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Artificial Stone: A Roman Revolution

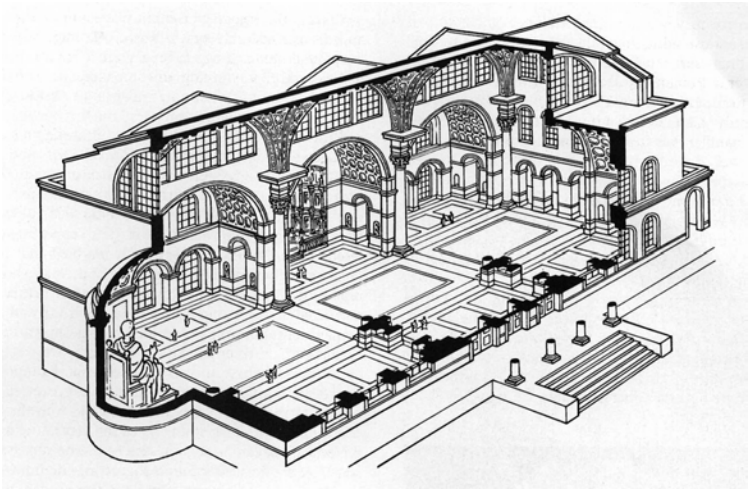
"THE ancient Romans," Voltaire complained, "built their greatest masterpieces of architecture, the amphitheatre, for wild beasts to fight in." In this "enlightened" verdict on Roman architecture critics and historians have joined for the last thousand years. Vision of the ancient Roman creations had long been clouded by Vitruvius's idealizing of ancient Greece. The arts of Rome, like Roman civilization as a whole, have had a bad press. The title of Edward Gibbon's classic Decline and Fall of the Roman Empire has dominated literary imagination. Awed by the grand spectacle of so great a civilization disintegrating, we have thought too little about its rise and the creations that made it great. Western pundits have applauded Rome's decline. "1 know not why anyone but a school-boy," Dr. Johnson decreed, "should whine over the Commonwealth of Rome, which grew great only by the misery of the rest of mankind." "The barbarians who broke up the Roman empire," Ralph Waldo Emerson agreed, "did not arrive a day too soon." Still, Roman creations are among the most remarkable works of mankind. And their architecture remains their most original and most enduring contribution to the arts of the West.

It is not so surprising that architects schooled in Vitruvius and the beauties of classic Greece have been slow to recognize the greatness of Roman architecture. For the beauties of classic Greece were revealed in the elegance of polished marble and survive with a charming patina. But the decisive new Roman material was concrete, which in modern times has borne the stigma of the commonplace. Concrete is the everyday substance of our sidewalks, driveways, and roads, of dams, bridges, and office buildings. How could it have been the raw material of a revolution in architecture and the shaper of new beauties?

The accidents of geology provided the Romans with a new basis for their concrete and their architecture. Mud, adobe, and mortar had of course been used for millennia. But the Romans added a new mineral to their concrete, **pozzolana** (Latin *pulvis puteolanus*). This volcanic earth they first found in thick strata at Pozzuoli (Latin *Puteoli*), a seaport near Naples, not far from Lake Avemus, the legendary mouth of hell. The discovery that pozzolana enriched concrete would harden in contact with water had been made when the people in Pozzuoli mixed this local volcanic sand with lime for buildings on the water's edge. Pozzolana was imported to Rome for bridges, wharves, and jetties until the same volcanic sand was found in large quantities in the nearby Alban Hills. By Augustus' time pozzolana was used in all concrete for buildings. "This substance," Vitruvius explained, "when mixed with lime and rubble, not only lends strength to buildings of other kinds, but even when piers of it are constructed in the sea, they set hard under water." Concrete made of pozzolana resisted fire as well as water, and would preserve Roman monuments through centuries.

We have been misled, too, by the legendary boast of Augustus (63 B.C.- C.E. 14) that he "found Rome a city of bricks and left it a city of marble." In fact the Romans found architecture a realm of marble, and would remake it in concrete. But in the time of Augustus, marble, used in Roman buildings mainly in slabs for facing or in decorative fragments for mosaics or pavements, was a material more cosmetic than structural. Like stucco, it covered a solid core of brick and concrete, which made their grand and distinctive buildings possible. Builders were so convinced of the unique qualities of their crucial new element, pozzolana, that, in the heyday of their high imperial age, they routinely incorporated it in the concrete for buildings, great or small. Bricks, one of the most ancient and familiar building materials, when added in the concrete gave character, novelty, and grandeur to their works. Walls of brick required less labor than stonework of the same quality, and could be made of local clay where there was no stone. Bricks, besides being wonderfully durable, protected against heat and weather. More than three thousand years before Augustus, the city of the biblical Abraham, Ur of the Chaldees, had been built of sun-dried brick and kiln-dried brick. The Tower of Babel was probably built of brick, as was Nebuchadnezzar's city of Babylon. In the great age of Roman architecture, bricks embedded in concrete helped hold together grand new shapes.

Roman bricks themselves record a saga of foresight and organization. Sun-dried bricks, Vitruvius explained, should be made only in spring or autumn and, to allow full and uniform drying, should be made at least two years in advance. The best bricks, like those at Utica, had been left to dry for five years. Under the Empire, when bricks were visible on the outside of buildings they were no longer the structural material. They were only a protective skin covering a structure of concrete. Roman bricks were made in several shapes and sizes. Often the bricks were cut into triangles which had their hypotenuse laid out and their apex inserted in a core of concrete. The commonest, which were about one and a half inches thick and two feet square, we would call large tiles, for they were thinner than our common bricks.



Reconstruction drawing of the Basilica of Constantine (Basilica Nova), 306-312 CE

As the decades passed, bricks became smaller and took new shapes, while the thickness of the mortar and its strength increased. During the first three centuries of the Empire, a proportion of the bricks in each brickyard were stamped as they were made, and so became historical documents, witnesses to the Roman sense of order and of history. Stamped bricks commonly carried the name of the owner of the estate where they were made, the name of the brickmaster, and sometimes too the names of consuls in office. In familiar Latin abbreviations they carried a message like this: "Brick from the estates of His Excellency, C. Fulvis Plautianus, Prefect of the Praetorian Guard, Consul for the second time, from the Terentian Brickyard, made by L. Aelius Phidelis." In their time these stamps probably were meant to serve for inventory or for taxation, but now they help us date Roman monuments and trace the development of their architecture. Brickmaking was eminently respectable, for senators not usually allowed to be in trade could be in the brickmaking business which was classed as a kind of agriculture. The dated bricks help us follow the Roman revolution in architecture, which Gibbon himself overlooked. Concrete, the drab and humble raw material of the Roman revolution, seems to have been beneath the dignity of his rotund eloquence. Nor does he celebrate the soaring, enveloping new shapes. Of course Vitruvius, though an opinionated conservative, dared not omit from his architects' guide a full discussion of the materials (including brick and concrete) in common use.

The shapes developed by the Romans—arches, vaults, and domes—have become so familiar and so essential to our architecture that we find it hard to believe they ever had to be created. The earlier architecture of the ancient West had been an architecture of mass. Dominated by posts, roofs, and walls, it displayed columns and architraves. Then the architect's problem was to arrange masonry or bricks to support a platform or a roof. There were variations only in the size, weight, and shape of the masses, the materials of the walls, the number and disposition of the columns. The great works of Greek temple architecture, as we have seen, were made to be viewed from the outside, not to be experienced from within. The inner chamber, the cella, was reserved for the priest alone. The Greek buildings were "trabeated" (from Latin *trabs*, beam). Such structures were dominated by the vertical and the horizontal, by right angles and rectangles that confined the architectural imagination.

The legacy of the Roman dome is seen in Venice's St. Mark's Basilica, 1063

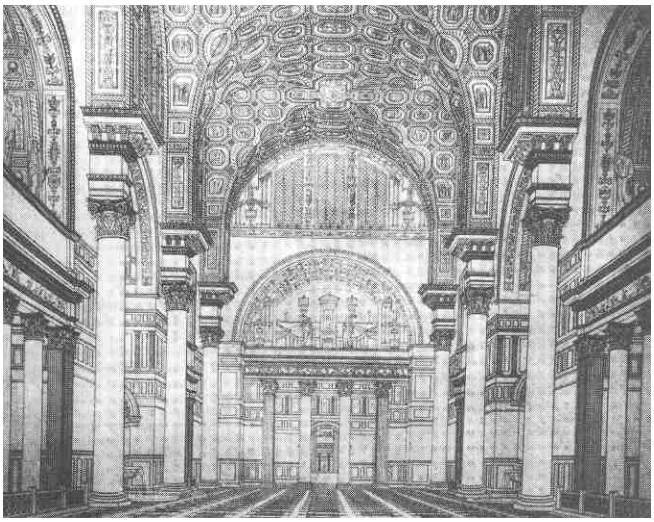
Even the few apparent ancient exceptions, like the pyramids, were masses for external viewing. In one of the grand revisions of the creative imagination, the Romans would change all this. They built an architecture of interiors, of vast enclosed spaces. And this was a new kind of space-within arches, vaults, and domes, in omnipresent dominating curves, where walls became ceilings, and ceilings reached up to the heavens. The artificial world, the world of interiors that architects would make for man, was transformed into anew curvesomeness. The classic Greeks had gathered out in the open air. Roman architecture brought people indoors to share their public and exchange their private concerns. Their spectacular new domed and vaulted shapes would dignify and glorify religious faiths, political hopes, and law-making efforts across the West—from Hagia Sophia to St. Mark's in Venice, St. Peter's in Rome, St. Paul's in London, the Capitol in Washington, B.C.E., and in American state capitals.

This grand Roman innovation in architecture would be accomplished in two centuries as the essential ingredient, concrete, was perfected gradually by trial and error. Vitruvius tried to explain the chemistry, but the improvements were not based on chemical theory. The remarkable qualities of perfected concrete in the Age of Hadrian, the Age of the Pantheon, would be attained by further trial and error in improving the proportions of lime and pozzolana and other ingredients in the mortar.

The techniques of laying concrete were also improved. In the beginning, each horizontal course was allowed to dry before the successor was applied. The result was an unsightly horizontal line of cleavage between layers. Then an improved slower-drying mixture allowed the successive layers to fuse into a single mass, and before the death of Hadrian in C.E. 137 pozzolana-enriched concrete had become a monumental building material in its own right.

The Roman Empire had brought cities into being and created a far-flung urban culture with common needs. And the new architectural creations arose from the needs of these Roman cities. While the glory of classic Greek architecture was in its temples to gods and civic deities, the grandeur of Roman architecture began in the public baths. How and why Romans acquired their mania for public baths remains a mystery. But its signs were everywhere.

Some of the earliest were the grand Stabian baths of the second century B.C.E. at Pompeii, with elegant arches and a soaring conical dome topped by a central opening that anticipated one of the most appealing features of the Pantheon three centuries later. Grand public bath buildings sanitized and enriched urban life all across the Roman provinces. Besides the *balneum*, or private bath, found in the town houses and country villas of wealthy Romans, there were the *thermae*, or public baths. Some historians count these among "the fairest creations of the Roman Empire." During the second century B.C.E. they multiplied at a great rate in Rome. It became common for a public-spirited citizen to make a gift of a public bath building to his neighborhood. Others were built commercially by contractors who hoped to make a profit from admission fees. Agrippa's census (33 B.C.E.) counted 170 such establishments in Rome, and a century later Pliny the Elder (23-79) had to give up counting. Soon there were nearly a thousand. When Pliny the Younger arrived for a brief stay at his country villa near Ostia, and did not want to fuel his own furnaces, he found "a great convenience" in the three public baths in the neighboring village.



Central hall of the Baths of Caracalla (restoration drawing), Rome, Italy. A long barrel vault was intersected by three shorter barrel vaults to make groin vaults.

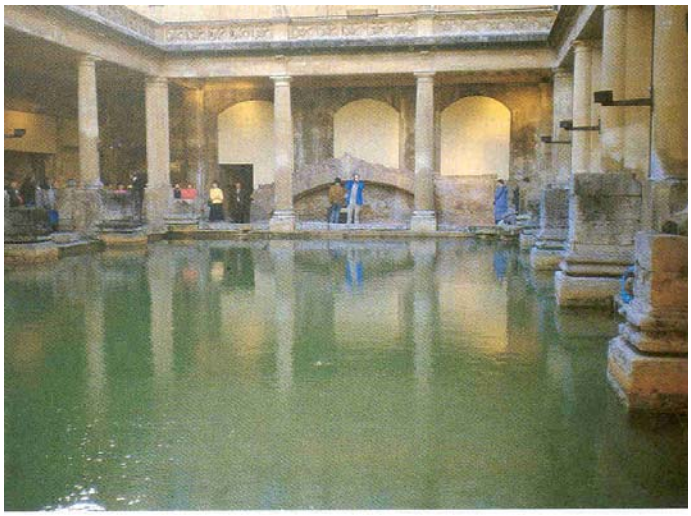
The essentials of a public bath were quite the same everywhere—a changing room, a sweating room heated by hot-air passages under the floor or in the walls, a large vaulted hall gently heated with intermediate temperatures, an unheated frigidarium partly open to the sky with a cold plunge, and a rotunda heated by circulating vapor, open at the top to admit sunlight at noon and in the afternoon. In addition, there were swimming pools. Nearby areas provided for strolling, for conversation, for sunning, for exercise, for various kinds of handball, hoop-rolling, and wrestling. Attached were concert halls, libraries, and gardens. The baths at their best were public art museums and museums of contemporary art. To them we owe the preservation of some of our best copies of Greek sculpture and our great treasures of Roman sculpture. The Farnese Bull, the Hercules, and the Belvedere Torso survived in the remains of the baths of Caracalla and the famous Laocoon group was found in the baths of Trajan.

This was emphatically public architecture, aiming to make every human function sociable. The latrine in the earliest Stabian baths at Pompeii was an open room with seats around the edges so the occupants could enjoy one another's company. In the remains of the Hadrianic baths at the distant Roman colony of Lepcis Magna we can still see the marble seats around three sides of a spacious open room, with the fourth side occupied by a statue in a niche. The social latrine became standard in public baths. If bathing could be a pleasurable social occasion, why not defecating?

In later envious centuries in the West, especially among other peoples like the British who were far from matching the Romans in plumbing, the baths became a symbol of Roman decadence. In Roman times, too, baths were the butt of moralists and bluenoses. In the early republic, it was still thought improper for Cato the Censor (234-149 B.C.E.) to take a bath in the presence of his son. Under the early Empire there was an increasing tolerance of nudity and the mixing of the sexes and no formal prohibition of mixed bathing. But for the women who objected there were special baths or separate designated times. Eventually popular outcry against scandalous behavior in the baths led Hadrian to issue a decree separating the sexes. Throughout the Empire baths were enormously popular, accessible to all free Romans at a nominal fee.

Not only the sexual promiscuity but other excesses aroused Roman concern. Besides the procurers of both sexes under the porticoes there were aggressive vendors of food and drink. Some Romans, it seemed, enjoyed the hot baths mainly "to raise a thirst" or stimulate their appetite. "You will soon pay for it, my friend," Juvenal (60-140?) warned, "if you take off your clothes, and with distended stomach carry your peacock into the bath undigested!" It was tempting to spend most of the day in the baths. The emperor Commodus (161-192), who imagined himself to be the god Hercules, took as many as eight baths a day, and exhibited his prowess in gladiatorial contests until his outraged advisers had him strangled by a champion wrestler. Efforts to prevent such excesses led to regulated hours of opening and closing.

To this conspicuous Roman institution, Edward Gibbon gives less than a paragraph of his seven volumes, casually reminding us that they "had been constructed in every part of the city, with Imperial magnificence." Though frequently satirized by Juvenal and others, the Roman baths left no literary, graphic, or sculptural art of their own. We have no script for the daily drama of the bath. The institution where Romans acted out much of their daily lives remained formless, unrecorded, and anonymous. Like the hotels and department stores of nineteenth-century America, they were Palaces of the Public, promoting, along with personal cleanliness, wholesome athletic activity, conversation, and the enjoyment of literature and the arts. So, too, they promoted urban pride and reincarnated the Greek ideal for which Juvenal pleaded—"a healthy mind in a healthy body" (*mens sana in corpore sano*). Like the great clocks in medieval town halls, they too were tokens of community. Nor were the Roman bathers mere spectators. This pioneer public amenity invited them to participate in a secular and sensuous synagogue.



The Roman baths at Bath, England, provided recreation and a choice of water temperatures in their pools. This picture shows one of the pools and some of the architecture as it looks today.

The public baths have left us some of our most impressive Roman ruins. A fragment of the remains of the Baths of Caracalla which altogether once covered twenty-seven acres has become a delightful opera house for open-air performances. The thirty-two acres of the ruins of the Baths of Diocletian now house the National Roman Museum, the Church of Saint Mary of the Angels, the Oratory of Saint Bernard, and a surrounding piazza. In their time the baths amazed visitors to the Imperial city.

The community bath, an enclosed structure to keep the water and the people warm, exploited the special qualities of the pozzolana-enriched Roman concrete to resist humidity and to shape interior space. The Roman architects also used their new materials for other civic functions that brought people together indoors. After the baths, basilicas were the most common and most characteristic Roman public buildings. A "basilica" (from the Greek for king) was a covered hall whose "royal" dignity came from its large size and the public and legal activities that it sheltered. In Roman times a basilica, usually attached to or near the forum, also housed markets, trials, and judicial hearings, public meetings, and covered promenades.

The basilica expressed, too, the same novel Roman interest in interiors. For basilicas throughout their history were usually simple and barnlike in their exterior. Decoration was on the inside. Their later form and their suitability for the Christian liturgy came from their widespread earlier use as a courtroom. In the first century B.C.E. the basilica commonly provided a raised platform at one end for the judge. With the coming of Christianity the raised end was enclosed by an apse, a semicircular half-domed extension of the wall, which made the whole design especially convenient for the Christian service. The earliest known basilica, the Basilica Porcia, was built by Cato the Elder in 184 B.C.E. as an addition to the Roman forum, and many others followed in Rome and elsewhere. The only building we can confidently ascribe to Vitruvius's own design is the Basilica at Fano (c.27 B.C.E.) which survives only in his description. These earliest basilicas, like Vitruvius's, were square or rectangular, and usually roofed by timbers. In due course they, too, would be laboratories for the Roman revolution in architecture.

The great incentive came in an unexpected way on the night of July 18, C.E. 64. The fire that broke out in Rome on that night, in Gibbon's words, "raged beyond the memory or example of former ages" and ravaged the city for nine days. Of

the fourteen regions of the city three were leveled to the ground, and seven were devastated. The cause of the fire was never finally determined. This was the tenth year of the reign of Nero (37-68; reigned 54-68), who had well earned the suspicion and contempt of all Romans by murdering his mother and his wife, by extorting from the rich and oppressing the poor. He had forced his successful generals to suicide, and randomly tortured and executed any who excited his suspicion. He scandalized the Senate and soiled the imperial dignity by his buffoonery in the theater and public ostentation of his meager talents as singer and poet. By the year 64 the hatred of all classes of Romans naturally fueled the rumor that he had set the fire himself. It was suggested that he had destroyed the center of Rome so he could rebuild it all into a vast palace of his own and then rename the city after himself.

"To divert a suspicion which the power of despotism was unable to suppress," Gibbon recounts, "the emperor resolved to substitute in his own place some fictitious criminals." He made many martyrs, for his victims were the unlucky adherents of the despised new sect called Christians. "Some were nailed on crosses;" reports Tacitus, "others sewn up in the skins of wild beasts, and exposed to the fury of dogs; others again, smeared over with combustible materials, were used as torches to illuminate the darkness of the night. The gardens of Nero were destined for the melancholy spectacle, which was accompanied with a horse race, and honored with the presence of the emperor, who mingled with the populace in the dress of and attitude of a charioteer. " The new sect had prophesied a second coming of Christ, with a worldwide conflagration. Nero loved classic Greek themes. In his legendary fiddling, he may have been using the Fire of Rome to accompany his own song to the lyre on the burning of Troy.

The fire's conspicuous historic consequences can be explained only if we grasp the contradictory character of Nero himself. He suffered a repressed and insecure childhood, for when his father died he was raised under the terrifying menaces of his uncle, the deranged emperor Caligula, until Caligula was murdered and succeeded by Claudius. Nero was then brought up by his mother, the impetuous and domineering Agrippina the Younger. She used the wiles of incest and murder to secure for him the imperial throne in place of Claudius's own son and rightful heir. Agrippina steered the resentful Nero into and out of marriages of convenience until finally she herself was murdered (C.E. 59) by Nero's hired assassins.

Yet Nero must have had hidden strengths of character. For despite this erratic childhood, when he became the first boy emperor of Rome in C.E. 54 at the age of seventeen, he opened his reign with five generous and constructive years. He tried to reform the circus entertainments by forbidding contests that would cause bloodshed, he banned capital punishment, and even set up procedures for slaves to bring legal proceedings against cruel masters. Claudius, his predecessor, had put forty senators to death, but the young Nero in these first years tolerated those who plotted against him, pardoned the writers of satiric epigrams, and even found ways to make the Senate more independent. Nero's clemency speedily became proverbial. Romans repeated his words when he signed his first death warrant, "Why did they teach me how to write?" After his first speech to the Senate he was acclaimed the herald of a Golden Age. If Nero had died in C.E. 59 when he was only twenty-two, he might have been celebrated as a noble precocious statesman.

What so suddenly happened to the man? A diabolical transformation occurred in the next three years, when he secured the murder of his demented mother, and then of his wife, so he could marry the wife of a senator. The surprising continuous thread in his life was an obsession with the arts. Even if he did not actually fiddle while Rome burned, the legend carried the truth that Nero was a man of consuming artistic passion. He even imagined giving up his throne to be a full-time poet and musician so that "they would adore in me what I am." And he believed he could use his art to bring his enemies to tears and repentance. This obsession lasted through his brief life, and, on June 9, 68, just as he was about to commit suicide at the age of thirty-one, he was reputed to exclaim, "What an artist dies in me!"

Nero's artistic aspirations were more than a madman's dream. The Great Fire of 64 gave him an opportunity that, as even hostile historians report, he seized with creative energy and imagination. The chance to rebuild Rome had not been offered since Rome was burned by the Gauls in 390 B.C.E. After that earlier fire, as Tacitus chronicled, the capital was rebuilt "indiscriminately and piecemeal." This time it would be different. By Nero's orders, Rome would be rebuilt "in measured lines of streets, with broad thoroughfares, buildings of restricted height, and open spaces, while porticoes were added as a protection to the front of the apartment-blocks (*insulae*). These porticoes Nero offered to erect at his own expense, and also to hand over the building sites, clear of rubbish, to the owners." He organized garbage removal by requiring that ships which carried grain up the Tiber must carry refuse downstream to be dumped in the Ostian marshes. He improved the water supply, required fire walls between buildings, and directed all householders to keep in the open their appliances for extinguishing fires. Tacitus (only ten years old at the time of the Great Fire) was Nero's bitter critic,

but he gave grudging credit to the mad emperor. "These reforms, welcomed for their utility, were also beneficial to the appearance of the new capital. Still, there were those who held that the old form had been the more salubrious, as the narrow streets and high-built houses were not so easily penetrated by the rays of the sun; while now the broad expanses, with no protecting shadows, glowed under a more oppressive heat."

Nero's aesthetic megalomania had subtle and far-reaching effects on Western architecture. For the Great Fire hastened the liberation from the architecture of mass, of parallels and right angles, which was the legacy of Greece into the architecture of curves, of vaults and domes. Nero's new building code, specifying that future structures be more fireproof by avoiding timbers or beams (*sine trabibus*), implied the new architecture of concrete and its sinuous shapes for interiors. Large indoor spaces would now be enclosed not by flat ceilings but by rounded vaults of the newly improved artificial stone. The Fire of 64 thus cleared the way for what Suetonius called "the new form for the buildings of the city." This was not the first nor the last example of man's endless capacity to make catastrophe the catalyst of creativity.

Nero seized the incendiary opportunity to create for himself a grand palace. Much of the Rome that would not be reconstructed according to his new building code was reserved for his personal palace. If completed it would have covered some 125 acres, about one third of the city. The Golden House (*Domus Aurea*) it came to be called, because its facade was covered with gold. And there were symbolic reasons for the name. The Augustan Age, which Nero hoped to equal or excel, had been called Golden (*aurea aetas, aurea saecula, aurei dies*). After the fire, the name was an ironic reminder that Nero's reign at its beginning had been predicted to be Golden. As Suetonius (c.69-post 122?) describes Nero's Golden House, it was impossible to exaggerate its magnificence:

> Its vestibule was large enough to contain a colossal statue of the Emperor a hundred and twenty feet high; and it was so extensive that it had a triple portico a mile long. There was a pond, too, like a sea, surrounded with buildings to represent cities, besides tracts of country, varied by tilled fields, vineyards, pastures and woods, with great numbers of wild and domestic animals. In the rest of the palace all parts were overlaid with gold and adorned with gems and mother-of-pearl. There were dining rooms with fretted ceilings of ivory, whose panels could turn and shower down flowers, and were fitted with pipes for sprinkling the guests with perfumes. The main banquet hall was circular and constantly revolved day and night, like the heavens. He had baths supplied with sea water and sulphur water. When the palace was finished in this manner and he dedicated it, he deigned to say nothing more than that he was at last beginning to be housed like a human being. (Translated by William L. MacDonald)

The Golden House was not just a complex of buildings, but a vast pleasure park, for in that age *domus* (like the later Italian villa) meant a whole establishment—a palace, gardens, ponds, and fields. Nero's Golden House, like Xanadu's imaginary Pleasure Dome, was set in a delightful rural landscape (*rus in urbe*), which he had transported into the very heart of Rome. Much is still to be learned from future archaeological excavations. But we already know that Suetonius gave us only a hint of the palatial fantasies. There was good reason for wiseacres in the Forum to warn: " All Rome is being made into a villa! Flee to Veii [an old Etruscan stronghold twelve miles north)—until the villa spreads to Veii."

Nero's Golden House broke "the tyranny of the right angle." Even the great courtyard in the center of the facade splayed out its flanks to make three sides of an irregular hexagon. The grounds of the Golden House, as we have seen, abounded in fantasy. The idea of a rural villa in the heart of Rome was itself fantastic. An artificial lake, on the low ground where the Colosseum would later stand, was surrounded by villages in the varieties of Greek classic architecture—a bizarre encyclopedic museum of the long Roman tradition of country villas.

Embedded in the center of the east wing, his octagonal hall with its circular canopy of concrete marked a new departure in architecture. It used man-made stone—Roman-improved concrete—to make almost any kind of shape. Here the vaults that had served the practical purposes of baths and of basilicas converged. The straight walls of an octagon merged into the smooth curves of a dome, creating a salon with a circular opening in the center. Fountains cascading down the rear completed the fluid spectacle. Interest now focused on the interior to

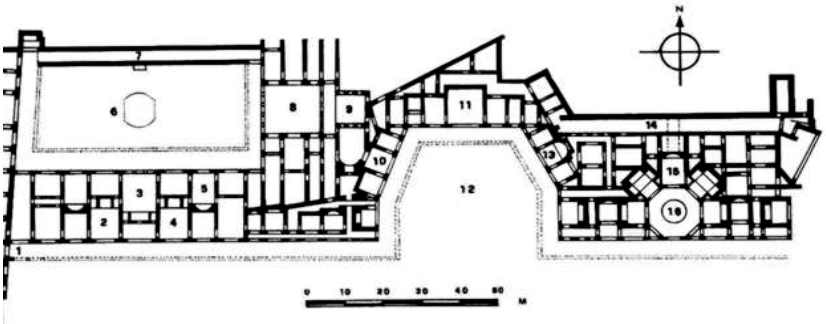


Diagram of the Golden House

create a new sense of closure. Light streaming down from the center and filtering between the columns that elevated the dome made this interior world newly autonomous. The elements of the Roman revolution in architecture were all there. Concrete-domed space now offered men interior heavens of their own creation and the domed interior, as we shall see, became a man-made New World.

Interior hall of the Golden House

The emperors who succeeded Nero were eager to relieve themselves of the odium of the expropriation that had provided the land for the palace, and they displaced Nero's palace by monuments to their own generosity. Aided by the Roman fires of 80 and 104, they erased the traces of Nero's megalomania. The low ground that Nero had made into an artificial lake to improve the vista from his palace became the site of the Colosseum (Flavian Amphitheater) for free public entertainment. On top of what had been the domestic wing of the Golden House, Trajan built grand public baths, where all could enter without charge. Under Domitian, Nero's porticoes around the Forum became an elegant shopping center. Only seventy years after its construction, all that remained of Nero's prodigious Golden House was the lonely 120-foot gilded statue of Nero. Legend reported that, after Nero, each emperor put the image of his head in place of Nero's. Unfortunately, the powerful early popes did not follow this example, but simply destroyed the statue.

The secular emphasis of the Roman architecture was signaled in the very names they gave to their grandest works. The Greeks knew their monumental buildings by the names of the gods whom they honored-the Parthenon (after Parthenos, the virgin goddess, Athena), or the Temple of Olympian Zeus. But Romans knew their architectural monuments by the names of the emperors who had them built-Nero's Domus Aurea, the Flavian Amphitheater (the Colosseum), Hadrian's Pantheon, the Baths of Caracalla. Roman architects never attained the celebrity of architects in later ages and received little credit for their most famous Roman buildings. The principal architect of Nero's Golden House was probably Severus, but we know little about him or the team of specialists he supervised, despite the radical novelty of the building he helped shape.

Romans had forgotten where the Golden House had stood when, in the fifteenth century, they dug under Trajan's Baths and came upon rooms that had been part of Nero's domestic wing. They could not explain these underground rooms painted in the Pompeiian style, and assumed that they were originally decorated grottoes. Later, Raphael, who had an intense interest in ancient Roman remains, had himself lowered down on ropes to study the "grottoes." Raphael imitated the style of the "grotto" walls, in which fantastic forms of people and animals were intermingled with flowers, garlands, and arabesques into a symmetrical design, when he painted the Vatican loggias. This was called *grottesche*—in the style of the grottoes. "Grotesk," William Aglionby's English treatise on painting explained in 1686, "is properly the Painting that is found under Ground in the Ruines of Rome." After Raphael (1483-1520), the word became popular for distorted, exaggerated, or humorous forms in painting or sculpture. And so today Nero's bizarre ambitions survive secretly in our everyday language.

If Nero's buildings were soon torn down, their example lived on. Twenty-five years after the Golden House, Domitian's palace, benefiting from still further improvements in the quality of concrete, followed the Neronian example with domes and curves enlivening even the domestic wing. In another twenty-five years, the newly liberated architecture flowered in Hadrian's villa, a curvesome world where people took for granted their gently shaping interiors.

Dome of the World

By a lucky accident of history, the best-preserved monument of ancient Rome, the Pantheon, is the triumph of the Roman revolution in architecture. That triumph survives, too, within our daily sight-in churches and mosques and synagogues, in urban chapels and country seats, in the political capitals of monarchies, dictatorships, and democracies. The dome of Hadrian's Pantheon lives on across the West, proclaiming the triumph of art over politics. Peoples who never knew the Roman Empire, nor ever were governed by Roman law, could not resist the grandeur of Roman architecture. The dome of the Pantheon has been imitated to exalt the God of the Hebrews, the Savior of Christians, the Allah of Muslims, and the Sovereignty of the People.

This versatility of the Pantheon style is no wonder, for it was a "canopied void." A symbol of man's ability to make space his own, Hadrian's dome provided a man-made emptiness for every religion and every nation to fill in its own way. Here we see at the same time a plain symbol of man's power, of the emptiness of that power and man's impatience to fill that void with something of his creation.

Roman Pantheon interior, Panini painting, 1740

When we visit the Pantheon today in Rome we find it hard to think of it as a triumph of prosaic and prudent organization. On the Campus Martius we see a vast domed cylinder fronted by a columned and pedimented porch in the familiar Greek style. As we pass through the porch, however, and enter the empty circular hall which is the Pantheon, we are overawed by its simple rotundity. This man-made world has as its own sky a coffered dome with its own light, through a large (twenty-seven feet in diameter) circular opening (or oculus) at the top. After the familiar solidity of the stone columns and flat ceilings of the entrance we are suddenly struck by the comprehensive openness of the interior. As the focused sun streams through the oculus, the building becomes a vast orrery, recording in the movement of sunlight the revolutions of the earth.

This triumph of what was most distinctly Roman in architecture was the creation of one of the most passionate Roman devotees of Greece, Hadrian (born 76; emperor 117-138). He actually did for the Greeks what they could never do for themselves when he formed a single Greek federation with headquarters in Athens. And he gave equal representation to all the Greek cities. He codified the Athenians' laws, and completed their Temple of Olympian Zeus. Having rebuilt the shrines of Delphi, he was personally initiated into the mysteries at Eleusis. He assumed the title Olympius proclaiming a Grecophile Roman emperor who admired beauty everywhere.

The Golden House of Nero, the Pantheon of Hadrian, the Hagia Sophia of Justinian, the Abbe Suger's St.-Denis, and more recently the Versailles of Louis XIV—all celebrate their inspirer and organizer rather than the technicians and professionals who designed and built them. The epoch-marking buildings have commonly fulfilled the vision of amateurs. These eponyms had the power and the will to do what expert builders and traditional craftsmen dared not.

Architecture, precisely because it is so collaborative, has opened opportunities for the amateur to try new stratagems, outrageous and expensive novelties. For centuries, only princes and popes and Maecenases could commission paintings and sculpture, could command marches, sonatas, and symphonies to be composed, could hire eulogies, epics, lyrics, and threnodies. But the designs themselves were the works of the artists. Pope Paul III could order Michelangelo to decorate the Sistine Chapel but could not design it. Architecture was different. Since the fulfillment required vast resources and the labor of many men, the sovereign could play the architect and create the design.

In the reign of Trajan, who preceded Hadrian, Apollodorus of Damascus (c.20 - c.130?) was the emperor's minister of works and chief engineer, designer of Trajan's forum, concert hall, and baths, and of several triumphal arches. Trajan's famous bridge across the Danube, which Apollodorus built, was the emperor's proof that the Empire would not be bounded by a mere river. Here Trajan showed "that there might be no obstacle to his going against the barbarians beyond it." The bridge itself became a symbol of the difference between the prudent Hadrian and his expansive predecessors. Hadrian destroyed the Danube bridge, fearing that it might help the barbarians to invade the Empire.

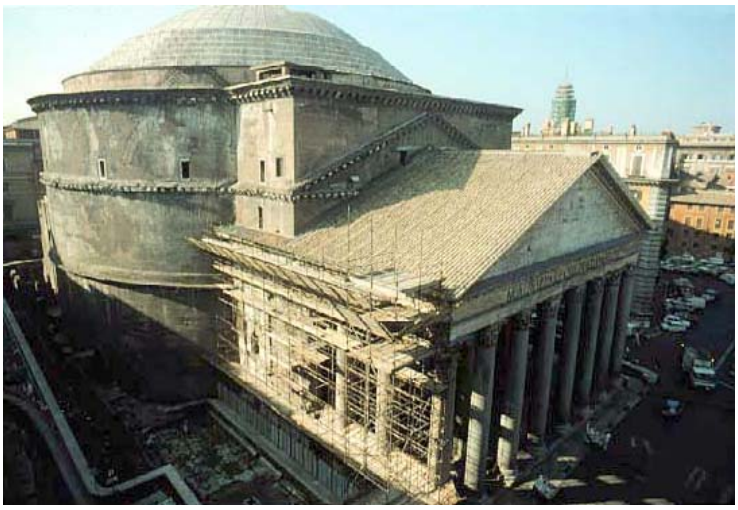
But in architecture Hadrian had the arrogance of the amateur. His own pretensions as an architect made the celebrated Apollodorus an irritant. Hadrian's envy of the great architect-engineer of his age produced the legend that Hadrian banished and then executed Apollodorus. Historic encounters between Apollodorus and Hadrian were still being reported by Dio Cassius a century later. Once when Emperor Trajan was consulting Apollodorus, Hadrian interrupted with some comment. At the time, it seems, Hadrian had been making architectural drawings of his own. Then Apollodorus impatiently retorted to Hadrian, "Be off, and draw your pumpkins. You don't understand any of these matters." Hadrian could never forget the slight. Yet as emperor he still sought the eminent professional's counsel. When Hadrian sent

Apollodorus his own design for the Temple of Venus and Rome, he formally asked the architect's opinion. Bluntly Apollodorus replied that the temple should have been built on higher ground to make it stand out more conspicuously on the Sacred Way. Within the temple itself, Apollodorus added, the statues had been made too tall for the height of the cella. "For now, if the goddesses wish to get up and go out, they will be unable to do so." Hadrian was understandably vexed, not only to be criticized so freely, but especially because the mistakes by this time could not be corrected.

If Hadrian was no expert architect, he was an enthusiastic and tireless builder, a model of the cultivated ruler. The roster of Roman emperors lists megalomaniacs, paranoiacs, matricides, and wife murderers. But the list could dazzle us also with the philosophical, poetic, and architectural talents of Roman emperors who sought immortality in the arts. Of these none excelled Hadrian. "His nature," the uncharitable Dio Cassius (I55?-post 230) wrote, "was such that he was jealous not only of the living but also of the dead." And, we might add even of the unborn, whom he was determined to impress.

Born in Rome in 76, Hadrian was only nine when his father died, and he was put in the care of his father's cousin, the future emperor Trajan. In Trajan's childless household, Hadrian was the emperor's favorite; he married Trajan's grandniece, and became the heir apparent. By the unusually early age of thirty, even while still fighting alongside Trajan in distant Dacia, he was made praetor. After the whimsical oscillations of court favor, Trajan formally adopted Hadrian as his successor just before his death in 117.

As emperor, Hadrian aimed to consolidate rather than extend the Empire. He traveled all across the Roman world from Britain to Palestine enforcing discipline and fortifying borders. In an age when absence from Rome was an invitation to rebellion by ambitious rivals, Hadrian showed self-confidence by his extended travels. Ruthless execution of his enemies, which he regularly blamed on others, helped him hold power for more than twenty years.



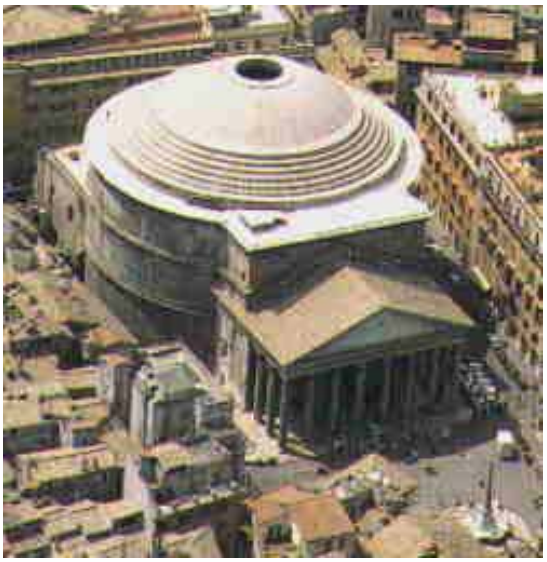
Monuments of Hadrian's ambitions, whims, enthusiasms, and prejudices were spread across the Empire. In northern Britain his great stone wall from Wallsend-on-Tyne to Bowness-on-Solway held the frontier against the barbarians. On one of his travels in Asia Minor he fell in love with a handsome youth named Antinotis (born c.110) and made him his companion. When Antinotis drowned in the Nile in 130 there were rumors that he had sacrificed himself for some mysterious purpose. To assuage the emperor's grief, cults of Antinotis sprang up across the Empire, and statues of Antinotis became familiar. A city in Egypt was christened Antinoopolis.

In the early 130s Hadrian had ordered a ban on circumcision, probably because of his horror of physical mutilation. He had made castration a crime equal to murder. But he ignored the sacred significance of circumcision for the Jews. In 134, protesting Hadrian's prohibition of their ritual, the Jews of Judaea, led by Bar Kokhba, rose in revolt. Then Hadrian's officers dissolved Judaea, which became Syria Palaestina under a consular legate and two Roman legions. In this way Hadrian made the Jews a "homeless" people, and created the Jewish Diaspora.

"The explorer of everything interesting" (*omnium curiositatum explorator*) was Tertullian's (160?-230?) praise of Hadrian. He showed his administrative talents in codifying the praetor's edicts to make the laws more certain, and in humanizing the treatment of slaves. Hadrian's creative spirit was best expressed in architecture. The remains of his villa at Tivoli sixteen miles northeast of Rome still charm the tourist. The original country palace, stretching a full mile, displayed his experimental fantasy. There, on the shores of artificial lakes and on gently rolling hills groups of buildings celebrated Hadrian's travels in the styles of famous cities he had visited with replicas of the best he had seen. The versatile charms of the Roman baths complemented ample guest quarters, libraries, terraces, shops, museums, casinos, meeting rooms, and endless garden walks. There were three theaters, a stadium, an academy, and some large buildings whose functions we still cannot fathom. Here was a country version of Nero's Golden House.

Tivoli's historic significance is less in its grandeur than in its wonderfully relaxed way of shaping the relics of the right-angled Greek masses into curves and vaults and domes. The emperor's circular island retreat, the Teatro Marittimo,

enclosed concave and convex chambers. Tivoli displayed every conceivable form of arch and undulation. There were temples to assorted gods, including one to the Greek-Egyptian god Serapis. The vestibule of the Piazza d'Oro was covered by a curious pumpkin vault, of the design that had excited Apollodorus' ridicule. The new architecture of interiors revealed itself too in the outward shapes. The exterior of the Piazza d'Oro expressed the curved interior, which was the heart of the building. The architecture of mass was being displaced by an architecture of space, no longer piling and hewing stone for the outside viewer, but creating a novel world within.

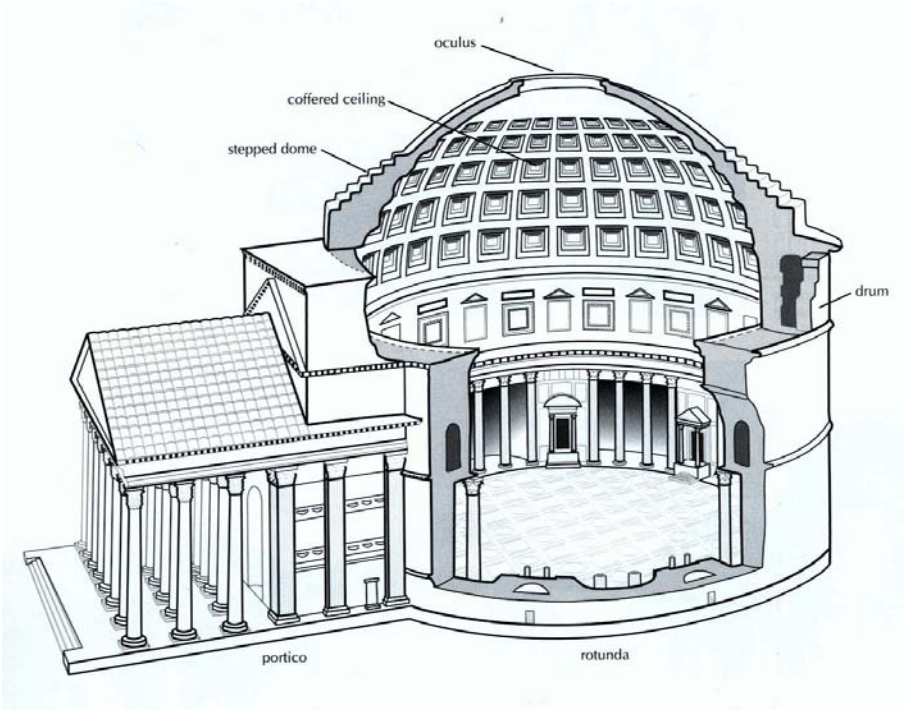


Hadrian's Pantheon in the heart of Rome, like Nero's renewal of the city, was another example of how catastrophe sparks creativity. For, like the Parthenon, it was not the first public building on its site. There Marcus Agrippa (64?-17? B.C.E.), friend of Augustus, had built an earlier Pantheon, which was destroyed by the fire of 80. Rebuilt by Domitian, it was again destroyed by fire in 110. This gave Hadrian his opportunity. In his new Pantheon, Hadrian would exploit all the possibilities of concrete with bold design and engineering technology. Astonishingly his building still stands for us to see. It stands because, having been consecrated as a church, it was cared for through the ages. But it must be experienced from within. It was perhaps the first great ancient monument designed as an interior. In its dazzling burnished void we are overwhelmed by the challenging circular emptiness of a rotunda 150 feet (43.3 meters) across and of precisely the same height. The natural light pouring through a circular open skylight reminds us that the natural world is still out there. Eight piers mark semicircular chambers serving as niches. But our eyes are carried upward to the coffered dome.

Modern architects are awed by the ingenuity that used an intricate scheme of concrete brick-reinforced arches to overarch so vast an opening and for eighteen hundred years bore the concrete dome's enormous weight. What made this possible was artificial stone shaped to order in the very place where it would be used. This first required a forest of timbers, beams, and struts to provide the hemispherical dome of wood on which the concrete could be poured. Concrete comprised nine tenths of the whole building. Brick only gave body and strength to the concrete and carried down the thrust of the weight. Marble facings and mosaic fragments were just veneer.

Concrete, too, was at the very foundation where it provided a solid deep ring on which the whole rested. For the rotunda walls concrete had been poured into trenches of a thin brick shell. As each layer dried, another brick shell was provided to make a trench for more concrete. And so it went until the terrace level from which the dome curved inward. At this point the timbers provided a wooden dome on which to pour the concrete. And negative wooden molds had been prepared to impress the shapes of the receding coffers.

The Romans had mastered some surprising subtleties with their rough raw material. Their concrete always included an "aggregate" of broken rocks. While these fragments, heavier than the matrix of lime and pozzolana and sand, increased the mass of the concrete and its supporting capacity, they also increased the weight. The higher up one went in the structure, the less need



Roman Pantheon, reconstruction drawing, 125-28 CE

there was to support weight and the more desirable that the material itself should have less weight. A close study of the concrete used in the rising levels of the Pantheon shows an astonishing subtle variation. The weight of aggregate used in the concrete decreases in regular layers upward in the building. The heaviest chunks of aggregate are in the foundations, and then they become lighter in the lower walls. The aggregate in the concrete of the topmost part of the dome is fragments of pumice, one of the lightest of volcanic rocks.

The idea of an intricate wooden frame large and strong enough to support the concrete cast for the Pantheon dome staggered the medieval imagination. So they created a plausible legendary alternative. Was it not possible instead that Hadrian's engineers had heaped up inside the rising Pantheon walls an enormous rounded mound of earth on which the cement dome could be cast? Of course this posed a new problem of how to clear the earth from the finished cylinder once the cement had dried. For this too they conjectured a solution. The shrewd Hadrian, they suggested, had the foresight to seed the earth with pieces of gold as the mound was built, and so left an automatic incentive for workers clearing the mound when the concrete vault had hardened in place.

To be an architect in concrete required creative organization and timing far beyond those needed for building in cut stone. For stones could be cut to size in advance, set aside, and then fitted as needed. But precisely because concrete was formless it was more demanding, taking shape only as it was put in place. At some stages one layer of concrete had to be fully dried before another was put on, at other points the layers were to be merged. At still others, like the top horizontal circles of the dome, the concrete had to be still tacky to take the rings of tiles around the oculus. The disciplined gangs of labor in Rome were put to good use. Scores of workmen were timed to arrive at the point where the mortar had dried, while others were climbing up and down ramps to deliver the concrete and the supporting bricks. Some manipulated cranes, and still others clambered up the inner wooden scaffolding, ready to fit facings of marble or trims of bronze.

Once the forest of timbers was removed, the visitor felt himself in a man-made cosmos. When the sun, "the eye of Zeus," streamed through the oculus at the crest of the dome the whole building became a planetarium. Some called the effect of this heavenly light in the man-made cosmos an "epiphany"-a sudden manifestation of an otherworldly being. "Pantheon " meant temple of all the gods (*templum deorum omnium*). "Perhaps it has this name," the historian Dio Cassius (155?-post 230) observed a century later, "because it received among the images which decorated it the statues of many gods, including Mars and Venus; but my own opinion of the name is that because of its dome the Pantheon resembles the heavens." Religious and imperial symbolism combined, for the Roman dominions were as extensive as the heavens, which were both the habitat of the gods and "the canopy of empire." Only a temple of all the gods could celebrate a state that encompassed the world, and Romans called their Pantheon the temple of the world.

It still carried this message a millennium later. Stendhal found it the very embodiment of the sublime. Shelley, while confessing his "propensity to admire," reported his impressions on March 23, 1819:

> The effect of the Pantheon is totally the reverse of that of St. Peter's. Though not a fourth part of the size, it is, as it were, the visible image of the universe; in the perfection of its proportions, as when you regard the unmeasured dome of heaven, the idea of magnitude is swallowed up and lost. It is open to the sky, and its wide dome is lighted by the ever-changing illumination of the air. The clouds of noon fly over it, and at night the keen stars are seen through the azure darkness, hanging immovably, or driving after the driving moon among the clouds. We visited it by moonlight. ...

While the Pantheon remains wondrously intact in its domed perfection, it has suffered minor pillages. The Pantheon we see today is not all that Hadrian dedicated in 128. The building was originally fronted by an extensive rectangular columned forecourt as long as the Pantheon itself. Some modem visitors have been disturbed by the present angular pedimented porch. But a circular building needed a clear signal of its entrance. This the Grecophile Hadrian supplied by a conventional form that might have satisfied Vitruvius, and may even have been built to his textbook specifications.
But after this obeisance to tradition, Hadrian made his own radical advance. The first Pantheon, by Agrippa (c.25 B.C.E), had been noted for its caryatids in the familiar Greek orders. Hadrian moved on to the dome. And the same subtle relations between the square, the circle, and the human figure, which Vitruvius had explained, were embodied in the Pantheon rotunda. It was these Vitruvian proportions that Leonardo da Vinci would celebrate. The dome rises from a wall above the paving exactly equal to its own height. In the vertical section the rotunda is half a circle inscribed in the upper half of a square. And the radius of the dome appears to be the same as the interior height of the cylinder.

The preservation of the Pantheon, despite the anti-pagan enthusiasms of the early Middle Ages, was itself a miracle. It was luckily still standing in 608, when Emperor Phocas in Constantinople allowed Pope Boniface IV to consecrate it as a

church "after the pagan filth was removed. ..so that the commemoration of the saints would take place henceforth where not gods but demons were formerly worshipped." For the five intervening centuries, while the surrounding buildings fell into ruin, the Pantheon had survived. Its metal fittings tempted robbers. The Byzantine emperor Constans II visited Rome long enough to take away its gilded bronze roof tiles, of which he was promptly robbed by Arab pirates off Sicily. The popes tried to improve the structure by adding towers to the front. The belligerent and profligate Pope Urban VIII (1568-1644; pope, 1632-1644) of the aristocratic Barberini family of Florence, the ally of Richelieu—and who first supported, then condemned, Galileo—was an architectural enthusiast. Patron of Bernini, he adored the Pantheon. In 1632 he inscribed on the back of the porch, "Pantheon, the most celebrated edifice in the whole world" (*Pantheon aedificium toto terrarum orbe celeberrium*). Then he proceeded to strip off the bronze from the roof beams of the Pantheon porch for one of his own projects. "What was not done by the barbarians," the Roman wits quipped, "was done by the Barberinis" (*Quod non fecerunt barberi, fecerunt Barberini*). The Pantheon metal appears to have been used to cast eighty cannon to be emplaced on the Castel Sant' Angelo, the colossal circular stone mausoleum that Hadrian had built for himself. Urban VIII argued that it was better to use the metal to defend the Holy See than simply to keep rain off the Pantheon porch. Still somehow the Pantheon has managed to retain its original bronze doors.

Despite minor desecrations, the Pantheon has remained the grand symbol of anew age in architecture. Until the twentieth century it was reputed to be the largest dome ever built (141 feet in diameter). While Hadrian left a bold mark on the architecture of Rome and the West, he was curiously reluctant to leave his name. Having rebuilt Agrippa's Pantheon, instead of inscribing his own name, he misled historians by restoring Agrippa's original inscription, "Marcus Agrippa, son of Lucius, three times consul, built this" (*M. AGRIPPA. L.F. COS. TERTIUM fecit*). But the dated bricks leave no doubt that the Pantheon was built between 118 and 128, under Hadrian. Probably it was less modesty than willfulness that made him refuse to sign the greatest architectural monument of the age. No wonder the ancients found him a baffling character—"niggardly and generous, deceitful and straightforward, cruel and merciful, and always in all things changeable." In 1520 the artist Raphael (1483-1520) chose to be buried there. In the nineteenth century, it became the tomb of the first two kings of the new Italian nation.

One of the versatile Hadrian's most memorable creations was the plaintive verse he wrote on his deathbed:

> Animula vagula blandula,
> Hospes comesque corporis,
> Quae nunc abibis in loca
> Pallidula rigida nudula,
> Nec ut soles dabis iocos. *Ad animam suam*
> (Little soul, wandering gentle guest and companion of the
> body, into what places will you now go, pale, stiff, and
> naked, no longer sporting as you did!)

And Hadrian did create a grand resting place for his body. His mausoleum, employed as the core of the Castel Sant' Angelo, begun in 135, three years before his death, remains even more conspicuous and more familiar to the tourist than the Pantheon. Mausoleums were usually round, and this too was a rotunda, a vast stone drum faced with marble and surrounded by statues. On top in the middle was a roof garden in the Babylonian style. He made it rotund to imitate the tomb of his idol Augustus, but far exceeded it in magnificence. This was also a final monument to the departed architecture of mass, for it had no significant interior, only a burial chamber. It would provide the setting for the tragic last act of Puccini's *Tosca*. And the future of Western public architecture lay in the fertile afterlife of the Pantheon.