. Pantheon façade (after Fontana)



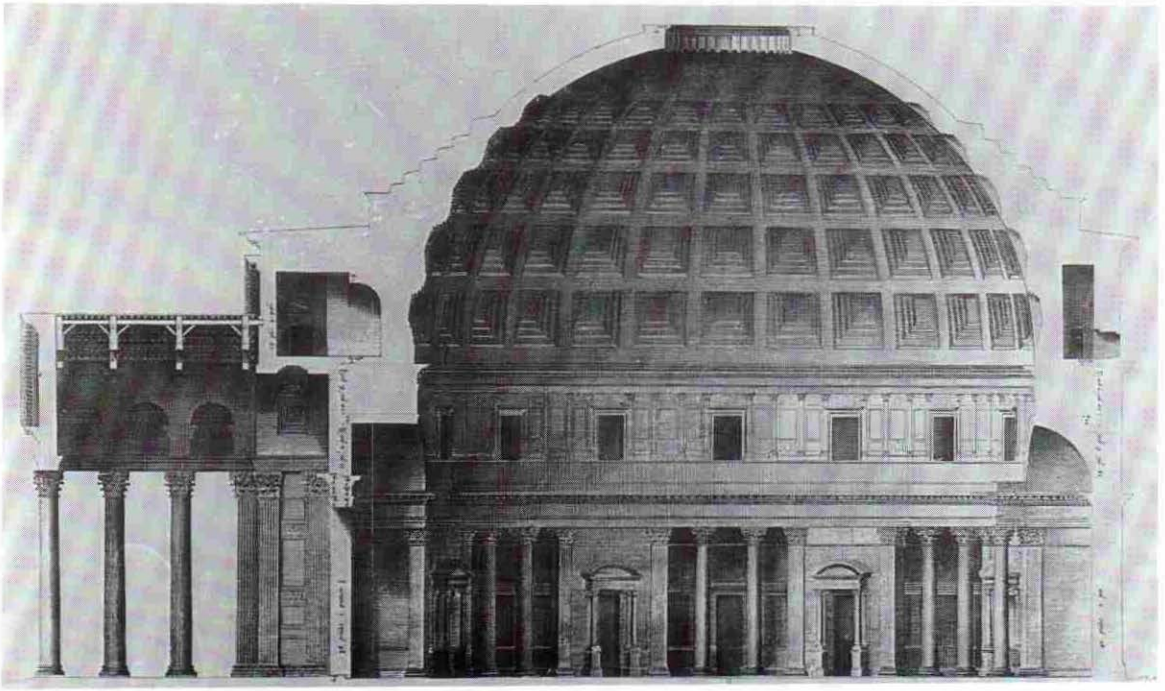
5. Pantheon façade (after Durm)



6. Junction at east between transitional block and rotunda



7. *Anta* pilaster



8. Pantheon section (after Desgodetz)

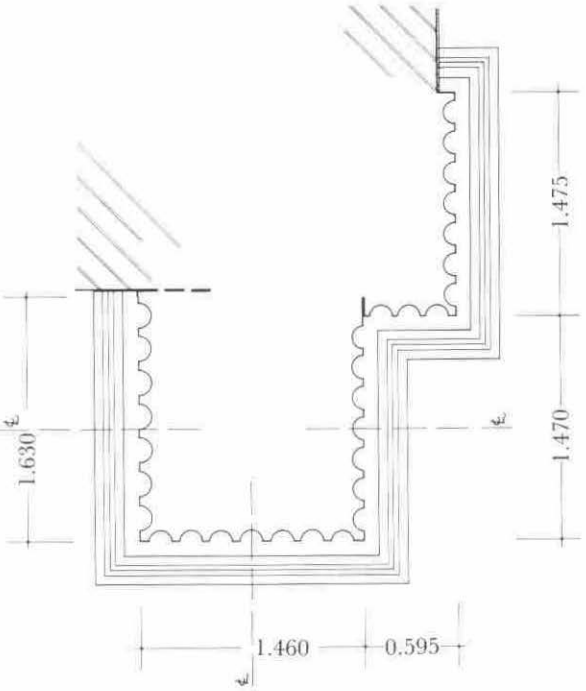


Figure 1 *Anta* left of portal: plan detail (1:50)

transitional block are oddly unbalanced in shape (fig. 1). The sides facing the pronaos niches are more than half a foot wider than the other two which, as is normal, match the 5 ft diameter of the portico columns.[17] By contrast, the capitals of all three faces are the same size, with the result that the capital of the wider pilaster is placed asymmetrically above its shaft, leaving a redundant strip of uncarved marble between it and the wall (plate 7).

7 The central aisle of the portico becomes narrower where it enters the transitional block (fig. 2). As a consequence, the barrel-vaulted ceiling once suspended over the portico's central aisle would have been a little wider and higher than the masonry barrel-vault over the passageway beyond.[18]

8 The brickwork of the transitional block is only bonded with the rotunda in the lower levels of the building. In the upper parts, the transitional block merely runs up against the rotunda (plate 6).[19]

While it can no longer be argued that such peculiarities are the outcome of different building campaigns, given the unity and consistency normally associated with monumental Roman architecture, some explanation is still wanting. The explanation we suggest is that there may have been an abrupt change in design, perhaps during the construction of the building. In particular we propose that the portico as it stands, with a height of around 59 ft for the order and 48 ft for the columns, is not as tall as it was first intended to be.[20] Ideally, it would have reached the level of the present upper pediment and the middle cornice of the rotunda, with a height of around 74 ft

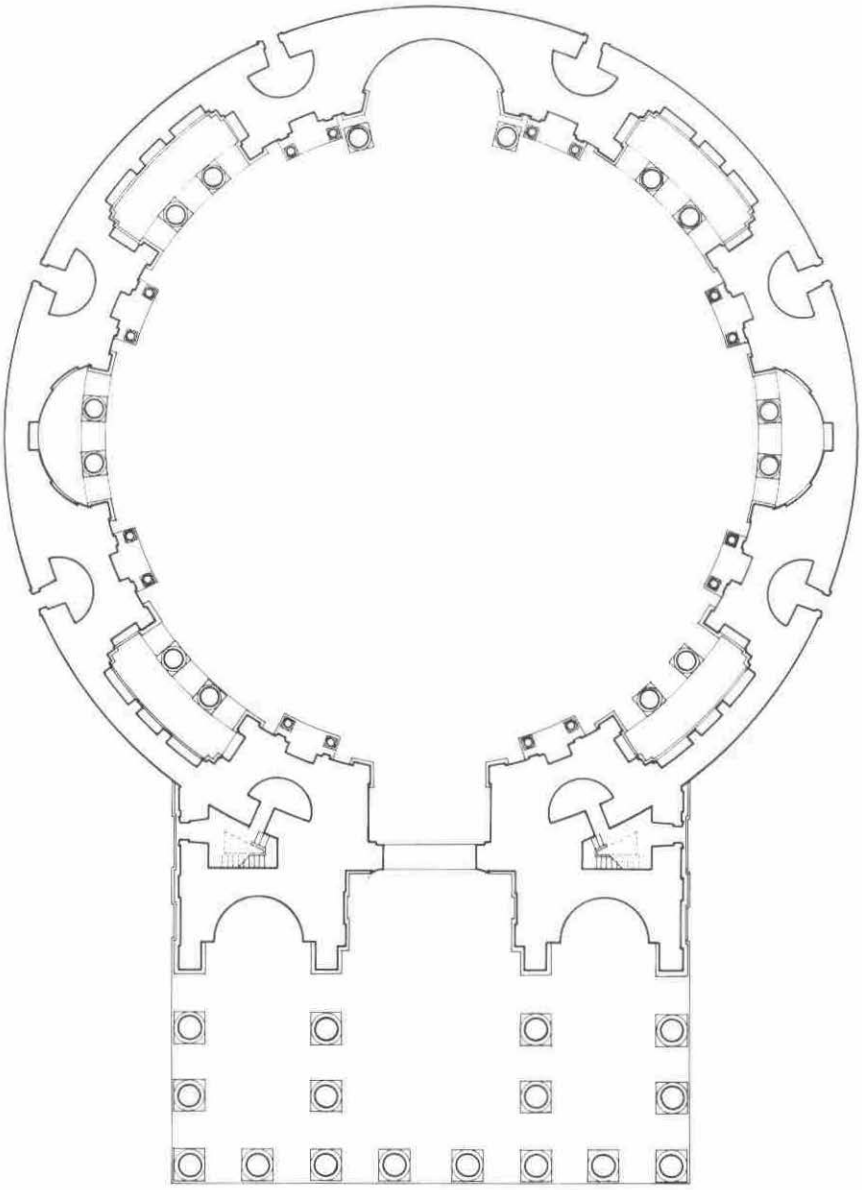


Figure 2 Pantheon as built: plan (1:500)

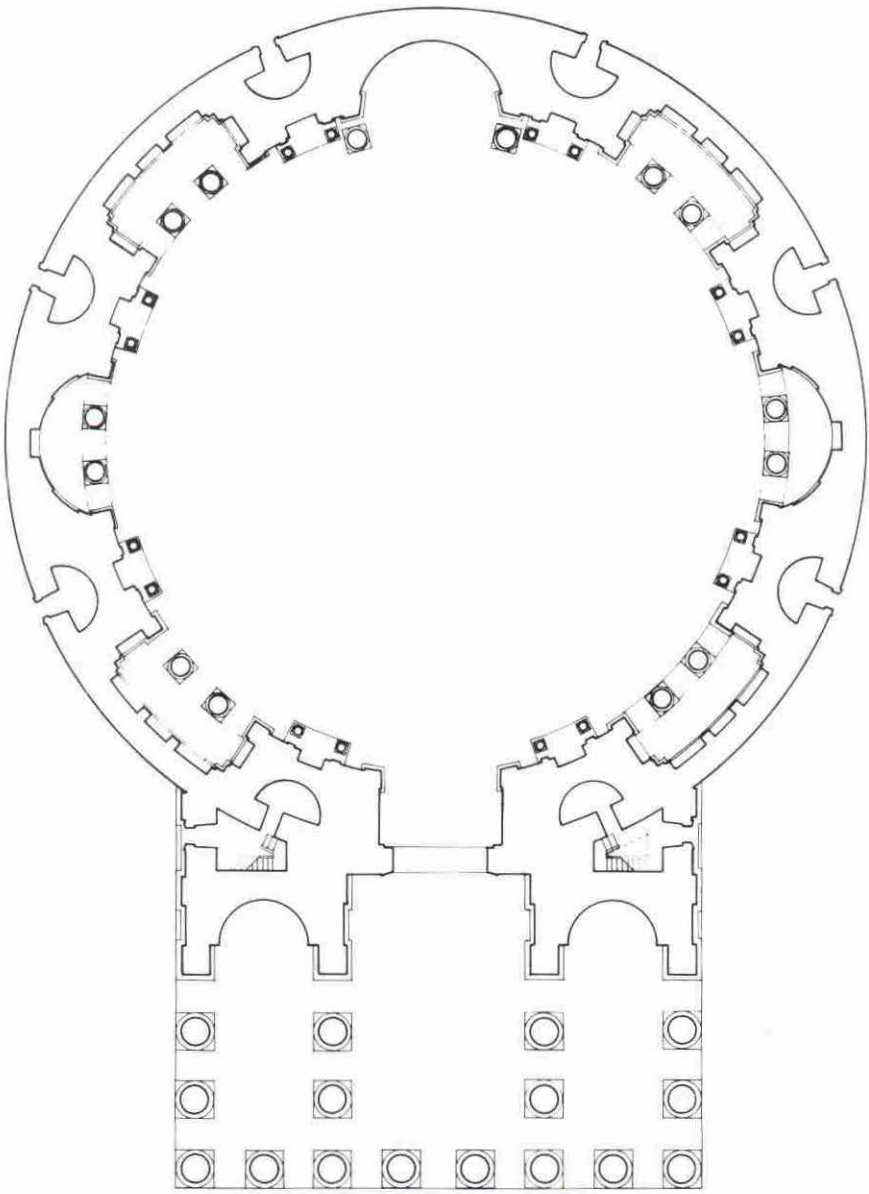


Figure 3 Pantheon as intended: plan (1:500)

for the whole order and 60 ft for the columns (compare figs 4 and 5).[21] The plan of the building would be very nearly the same as at present, with taller columns of the same proportions (and hence of larger diameter) standing in the same positions, and on the same foundations (compare figs 2 and 3). The main difference between the original project and the one which was executed would have been the successful integration of the taller portico with the rest of the building.

The various difficulties that have been itemized can be seen as being the consequences of reducing the height of the portico and of the readjustments to the design that became necessary. In the intended project:

1 The pediment of the taller portico would be at the same level as the present pediment of the transitional block, so that the second pediment would not exist at all.[22] Once the portico had been lowered, the vestigial secondary pediment was then required to link the now interrupted ends of the mid-cornice of the rotunda.

2 The middle cornice of the rotunda would be continuous with the cornice of the taller portico. The lower cornice of the rotunda, which lacks modillions and is different in profile from the two above, could continue along the flanks of the transitional block as a string course without being too near the level of the capitals.[23]

3 The portico pediment would be less tall in relation to columns of greater height, and the proportions of the whole façade therefore less squat and more comparable with those of other contemporary porticoes.[24]

4 The size and the spacing of the modillions in the larger cornice of a taller order would be greater, so their arrangement could then match that of the two upper cornices of the transitional block and rotunda.[25]

5 The columns of a taller portico would be larger in diameter, and so would stand more closely together to produce the widely employed 'pycnostyle', or closely grouped, spacing. Larger columns of the same proportions would measure 6¼ ft in diameter, and produce intercolumniations of 9 ft (15¼ minus 6¼ ft).[26] The ratio 6¼:9 is not only consistent with the usual pycnostyle rhythm of around 1:1½, but the column spacing of 15¼ ft also seems better suited to a column diameter of 6¼ ft, since the intercolumniations now become whole numbers of feet.[27]

6 The *antae* would not have the peculiarities of the existing ones, which can be understood as a consequence of reducing the column diameter from 6¼ ft to 5 ft. If an *anta* 5 ft square was substituted for one centred in exactly the same position measuring 6¼ ft, there would be a gap between the *anta* and the wall behind of ⅝ ft (half of 1¼ ft). This would explain both the curious extra width given to the pilasters facing towards the niches, and the misalignment of their capitals, which were not widened in order to avoid a conspicuous discrepancy with the other capitals of the portico.[28]

7 The narrowing of the central aisle as it passes into the transitional block, together with the lowering of the vault, can also be related to a reduction in the column diameter. With a taller portico, lines of evenly spaced columns and pilasters could have continued all the way from the portico façade to the entrance of the rotunda, with only one pilaster beyond each of the two

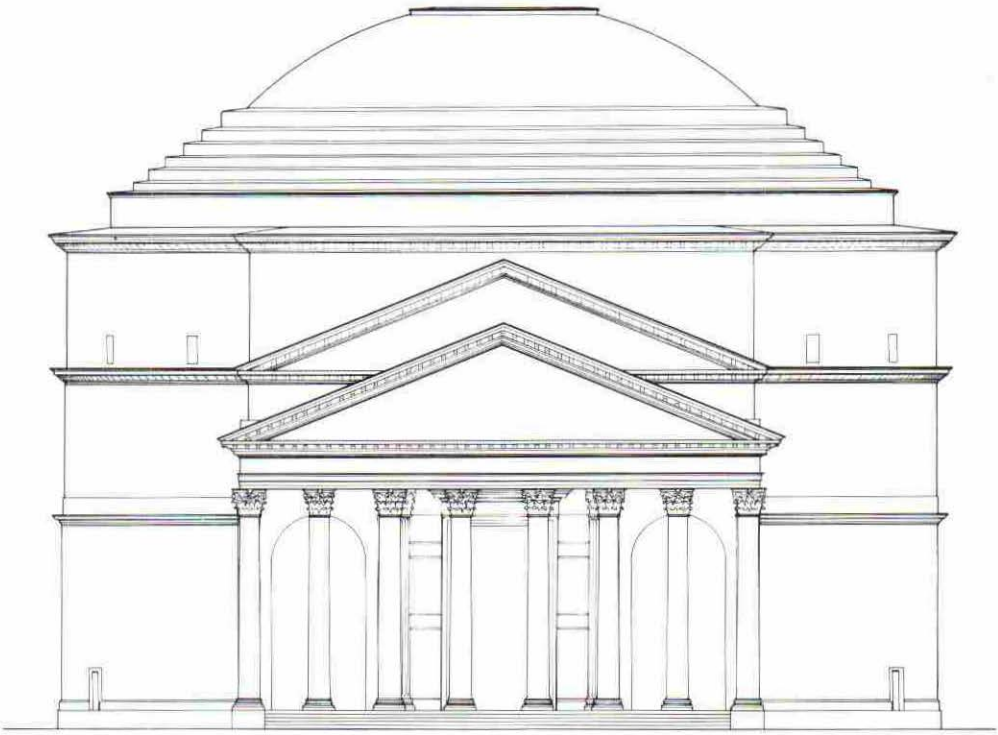


Figure 4 Pantheon as built: façade elevation (1:500)

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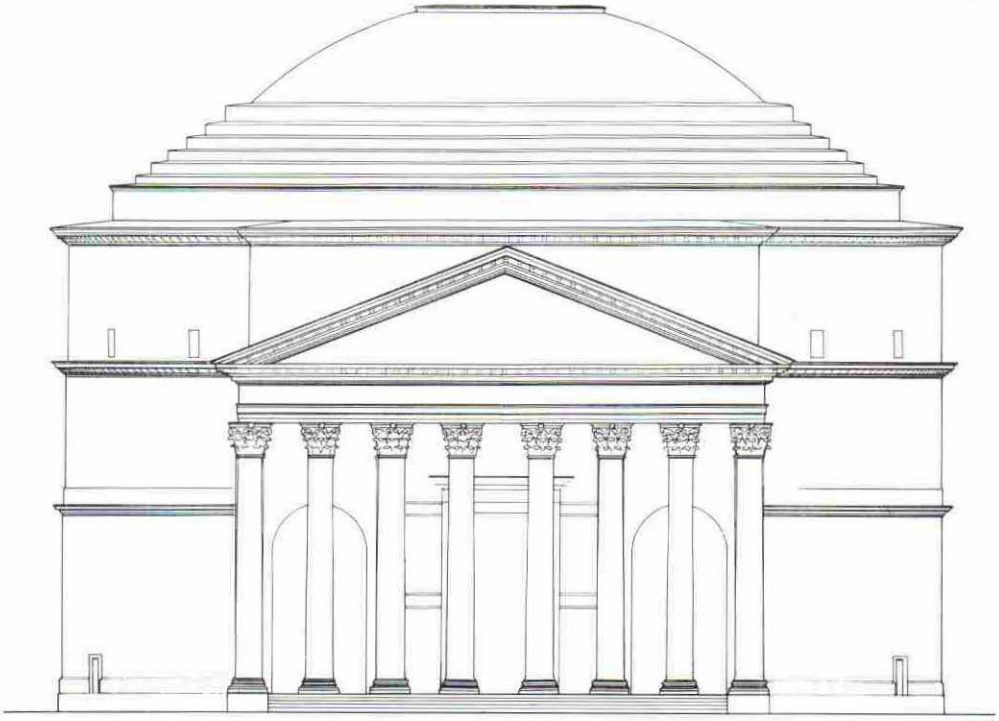

Figure 5 Pantheon as intended: façade elevation (1:500)

MWJ

innermost *antae* (fig. 3).[29] The tightly grouped arrangement of the existing passageway pilasters disrupts this regular rhythm but avoids other problems resulting from the change in design. The coupling of additional pilasters with the *antae* allows their inner faces to be kept to 5 ft in width, and also prevents the final intercolumniation from being too long.

8 The discontinuation of the bonding between the transitional block and rotunda could represent the actual moment when it was decided to change course. It may well have then seemed prudent to proceed with the rotunda alone, while awaiting the detailed finalization of the new design and its effect on the transitional block.

Although the columnar system of the original project can be readily visualized, much less clear are the initial intentions for the masonry fabric of the transitional block, which must have been extensively tailored to the revised design. This is clear from the entrance passage where the barrel-vault springs from directly above the present, i.e. lowered, pilaster order. Above this level, where there is now a row of chambers (plate 8), changes could have been even more radical because construction would not have commenced here before the new project was underway. In the original scheme there are two possibilities for the upper part of the transitional block. In one, the gabled roof of the portico would terminate at a transitional block the same shape and size as the present one (compare figs 6 and 7).[30] In the other, the portico and the transitional block would be covered by one and the same gabled roof, which would meet the rotunda directly (fig. 8).[31] On lowering the portico, the transitional block may only have been built up and given a flat roof to avoid the disastrous appearance of two gabled roofs stacked one behind the other (and this would provide an additional explanation for the hiatus in the brickwork bonding).[32] In either alternative there would have been little if any of the heavy brick and concrete superstructure above the entrance passage, in which case the masonry vault and the additional brickwork where the passage narrows need not have existed.[33]

Whatever its precise arrangement in the original scheme, the transitional block would have in effect been an integral part of the much larger portico. Viewed from the Pantheon's forecourt, this lofty portico would conceal any glimpse of the rotunda, and so enhance even further the dramatic power of entering the great domed interior after passing through the more traditional trabeated structure in front.[34] In its proportions, the portico would be more akin to other monumental porticoes of the period and would be of an appropriate scale for the enormous rotunda. The portico and rotunda being coherently united, the original design would have produced a simple and well-ordered building in both its plan and its elevation and section.

The proportions and dimensions of the building would also be coherently related in numerical terms, as they so often are in Roman architecture.[35] It seems that the plan of the building is governed by a simple geometric figure composed from two squares of equal size and sharing a common side, with one of these inscribed within a circle 150 ft (100 cubits) in diameter (fig. 9).[36] The circle passes through the centres of the perimeter columns inside the rotunda, while the sides of the projecting square pass through the centres of the

perimeter columns of the portico.[37] The width of the portico actually measures around 108 ft rather than 106 ft (150 ft ÷ $\sqrt{2}$), presumably so as to achieve the pycnostyle rhythm, standard intercolumniations of whole numbers of feet (9 ft), and a central intercolumniation one foot wider (10 ft).[38]

There would also be simple proportional relationships in cross-section (fig. 9). As has been well understood, the clear diameter of the hall from wall to wall (about 147 ft) is equivalent to the clear height of the dome.[39] The upper cornice inside runs at almost exactly half this height, 74¼ ft above the paving, a level which corresponds with the mid-cornice outside.[40] On the other hand, the vertical dimensions of the present portico – 40 ft for the shaft height, 48 ft for the columns, 59 ft or so to the cornice, and 84 ft to the apex of the pediment – do not together relate in any notable way to the principal dimensions of the rotunda.[41] However, the corresponding heights for the proposed portico would be 50 ft for the shaft, 60 ft for the column, 74¼ ft to the level of the cornice, and about 100 ft to the high point of the pediment.[42] Here, 50 ft, 60 ft and 100 ft are related harmoniously both to one another and to the crucial 150 ft rotunda diameter. Rather than the numerically preferable 75 ft, the slightly lower 74¼ ft dimension tallies with the internal height of the drum and has the advantage of allowing an entablature to column proportion of 1:4¼, a ratio widely preferred to 1:4 which was perhaps thought to appear over-heavy.[43]

Quite apart from the aesthetic and proportional suitability of the larger columns, a 60 ft column height appears to have been considered particularly appropriate for a monumental Corinthian order. Ever since the early Imperial period, Corinthian columns had tended to be made in a comparatively limited number of standard sizes. These suit the one proportional rule consistently applied to this order – that the height of the shaft should be 5/6 that of the whole column.[44] By far the most common heights are multiples of 6 or 12 feet for the complete column (24 ft, 30 ft, 36 ft, 48 ft or 60 ft), with multiples of 5 or 10 feet for its shaft (20 ft, 25 ft, 30 ft, 40 ft or 50 ft), and standardization is most consistent in columns with monolithic shafts. The actual columns of the Pantheon's portico are 48 ft tall, the second largest of these standard sizes, in common with those of, for example, the Temple of Vespasian, that of Antoninus and Faustina, or the Baths of Diocletian.[45] 60 ft was the largest of these sizes, and columns this height were used in only the most select of buildings, such as the Temples of Mars Ultor, of Trajan, and of Venus and Rome.[46] With the special satisfaction that the heights of both the shaft and the column are multiples of 10 ft, the exemplary size for the Corinthian order was 60 ft. This colossal dimension might very occasionally be exceeded, but only in the case of columns made up from drums, never in those with monolithic shafts.[47]

It is most significant that the first building to have a portico supported on 60 ft columns with monolithic shafts may well have been the massive temple built by Hadrian to his adoptive father, Divine Trajan, which was under construction at about the same time as the Pantheon.[48] Besides their common date and patronage these buildings both had octostyle porticoes (probably of the same width) incorporating monolithic column shafts of Egyptian granite.[49] If, as is proposed here, the Pantheon was also to have had 60 ft columns with

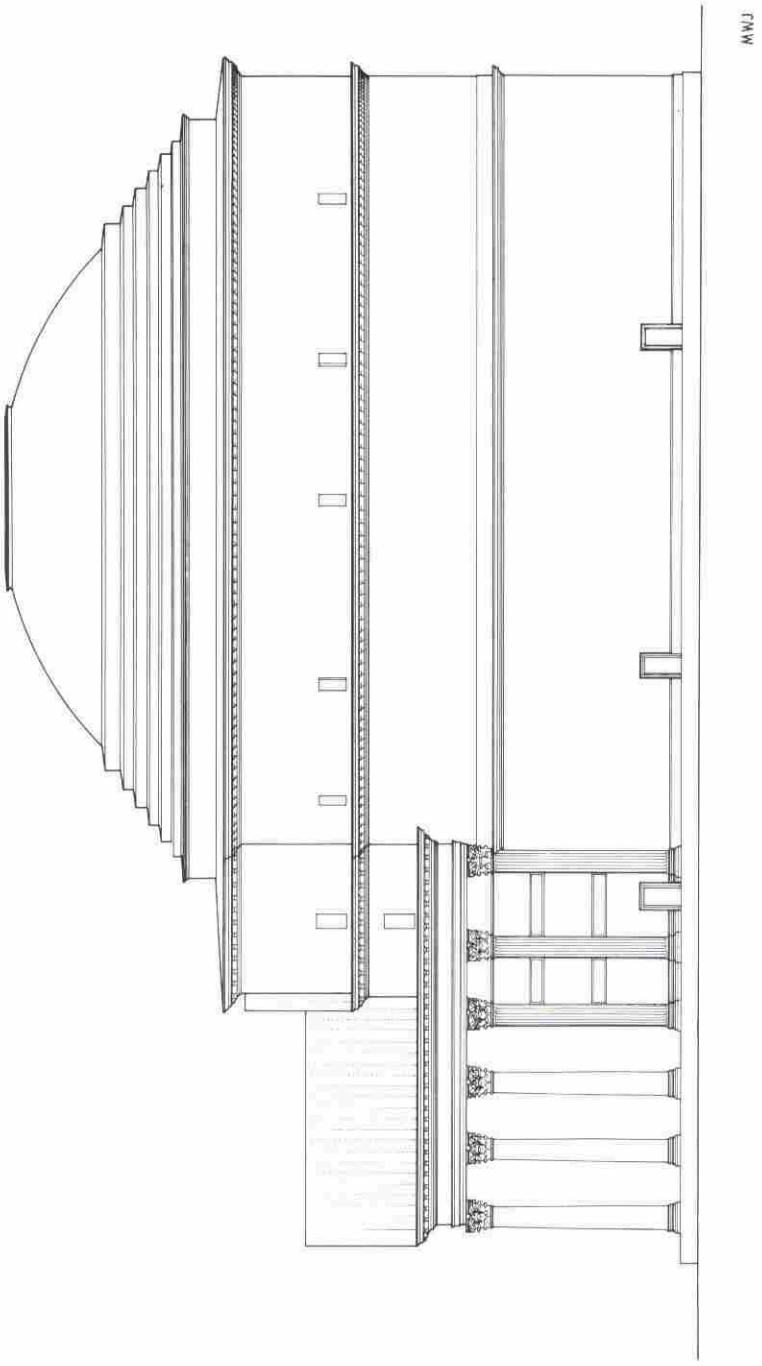

Figure 6 Pantheon as built: side elevation (1:500)

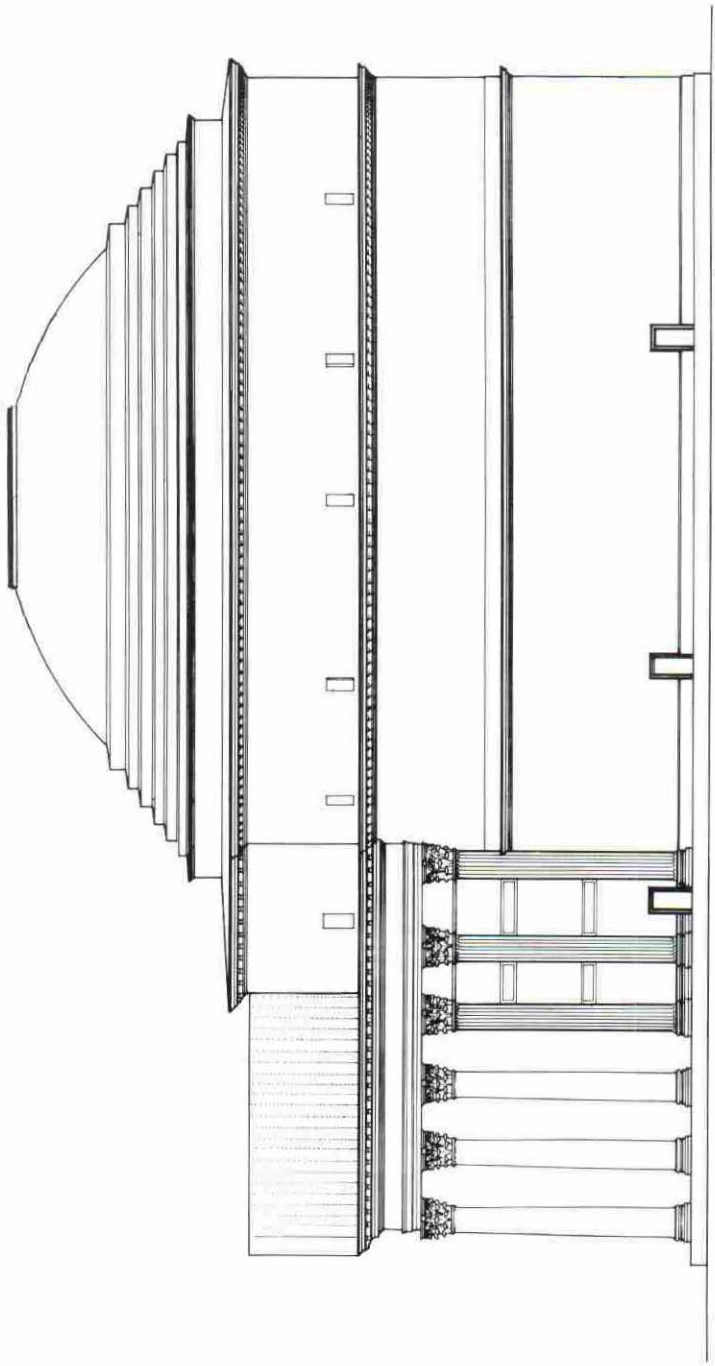

Figure 7 Pantheon as intended: side elevation, first possibility (1:500)

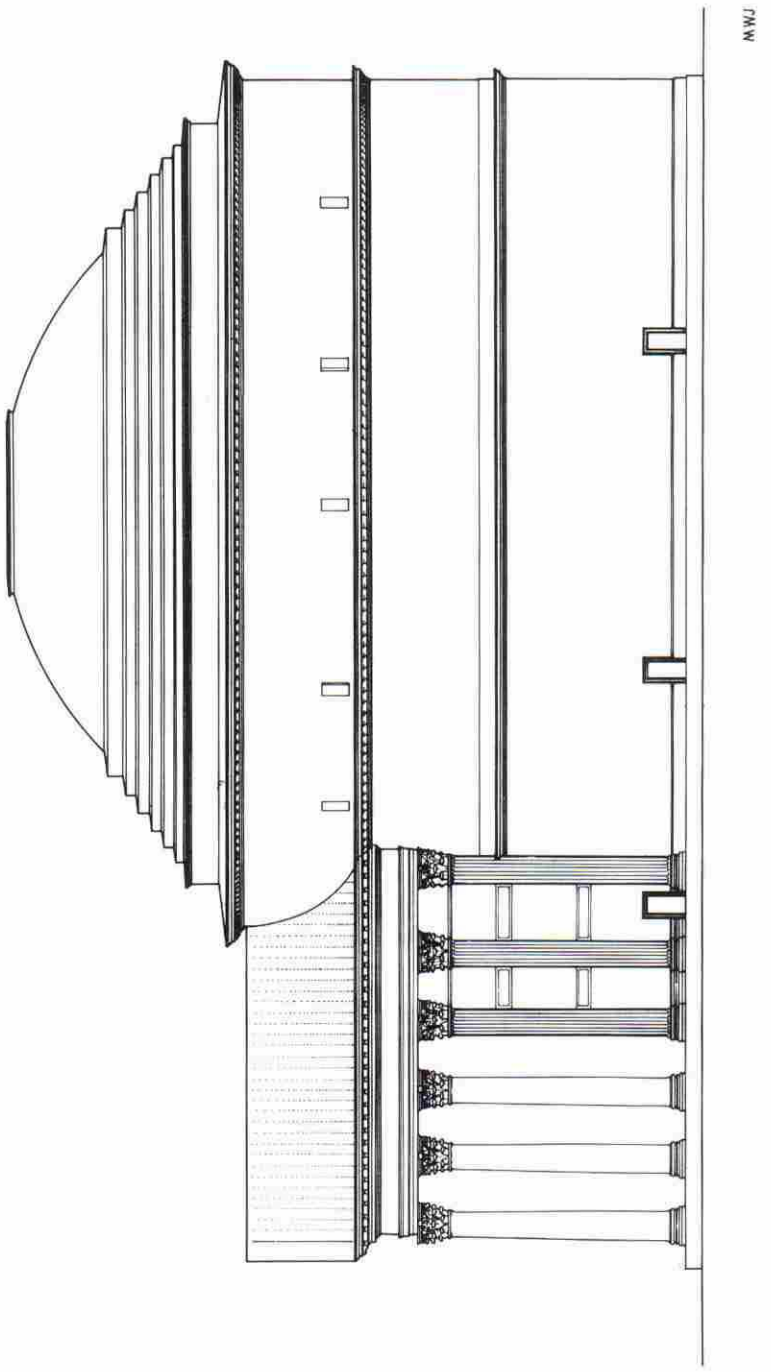

Figure 8 Pantheon as intended: side elevation, second possibility (1:500)

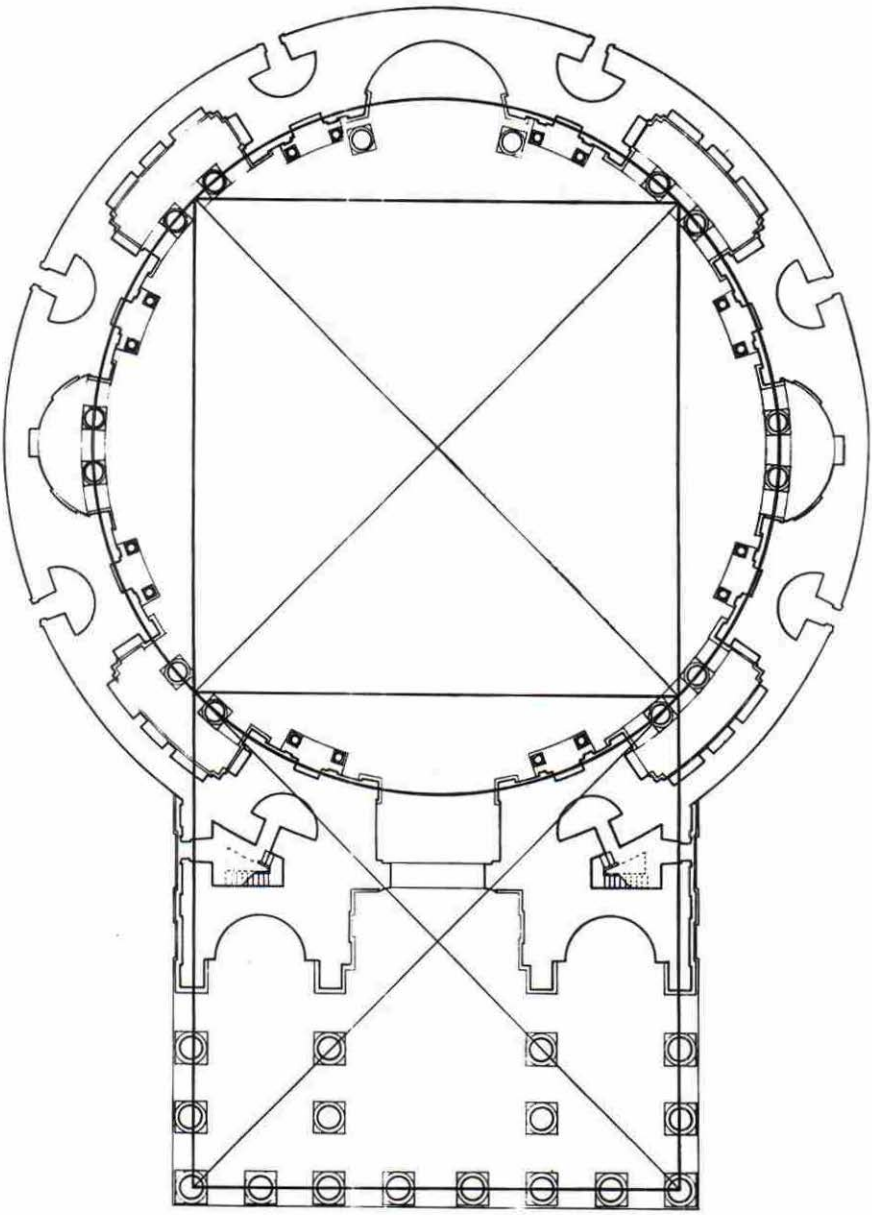

Figure 9 Pantheon: geometric arrangement (1:500)

monolithic shafts, it too would have been at the forefront of developments in this field.

In this context it is not difficult to imagine circumstances which may have brought about a reduction in column size. The critical factor may have concerned the availability of the gigantic 50 ft granite monoliths weighing about 100 tons (almost double the weight of 40 ft shafts), since their quarrying and transport must have been a daunting undertaking.[50] A papyrus of AD 118 mentions difficulties and delays in the transportation of one such monolith, and it may not be idle to speculate that this was intended for either the Temple of Trajan or the Pantheon.[51] If the speed of production was far slower than anticipated (or if, for instance, a large consignment of shafts were lost at sea), then it may not have been possible for both of these buildings to be completed on programme. In this situation, construction of only one of these buildings may have continued according to schedule, while for the other the least disruptive courses of action would have been either to cease work until the granite shafts eventually arrived or to use shafts (of the correct height) made up of drums, but even this would have entailed lengthy delays since the appropriate marble may not have been readily available.[52] In the event, the recourse to using 40 ft monoliths which could have been immediately available from stockpiles or by being diverted from other building operations would have been a more drastic solution reducing the scale of the whole portico.[53]

The reduction in column height would have had a less dramatic effect on the Pantheon, with its attached portico, than on the Temple of Trajan, where the height of the whole building was determined by its columns (some of which may have already been in place). Furthermore, if a choice between the buildings was forced by a serious shortage in the supply of 50 ft monoliths, Hadrian may have seen political advantages in dutifully consigning all of them to the temple of his own father, the great *triumphator* Trajan, while allocating smaller shafts of granite (thereby retaining their Imperial associations) to the Pantheon, a building which he – emperor but not deity – would use as an assembly hall.[54] Whatever his motives for accepting a compromised Pantheon, Hadrian may also have appreciated the associated savings in time (and expenditure), which could have allowed him to enjoy the use of the rotunda's magnificent interior years earlier than might otherwise have been possible.[55]

To discontinue the original project for the Pantheon and to change to a modified design can have been no light matter. It is thus a testimony to the resilience of the original conception that it suffered such a significant revision and still produced so successful an outcome. With hindsight, however, part of the Pantheon's ultimate success must surely depend on its unconventional and enigmatic appearance, allowing the monument to be more easily assimilated into a romantic vision of Antiquity. Yet had the Pantheon been built faithfully to the original project, there would have emerged a less intriguing building but a still greater masterpiece of even surpassing grandeur.

Paul Davies

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Mark Wilson Jones

ACKNOWLEDGMENTS

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NOTES

Dimensions are expressed in terms of the Roman foot, for which a reasonable approximation is 0.296 m. There is no ascertainable fixed value for this unit, and it may be that the length actually used in the construction of the Pantheon was, say, 0.2955 m (in which case the dimensions we cite will be slightly too small). We have sometimes provided our own measurements, but in other cases we rely on the authoritative A. Desgodetz, *Les Edifices antiques de Rome*, 1697 ed., and on E. Cresy and G. L. Taylor, *The Architectural Antiquities of Rome*, 1821, where the vertical dimensions are especially dependable (see n. 20).

1 See T. Buddensieg, 'Criticism and Praise of the Pantheon in the Middle Ages and the Renaissance', in *Classical Influences on European Culture AD 500–1500*, ed. R. R. Bolgar, 1971, 259–67, for a discussion of early attitudes towards the Pantheon.

2 S. Serlio, *Tutte l'Opere d'Architettura, et Prospetiva*, 1619, bk III (1st ed., 1540), f. 50r: 'il più bello, il più integro, & il meglio inteso [edificio], & è tanto più maraviglioso de gli altri, quanto che havendo egli molti membri: cosi ben tutti corrispondono al corpo, che qualcunque persona vedendo tal corrispondentia ne riman satisfatto'. A precedent for Serlio's illustration (f. 51v) is provided by the woodcut in J. Mazochius, *Epigrammata Antiquae Urbis*, 1521, f. 6v, where similar alterations are made to the façade. Serlio treated the interior in a similar manner (ill: f. 52r and 54v), rearranging the pilasters of the upper storey so as to align with the order below (compare Francesco di Giorgio's earlier drawing, Cod. Sal., f. 80r, discussed by Buddensieg, as n. 1, 263–6). Adjustments of this sort are made by Antonio da Sangallo the Younger (UA 874; see Buddensieg, ibid.; in the same drawing Antonio modified the transitional block, lining up the pilasters leading to the rotunda's portal with the portico columns). Serlio (f. 52v) specifically criticized the interior by suggesting that the arch over the end exedra was only installed after the Pantheon had been converted into a church.

3 Michelangelo's theory is recorded in G. Vasari, *Le Vite de' più Eccellenti Pittori, Scultori ed Architettori*, ed. G. Milanesi, 1878–85, IV, 511–12 (Life of Andrea Sansovino). According to him, there were three architects: the first designed the lower storey inside the rotunda, the second designed the upper storey, while the portico was the work of the third. A seventeenth-century source (Bibl. Vat., Cod. Barb. lat. 4309, f. 11v, see Buddensieg, as n. 1, 265, n. 2) records Michelangelo's comment that the lower storey of the interior (alone) was a '*disegno angelico*' (unlike Aretino who said in a letter of 1537 that the whole building was divinely conceived, see *Lettere sull' Arte di Pietro Aretino*, ed. E. Camesasca, I, 1957, 49–50). Palladio's opinion about the Pantheon's dating appears in his *I Quattro Libri dell' Architettura*, 1570, IV, 73. The same idea was previously put forward by A. Fulvio, *Antiquitates Urbis*, 1527, f. 93v, and Peruzzi also believed the portico to be a later addition, see H. Burns, 'A Peruzzi drawing in Ferrara', *Mitteilungen des Kunsthistorischen Institutes in Florenz*, XII, 1966, 249. In one of his drawings Palladio adjusted the design of the façade so that the architrave of the portico aligned with the lower cornice of the rotunda (RIBA, VIII, f. 9r; see G. G. Zorzi, *I Disegni delle Antichità di Andrea Palladio*, 1959, ill. 165). Palladio disagreed with Serlio about the arch over the end exedra of the interior (n. 2), believing it to form part of the original project.

4 A. Desgodetz, *Les Edifices antiques de Rome*, 1. The first inscription reads: M AGRIPPA L F COS TERTIVM FECIT; the second: IMP CAES L SEPTIMIVS SEVERVS . . . ET IMP CAES M AVRELIVS ANTONINVS . . . PANTHEVM VETVSTATE CORRVPTVM CVM OMNI CVLTV RESTITVERVNT.

5 C. Fontana, *Il Tempio Vaticano e sua Origine*, 1694, VII, 451–74; ill. p. 457. Fontana also depicted how he supposed the interior of the Republican rotunda would have appeared, how it had been first transformed by Agrippa, and how it was subsequently altered (pp. 457, 467). M. F. Blondel, *Cours d'Architecture*, 1698 ed., 160, had also concluded that the upper storey which still existed in his day was not the original (Agrippan) one, and vehemently condemned its design; in 1747 it was stripped away by Paolo Posi and replaced by the present upper level. A part of the former arrangement was restored by Alberto Terenzio in the 1930s.

6 F. Milizia, *Roma delle Belle Arti del Disegno; Parte Prima: Dell' Architettura Civile*, 1787, 47–8; he also lists several 'defects' still apparent in the interior, 54–5. See also F. Milizia, *Dell' Arte di Vedere nelle Belle Arti di Disegno*, 1792 ed., 143–7; also published in *Scelta di Operette*, 1826, 148–50. Other scholars at this time began to argue (as had Inigo Jones much earlier, see *Inigo Jones on Palladio*, ed. B. Allsopp, 1970, I, 56), that the whole building belonged to one single campaign (of Agrippa), see especially L. Hirt, *Osservazioni Istorico-Architettoniche sopra il Panteon*, 1791 (although he still supposed the interior to have been remodelled afterwards, and reconstructed how he imagined it appeared originally, ill. 5), and also C. Fea, *L'Integrità del Pantheon rivendicata a Marco Agrippa*, 1820.

7 L. Beltrami, *Il Pantheon*, 1898, 41–6. Beltrami later expressed the view that the whole of the Pantheon was Hadrianic, see *Il Pantheon Rivendicato ad Adriano*, 1929. Nevertheless, the notion that the portico is a later addition has still persisted, see e.g. G. Lugli, *Itinerario di Roma Antica*, 1970, 439–40, where the portico is suggested to have been added by Antoninus Pius.

8 J. Durm, *Die Baukunst der Etrusker; Die Baukunst der Römer (Handbuch der Architektur II. 2)*, ed. 1905, 557, ill. 631. Durm also reproduces various reconstructions (ills 644, 647 and 648) of the rotunda interior before he supposed it to have been transformed under Septimius Severus.

9 R. Lanciani, *The Ruins and Excavations of Ancient Rome*, 1897, 483; G. Cozzo, *Ingegneria Romana*, 1928, 255–97.

10 See K. de Fine Licht, *The Rotunda in Rome*, 1968, 186–90, 247–8, 285–91 (n.22–48), 316 (n. 51, 52), for discussion of the contributions to the dating of the Pantheon made by Chédanne, Guey, Bloch and others.

11 J. B. Ward-Perkins, *Roman Imperial Architecture*, 1981 (2nd ed.), 111–12; W. L. MacDonald, *The Architecture of the Roman Empire*, I, 1982 (2nd ed.), 112; and *The Pantheon*, 1976, 14, 67–8.

12 See R. Vighi, *The Pantheon*, 1957 (English ed., tr. J. B. Ward-Perkins), 11–12. Vighi develops the similar ideas expressed previously by G. T. Rivoira, *Architettura Romana*, 1921, 149–50.

13 MacDonald, *The Architecture of the Roman Empire*, 112–14, and *The Pantheon*, 62–70. Although he praises the existing composition, in his reconstruction the portico is significantly increased in size relative to the rotunda, *The Architecture of the Roman Empire*, ill. 8, *The Pantheon*, ill. 16; de Fine Licht, *The Rotunda in Rome*, 188.

14 The slopes of the pediment, around 23°, is steep but perhaps not exceptional, see de Fine Licht, *The Rotunda in Rome*, 44, and A. M. Collini, 'Indagini sui Frontoni dei Templi di Roma, I', *Bullettino della Commissione Archeologica Comunale di Roma*, LI, 1924, 299–347, especially the table on p. 324. However, there is no parallel for the ratio between the height of the pediment (Cresy and Taylor: 7.73 m = 26.13 ft) and that of the order (Cresy and Taylor: 17.50 m = 59.11 ft), of around 1:2¼. Façades of similar scale include the hexastyle Portico of Octavia which has an equivalent ratio of around 1:3½ (Desgodetz, 165), and the hexastyle Temple of Saturn with one around 1:3 (Desgodetz, 121). The octostyle Temple of Mars Ultor had a ratio of just below 1:4 (see V. Kockel, 'Beobachtungen zum Tempel des Mars Ultor und zum Forum des Augustus', *Mitteilungen des Deutschen Archaeologischen Instituts; Roemische Abteilung*, XC, 1983, 421–48, especially p. 428 and figs 8 and 15). Other examples include the hexastyle Temple of Minerva at Assisi, with a ratio (excluding the pedestals) of just over 1:4 (see U. Tarchi, 'Relievi e ricostruzioni di Monumenti Romani dell' Umbria', *Bullettino della Commissione Archeologica Comunale di Roma*, LXIX.2, 1941, 35–46, illustrated as fig. 3), and the Maison Carrée at Nîmes, with a ratio of nearly 1:4½ (see R. Amy and P. Gros, *La Maison Carrée de Nîmes*, 1979, I, 85–98 and 100).

15 The portico pediment would have 47 modillions if the missing right hand corner were restored. On the front of the transitional block, in both the pediment and the (restored) crowning cornice, there are 41 modillions.

16 The average diameter of the columns, excluding those at the corners (the one on the left is not original, and the other is slightly wider as was the custom), is 5 ft (Desgodetz: 1.479 m, =5.00 ft; Cresy and Taylor: 1.494m, =5.05 ft). Discounting the wider central spacing, the intercolumniations measure on average 10¼ ft (Desgodetz: 3.032m, =10.24 ft; Cresy and Taylor: 3.020m, =10.20 ft), equivalent to a little over 2 diameters. Comparable porticoes usually have columns spaced much closer together, with intercolumniations of 1½ diameters or thereabouts – the arrangement known as pycnostyle. Imperial buildings with pycnostyle column spacings include the temples of Mars Ultor, of Castor, of Vespasian, and of Antoninus and Faustina (Desgodetz, 139, 127, 137, and 111); see also M. Wilson Jones, as n. 44; a rare exception is the peripteral Temple of Venus and Rome with intercolumniations twice the column diameter (see A. Barattolo, 'Il Tempio di Venere e di Roma: Un Tempio "Greco" nell' Urbe', *Mitteilungen des Deutschen Archaeologischen Instituts; Roemische Abteilung*, LXXXV, 1978, 397–410).

17 The dimensions given in fig. 1 are averages taken from the four *antae*. On the sides flanking the entrance way the extra width is avoided by adding coupled pilaster-faced pillars; on the sides running along the exterior elevation, however, a discrepancy of over half a foot between the edge of the pilaster and that of the marble blocks from which it is carved is clearly visible.

18 For the barrel-vaulted ceiling, see de Fine Licht, *The Rotunda in Rome*, 54–8.

19 For discussion of the bonding at this juncture, ibid., 85–8.

20 The height of the middle cornice is given by Desgodetz as 22.05m (=74.48 ft), and by Cresy and Taylor as 21.89m (=73.97 ft). This level corresponds with that of the upper cornice inside, which we measure at 22.03m (=74.43 ft). For the portico, Cresy and Taylor give the column height as 14.15m (=47.81 ft), a figure which corresponds well with the precise dimension taken by G. P. Stevens ('Entasis of Roman columns', *Memoirs of the American Academy in Rome*, IV, 1924, 121–52) of 14.14m (=47.75 ft).

21 According to Cresy and Taylor the height of the existing order is 59.10 ft tall, comprising 47.81 ft for the column and 11.29 ft for entablature. If an order 74 ft tall had the same proportions it would have columns 59.85 ft tall supporting an entablature 14.15 ft tall.

22 See also n. 30 and 31.

23 The height of the lowest cornice also corresponds with the heights of the pronaos niches and the door frame (see n. 40). The upper relief panels on the flanks of the transitional block and in the entrance passageway could have also been aligned at this height.

24 With taller columns, the relative height of the pediment would approach a proportion of 1:3, and thus be comparable with that of other porticoes, see n. 14. Although the apex of the present transitional block pediment does not quite reach the underside of the top cornice (see n. 40), that of a portico pediment of the same pitch at this level would do so: with a greater projection of its cornice, it would be slightly wider and therefore slightly taller (fig. 5). Its height would be about 100 feet above the portico pavement (74 ft for the order + 26 ft for the pediment).

25 The decrease in the number of modillions (see n.15) from 47 to 41 is broadly in proportion with the increase in the size of the order. The 47 modillions of the present portico are more frequently spaced than is usual, 6½ per bay, whereas the 41 modillions would have a rhythm of 5½ per bay; this is greater than that in early Imperial temples, e.g. Mars Ultor (4 per bay), but close to that of such buildings as the Temple of Vespasian (5½ per bay), or the Temple of Hadrian (5 per bay), see Wilson Jones, as in n. 44, fig. 1.

26 Like the vast majority of Corinthian columns with monolithic shafts, the existing 5 ft columns have a diameter one eighth the shaft height (Cresy and Taylor: 11.80m, =39.87 ft); see Wilson Jones, as n. 44. The 50 ft shaft of a 60 ft column would measure 6¼ ft in diameter, as do other examples of monolithic shafts this size, for instance, the Column of Antoninus Pius (see Ward-Perkins, as n. 49) or those from the Baths of Trajan (see Amici, as n. 48).

27 Vitruvius, III, 3, 2, gives the ideal pycnostyle ratio as 1:1½, but P. Gros, *Aurea Templa*, 1976, 105–6, has shown that in practice this could be a little wider or tighter; see also Wilson Jones, as n. 44. In buildings of great size these narrow intercolumniations do not inhibit the ease of passage between the shafts. A building of the same scale, with 60 ft columns and with a column spacing of under 1:1½ is the octostyle Temple of 'Bacchus' at Baalbek (see R. Wood, *The Ruins of Balbek*, 1757, pl. 23).

28 If the columns were wider, the pilaster faces could project further from the revetted flanks of the transitional block, perhaps by as much as a foot to correspond with the width of a flute; a projection of this amount would be one sixth the pilaster width, a proportion commonly used, as for example in the Temple of Serapis, the Portico of Octavia, the Arch of the Goldsmiths or the top storey of the Colosseum (Desgodetz, 151, 173, 219, 275). There is a slight breaking forward of the entablature where the portico meets the transitional block (now very eroded), see e.g. Desgodetz, pl. 2 and 4, and Blondel, *Cours d'Architecture*, ill.: I.2, 154) which could have been avoided if the column shafts were wider. The outer faces of the plinths of the perimeter columns and pilasters could be brought into line with the edge of the platform's top step, see our figs 2 and 3.

29 Antonio da Sangallo the Younger had considered this alignment to be preferable, see n. 2.

30 The two upper corners of the transitional block, which protrude conspicuously above the roof of the present portico, would be completely concealed from the Pantheon's forecourt by the taller portico. The ceiling over the entrance passageway might either be barrel-vaulted or flat. Perhaps a flat ceiling was intended originally, and a barrel vault only introduced in the revised project as a means of compensating for the reduced volume of the portico. The present vaulted ceiling has the disadvantage of terminating at the back of the pediment, rather than there being an arcuated entablature like that of the Temple of Hadrian at Ephesus.

31 Thus the roof of both the portico and the transitional block could have the same system of trusses, whose ridge could have been supported by the pier which divides the frontal cavity in the rotunda at the same level. In this design there would be no brickwork above the bottom of the trusses and hence none of the existing chambers. The intended function of these chambers (rather than simply as load-saving voids) is not at all clear: they are windowless and as such not well suited for many uses (such as accommodating the library later installed 'in the Pantheon' by Sextus Iulius Africanus, see *Kestoi, Oxyrhynchus Papyri*, 412, 63–8, which would be better housed

inside the rotunda, for instance in the recesses of the *exedrae* walls). The staircases behind the two pronaos niches (entered from small doors in the flanks of the transitional block) would have served only to give maintenance access to the roof and the upper parts of the rotunda.

32 Besides the breaks in the bonding between the rotunda and the transitional block on the outside of the building (see n. 19), a break is also illustrated by Cresy and Taylor, I, pl. 52, in their longitudinal section.

33 Evidence that this brickwork was inserted can be seen in two diagrams in Beltrami, *Il Pantheon*, figs 10 and 35. These show that the shuttered foundations beneath the inner files of portico columns run from the façade and continue to the rotunda without any offset corresponding with the narrowing of the passageway, and that the plinths of the passageway pilasters actually overhang the edges of these foundations. This indicates that the narrowing was not foreseen when the foundations were laid, and implies a subsequent change in plan.

34 This argument has been applied to the *executed* project (MacDonald, *The Architecture of the Roman Empire*, 112; Ward-Perkins, *Roman Imperial Architecture*, 111) somewhat optimistically perhaps, by over-estimating the contribution of the podium, or platform, on which the Pantheon stands. This was, in fact, not especially high (de Fine Licht, *The Rotunda in Rome*, 36–8, gives 5 steps with a height above the forecourt of only between 1.11m and 1.15m, about 3¾ ft).

35 For recent studies on the setting out and dimensioning of centralized Roman buildings see D. M. Jacobson, 'Hadrianic Architecture and Geometry', *American Journal of Archaeology*, XC, 1986, 69–85; M. Ueblacker, *Das Teatro Marittimo in der Villa Hadriana*, 1985; and M. Wilson Jones, 'Design principles in Roman architecture: the setting out of centralized buildings', forthcoming.

36 For recent proportional studies of the Pantheon, see de Fine Licht, *The Rotunda in Rome*, 194–8, and H. Geertman, '*Aedificum Celeberrimum*: Studio sulla Geometria del Pantheon', *Bulletin Antieke Beschaving (BABesch)*, LV, 1980, 203–29. As Jacobson (see n. 35) has pointed out, Geertman's theory does not allow for the primacy of the Roman foot (and neither does de Fine Licht's), although it does propose a layout based upon a circle and inscribed square.

37 The column-centre to column-centre diameter of the rotunda (recognized to be a significant dimension by MacDonald, *The Pantheon*, 68) measures 44.54m, =150.47 ft.

38 The width of the portico measures 31.99m, =108.07 ft; compare
15¼ ft × 7 + 1 ft = 107¾ ft. If there was an ideal pycnostyle column spacing, the portico width would measure 110⅜ ft, i.e.
15⅝ ft × 7 + 1 ft. The portico of the Temple of Antoninus and Faustina likewise has a central spacing one foot wider than the side intercolumniations (Cresy and Taylor, I, pl. 58). Other appropriate dimensions in plan include the 30 ft diameter of the oculus, the 10 ft width of the paving squares, and the 20 ft widths of the pronaos niches and rotunda portal. Since the Pantheon appears to have been laid out on a predetermined axis (established by the earlier Pantheon of Agrippa, see e.g. de Fine Licht, *The Rotunda in Rome*, 173–8), the external diameter of the rotunda, about 188 ft, may have been determined simply by structural requirements and by the proximity of the boundary wall of the adjacent *Saepta Iulia*.

39 The wall-to-wall diameter of the rotunda measures 43.62m, =147.36 ft. According to Desgodetz, the total height of the rotunda is 43.5m, =147.0 ft.

40 The external cornice heights given by Cresy and Taylor are 12.50m (=42.22 ft) for the lower, 21.90m (=73.97 ft) for the middle, and 30.51m (=103.07 ft) for the upper. The upper cornice runs at just above the 100 ft level of the pediment's apex (see n. 24), the mid-cornice level corresponds with that of the main cornice inside the rotunda (22.03m = 74.43 ft), and the lower cornice aligns with the top of the pronaos niches and the doorframe, and may have been intended to marry up with a projected arrangement of the interior, see our Addendum and fig. E. Measured from the forecourt pavement (i.e. including the podium, see n. 34), the total height of the drum, 106¾ ft, nearly equals the width of the portico, 108 ft, while the total height of the building, about 156 feet, is almost exactly bisected by mid cornice which is about 78 feet (74 ft + 3¾ ft = 77¾ ft).

41 See n. 14, 20, 21, 26.

42 See n. 24.

43 The proportion is 1:4¼ for both the external (see n. 21) and internal orders (columns: 10.57m, =35.71 ft; entablature: 2.51m, =8.48 ft) of the Pantheon, as it is for other surviving Imperial monuments in Rome; see Wilson Jones, as n. 44.

44 M. Wilson Jones, 'The Design of the Corinthian Order', in *Tempio di Adriano*, ed. L. Cozza, II, forthcoming.

45 Monuments listed by Wilson Jones, as n. 44, with columns 48 ft tall include the Temples of Antoninus and Faustina, of Minerva and of Vespasian, the Baths of Nero and of Diocletian, and the Column of Phocas.

46 Monuments listed by Wilson Jones, as n. 44, with columns 60 ft tall are: the Temples of Concord (probably), of Mars Ultor, of Venus and Rome (probably), and of Trajan, the Baths of Trajan, the Column of Antoninus Pius, and the Temple of 'Bacchus' at Baalbek.

47 Buildings with columns greater than 60 ft in height include the Temple of Jupiter at Baalbek and the Basilica of Maxentius with columns around 66 ft tall (see Wilson Jones, as n. 44), the

Temple of Jupiter Optimus Maximus with columns perhaps the same size (see e.g. S. B. Platner and T. Ashby, *A Topographical Dictionary of Ancient Rome*, 1929, 302), and the Temples of Serapis and of Hadrian at Cyzicus with columns this size or even larger (see e.g. Ward-Perkins, *Roman Imperial Architecture*, 134, 281–2). Although no monolithic shafts of a size greater than 50 ft have been found in buildings, Scaife, as n. 49, discovered the remains of two measuring 60 ft in the *Mons Claudianus* quarry in Egypt.

48 One of the first buildings to have 60 ft columns with 50 ft monolithic shafts may be the Baths of Trajan, dedicated AD 109; see C. M. Amici, *Foro di Traiano: Basilica Ulpia e Biblioteche*, 1982, 76–7.

49 This can all be deduced from the little that is known about the Temple of Trajan; see e.g. Platner and Ashby, *Dictionary*, 244; P. Zanker, in 'Das Trajansforum in Rom', *Archäologischer Anzeiger*, [85], 1970, 537–44; and J. B. Ward-Perkins, '*Columna Divi Antonini*', in *Mélanges d'Histoire Ancienne et d'Archéologie offerts à Paul Collart*, 1976, 345–52. On the origin of the granite, see de Fine Licht, *The Rotunda in Rome*, 39–40, and C. H. O. Scaife, 'The Origin of some Pantheon Columns', *Journal of Roman Studies*, XLIII, 1953, 37. According to Scaife, the grey granite shafts on the Pantheon's portico come from the same Egyptian quarry (*Mons Claudianus*) as those from the Temple of Trajan.

50 The density of granite being about 2,800 kg per cubic metre, a column shaft 11.8m (= 40 ft) tall (average diameter, say, 1.4m) would weigh 50 tonnes, whereas one 14.8m (= 50 ft) tall (diameter, say, 1.7m) would weigh 96 tonnes.

51 *Griechische Papyri im Museum des Oberhessischen Geschichtsvereins zu Giessen*, ed. E. Kornemann and P. M. Meyer, I.3, 56–8, no. 69. We thank J. Theodore Peña for this reference. The document speaks of supplies of barley being urgently needed by the transport team moving a 50 ft column shaft.

52 Blocks of the appropriate size would have had to be specially ordered from suitable quarries and the shafts then fluted, a time-consuming process carried out *in situ*, see A. Claridge, in *Tempio di Adriano*, ed. L. Cozza, 1982, 27–30.

53 Shafts 40 ft tall are far more common and so it is reasonable that supplies could be quickly obtained. In the seventeenth century, two shafts of this height were conveniently found for the restoration of the left-hand side of the portico, see de Fine Licht, *The Rotunda in Rome*, 241.

54 Dio Cassius, LXIX, 7, 1. P. Godfrey and D. Hemsoll, 'The Pantheon: Temple or Rotunda?', in *Pagan Gods and Shrines of the Roman Empire*, ed. M. Henig and A. King, 1986, 195–209, suggest that the Pantheon was not a temple (temples were never used by emperors for such purposes), and that Hadrian's building was designed as an Imperial audience chamber. For the imperial associations of red granite in particular, see ibid., 202.

55 It seems quite possible that funds set aside for the completion of the Pantheon were limited; Amanda Claridge has suggested to us that the marble facing along the flanks of the transitional block has weathered unevenly because the grain of the stone does not always run in the best direction – a possible conclusion being that material was scarce, and perhaps that funds were restricted. If in the final completion of the building expenditure had been cut back, then a necessary restoration so soon under Septimius Severus, to which one of the façade inscriptions refers, becomes easier to understand (. . . PANTHEVM VETVSTATE CORRVPTVM . . . RESTITVERVNT), and even a possible restoration under Antoninus Pius would become more reasonable (*SHA*, *Ant. Pius*, VIII, 2).

ADDENDUM

With a comparable critical history (see notes 1–8), and in view of various discrepancies in design, it would seem possible that the interior of the Pantheon was not articulated in exactly the way it was first conceived. The evidence of a previous scheme is less substantial here than for the portico, but the main problems can nevertheless be outlined, and other arrangements tentatively considered.

Until the refacing of 1747, there was a zone above the lower storey consisting of two plain bands, and above this the much criticized upper storey where the pilasters were not aligned with the order below (fig. 10b). Whatever the drawbacks – or indeed the merits – of this scheme, there are associated with the eight exedrae positioned around the central drum specific design conflicts:

1 In the entrance exedra, the doorframe cuts through into the level of the lower storey entablature, and then supports its own separate frieze and cornice (fig. 10c).

2 The arches over the entrance and end exedrae are not semicircular but horseshoe-shaped, and break into the upper storey where they sliced through the pilaster order which was once there (fig. 10c).

3 The tile-faced barrel vaults and semi-domes of the four diagonal and two lateral exedrae all spring from considerably above the internal architraves (fig. 10a). In the case of the diagonal exedrae, the capability of the top storey 'windows' to admit extra light from above is greatly reduced by obstructive and unsightly bracing arches above the column screens; and if, as seems likely, these arches were once hidden by false ceilings, then any advantages of additional lighting would have been lost altogether.

These difficulties could have all been avoided if the lower storey columns were 6 or so feet taller, i.e. 42 ft ($60 \text{ ft} \div \sqrt{2}$) in height or thereabouts (figs 10d and e):

1 The door frame would fit comfortably beneath the entablature, and the separate frieze and cornice would be omitted.

2 The arches over the entrance and end exedrae could be semicircular if they were formed by an arcuation of the entablature, a fairly common device in Hadrianic building. However, with a taller order there might have been no need to gain extra height by having arches, and instead these exedrae could have been screened like the rest (in which case, if there was a revised design for the portico where a flat ceiling was replaced by a barrel vault, as n. 30, then the arches over the axial exedrae may have been put in at the same time to introduce a corresponding accent).

3 The vaults and semidomes would now spring from much nearer the level of the architraves, and there would be no need for the obstructive bracing arches, since so much less would be supported by the column screens.

The main effect of taller interior columns would be to increase the height of the lower storey at the expense of the areas above. An upper storey could be retained if the band zone were eliminated, although it is also possible that the different proportions might have called for some sort of attic above, perhaps with no pilaster order. Taller columns would be quite in keeping with the scale of the rotunda, they would be disposed with the same pycnostyle spacing as the intended columns of the portico and would give greater prominence to the exedrae, thus expressing more clearly the spatial organization of the interior. However, once the height of the portico columns was reduced, smaller columns in the rotunda would then have the significant advantage in making a clear hierarchical distinction between the scale of the internal and external orders.

The possibility that there could have been an earlier scheme for the interior of the Pantheon does not alter the fact that the final design was itself a brilliant success with special qualities all of its own. The refacing of 1747 may have put right what many may have considered to be problems, but the imaginative delicacy of the upper levels was alas destroyed and replaced with a more oppressive uniformity.

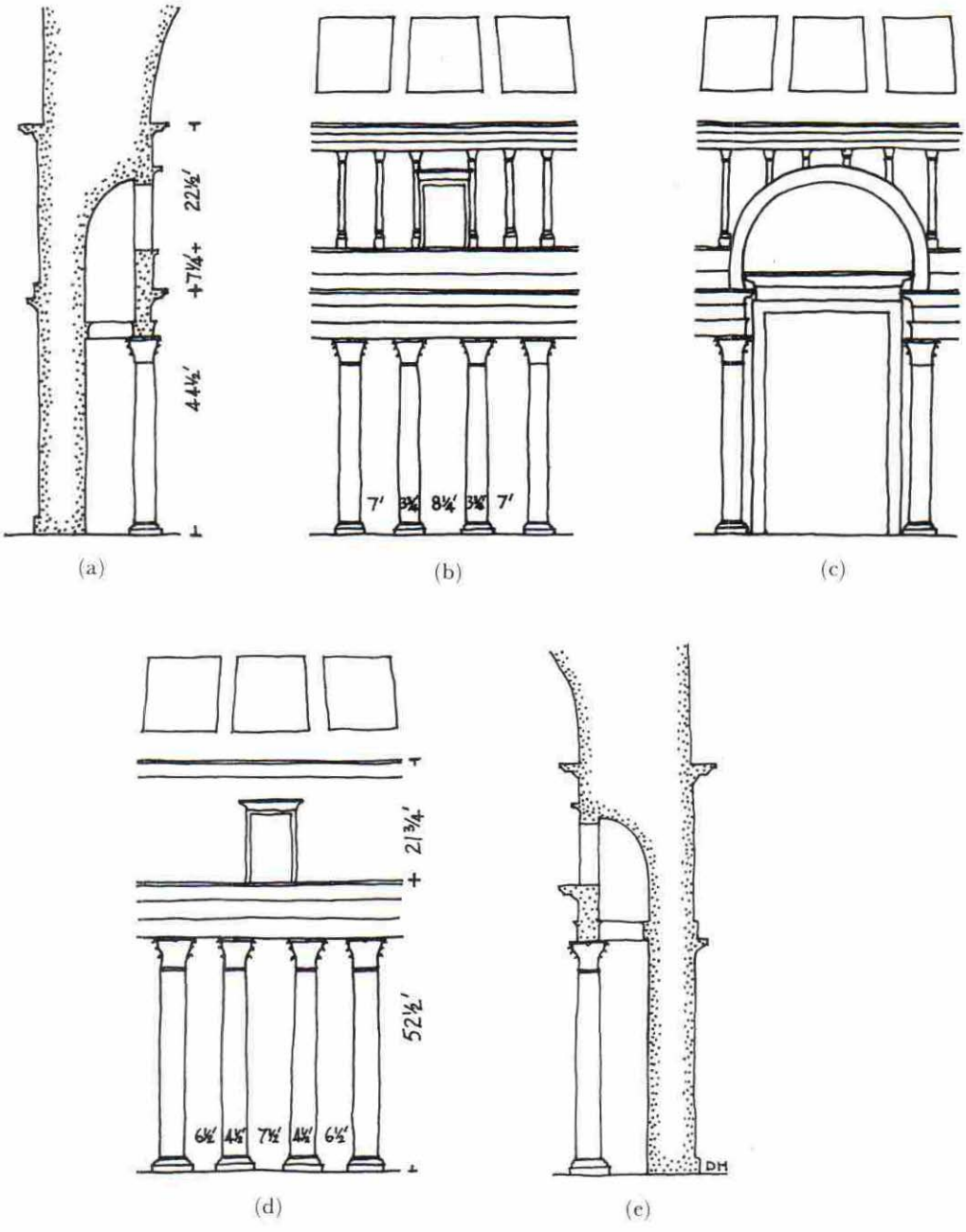

Figure 10 (a) Lateral exedra as built: section; (b) Lateral exedra as built: elevation; (c) Entrance exedra as built: elevation; (d) Lateral exedra as intended (?): elevation; (e) Lateral exedra as intended (?): section