arts

Essay

Temple of Death! The Sight of You Chills Our Hearts—Ruminations on Affect in Architecture

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Abstract: This essay discusses the affect of a group of well-known buildings and one project from antiquity to the recent past: Pantheon, Rome; Hagia Sophia, Istanbul; Leon Battista Alberti's Sant'Andrea, Mantua; Etienne-Louis Boullée's Project for a Newton Cenotaph; Louis I. Kahn's Salk Institute for Biological Studies, La Jolla and Frank O. Gehry's Guggenheim Museum, Bilbao. Despite the disparities in time, at least two of the works considered have characteristics in common, while others have more.

Keywords: affect in architecture; concealed structure; nature incorporated in architecture

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Every work of architecture, from the sublime to the squalid, possesses AFFECT, the emotional charge, which may range from disgust to delight.[1] The title of this essay, a quotation from Étienne-Louis Boullée's *Architecture, Essay on Art*,[2] suggests how overwhelming that emotion may be. In this essay, we explore a few notable examples of structures, ranging in date from the early second century to the late twentieth, that create strong emotional reactions, as well as one unbuildable project that, had it been constructed, surely would have done the same. All the buildings have been experienced by the author.

Although each of the designs has its unique character, in encountering them one by one the reader begins to realize some of them share more than one characteristic that creates the effectiveness of the affect. A central purpose of this essay is to point out these shared characteristics. The experience of a work of architecture is kinetic, as opposed to that of a painting, which can be seen in its entirety (but hardly understood) in a first look. Affect of a building often depends on how the designer arranges the sequence of its spaces. Large size is often a major factor, as is novelty of structure. Concealing actual structure is often a crucial factor in affect. Several of the designs seek to invoke the cosmos to make political, religious, or scientific points. Readers are urged to keep this list in mind as they consider and compare the examples under scrutiny. This essay contains little new information. No one could hope to be a specialist in all the periods represented. Rather, the essay is dependent on the work of many scholars, to whom I offer my gratitude. The novelty of the essay lies in its analysis of these superb examples of architectural affect together as a group.

1. Guggenheim Museum, Bilbao

A few months after Frank Gehry's Guggenheim Museum in Bilbao opened in 1997,[3] my wife Leslie and I visited it on a Sunday afternoon, as local families brought their children to see it for the first time. We stood in the vertiginous central atrium and watched the entering visitors' reactions (Figure 1). They looked from side to side, then up. Responding to the emotion of delight, they then smiled.

Using the age-old architectural trick of compression and release—leading a visitor through a narrower, lower space into an unexpectedly tall, light-filled space—Gehry had set them up to smile. First, had come a long descent down a broad outdoor staircase (Figure 2) to a lobby of gracious, but hardly surprising size (Figure 3).

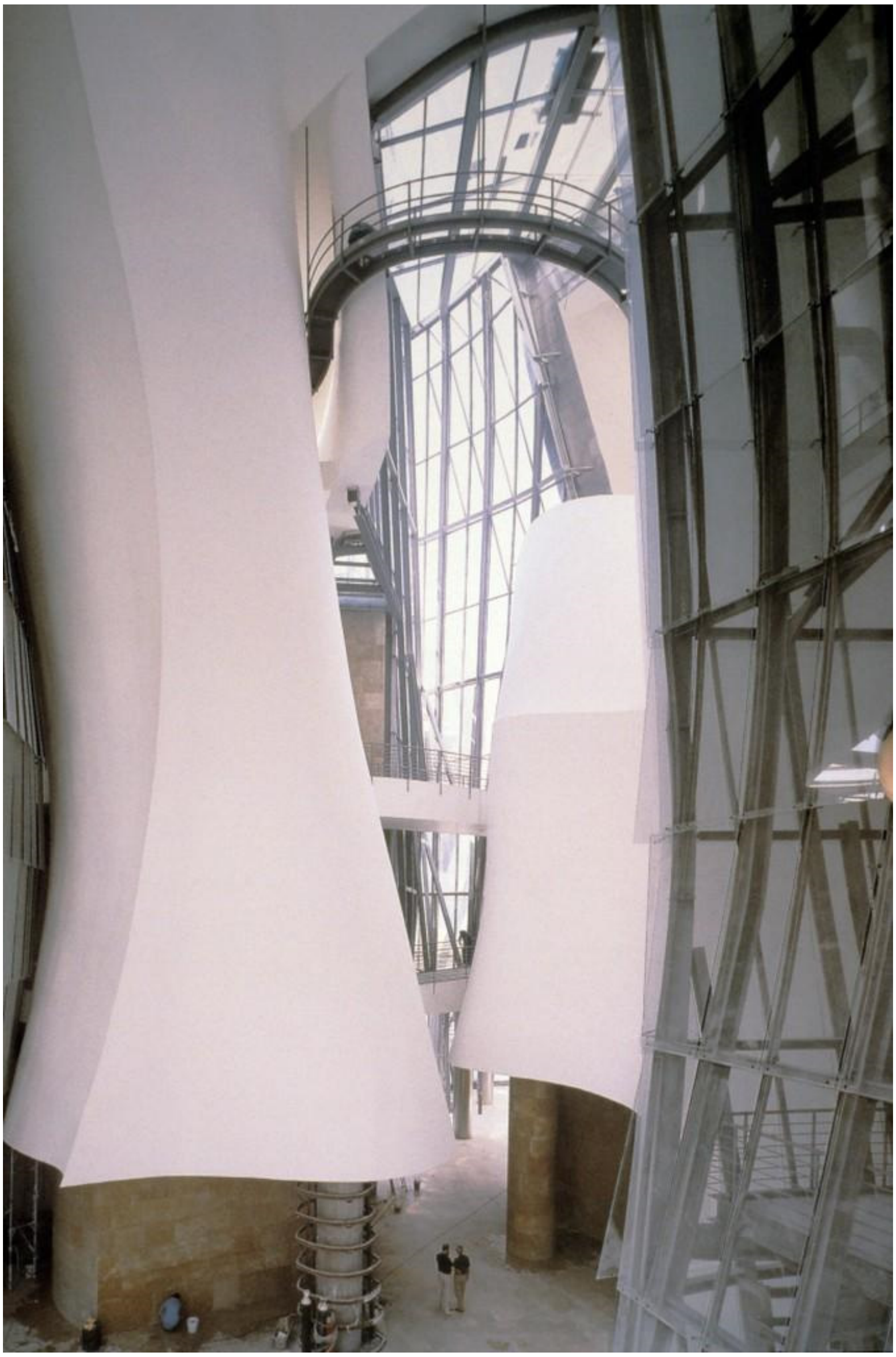


Figure 1. Frank Gehry, Guggenheim Museum, Bilbao. Visitors entering atrium after passing under a lower ceiling.

There they bought their tickets. Then, Gehry led them through a lower passageway into his towering atrium.

Curving swirls of structure-concealing white plaster rose between steel and glass forms to create a ballet of solids and voids, the smooth, curvaceous verticals of plaster alternating with the sharp-edged, angular towers of brittle glass (Figure 4). The eternal architectural verities of weight and support disappear into a world of balletic motion. Who could resist smiling at such visual joy?

Figure 2. Guggenheim Museum, Bilbao, exterior stair to main entrance.

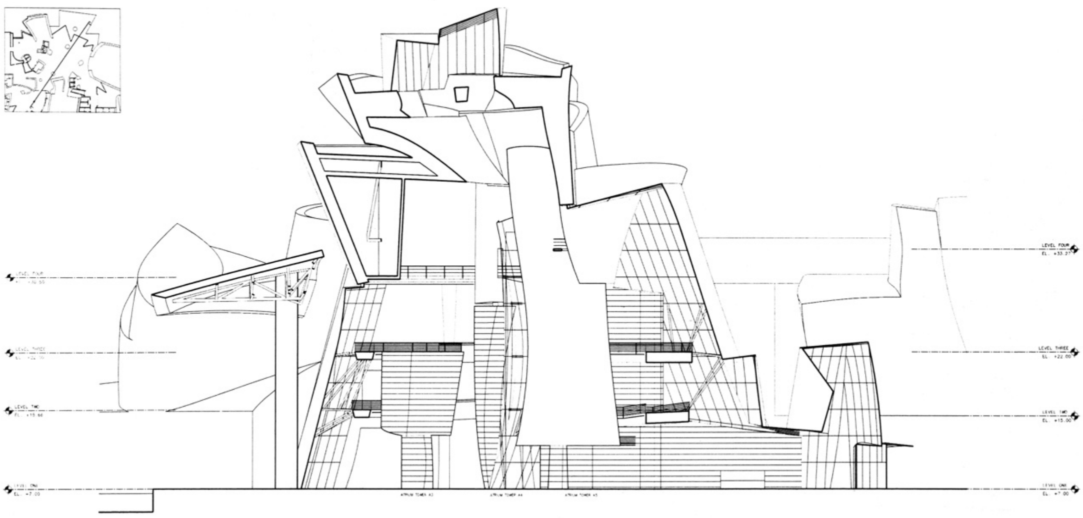


Figure 3. Guggenheim Museum, Bilbao. Section (r to l) through entrance with canopy, lobby with ticket desk, low passage to atrium, atrium, outdoor terrace with canopy overlooking the Nervion River.

Figure 4. Guggenheim Museum, Bilbao, view into top of atrium.

The utter novelty of the architecture—no space quite like this had existed before—joined with the surprise of the size and height to create what one might call a WOW affect. Contemporary advances in digital and building technology made this possible. Gehry's office used software developed to design French fighter jets to calculate the stresses the novel structure would have to sustain.[4] No two parts of the construction are identical. Computers calculated the precise dimensions of each piece and specified the precise time at which it would arrive on site to be put in its proper place. To coordinate the construction in Bilbao with direction sent from the Gehry office in California, 37,000 faxes were transmitted across the Atlantic.[5] One can argue the purpose, even the meaning, of the building is to celebrate the visual delights that digital technology can create in a brilliantly designed building. It is a work of art designed to display works of art, and to attract visitors from around the world to underpin the economy of Bilbao and the Basque Region. Among the elements that play a role in the affect of the Guggenheim are the novelty of the space, surprise on seeing the interior, inability to understand the structure on first viewing and, of course, visual pleasure.

2. Pantheon, Rome

The Pantheon in Rome (Figure 5) was designed to overwhelm visitors with the unexpected size of an interior vaster than any previously constructed anywhere. It was begun during a time when Rome enjoyed its greatest power, by the emperor Trajan (r. 98–117) and completed by his successor Hadrian (r.117–138). The great size of its interior space alone had an affect that has outlasted the empire nearly 2000 years. When the contemporary Japanese architect Tadao Ando first visited Rome, the emotional impact of the Pantheon's interior on him was revelatory:

> *I first experienced space in architecture inside the Pantheon in Rome. . .what I experienced was not space in a conceptual sense.*
>
> *It was truly space made manifest. . .. It was this power of architecture that moved me.*[6]

Figure 5. Giovanni Battista Panini, *Interior of the Pantheon*, c. 1734. National Gallery of Art, Washington, D.C.

Since the Pantheon's early history is difficult to know accurately, we proceed with caution and try to indicate where the interpretation of that history is based on hypotheses.[7] Hadrian became emperor when Trajan died in 117. For that reason the starting date for its construction has traditionally been given as 118, the year the new emperor arrived back in Rome, and its conclusion as 126–28. Two earlier Pantheons had risen on the same site, one built by Marcus Agrippa (63-12bce), son-in-law and chief assistant of the first emperor, Augustus (r. 27bce-14ce). That burned and was rebuilt under Domitian (r. 81–96). Since both structures succumbed to fire, they must have been in good part made of wood. Recent scholars have plausibly suggested the present building was begun by Trajan and then completed by Hadrian, who surely was responsible for its final appearance.[8]

The name Pantheon comes from Greek—*pan* (all) and *theos* (god)—and suggests a building for all the gods. Originally, the word may have been meant by Agrippa to suggest the new emperor, Augustus, has assumed the status of a deity that rulers in Asia, but not in Rome, traditionally assumed for themselves. Augustus had refused to make such a claim, but Agrippa may have gone ahead with the story anyway, thus denying Augustus' politically useful public modesty. In the present building, the inscription on the façade (Figure 6) strangely recalls the original dedication by Agrippa.[9] Hadrian, from Spain and the first non-native-born emperor, may have wanted to associate himself with Augustus to cancel suspicions created by his foreign origins. In any event, the eight-column portico reused the typical temple front developed in previous centuries in Greece as the mark of the house of a god (Figure 6). The single, red granite, 40 m. shafts of the columns are impressive in themselves. Quarried on the Sinai Peninsula, they were dragged to the Nile River, each put on a barge to Alexandria, then transferred to a single ship and sent off to Italy, where they were transferred to another barge and floated up the Tiber to the center of Rome. Only a Roman emperor could have ordered or afforded such extravagance. Behind the front row of columns two more rows of grey granite single shafts subdivide the porch into two side spaces that end in niches in which statues of Augustus and Agrippa may have stood and a middle space that leads to the single, relatively low door that offers entrance into the interior (Figure 7).

Figure 6. Pantheon, Rome, facade.

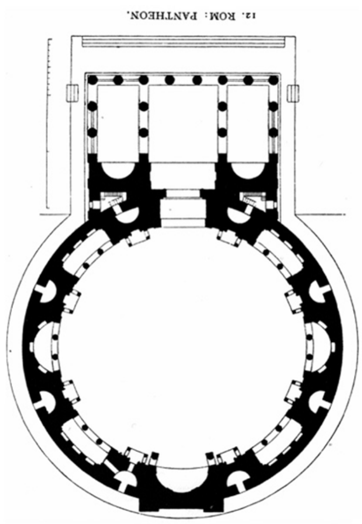


Figure 7. Pantheon, plan, north at top.

The vastness of the interior is a grand surprise. Instead of the standard rectangular interior offered by earlier temples, the Pantheon boasted a circular space, 150 Roman feet in diameter, that rose to a semicircular dome 150 Roman feet in height (Figure 8). The apex of the dome opens into a void 30 Roman feet wide, through which a disk of sunlight shines on the interior walls, or rain enters on inclement days (Figure 5).

Figure 8. Pantheon, Rome, dome.

The only such concrete structure in the world without metal reinforcement, the dome is made of a variety of materials, arranged in horizontal layers with the heaviest at the bottom graded to the lightest at the top, to lessen the weight and thus the load of the dome to insure its stability. The hole at the top, which aids in reducing its weight, replaces the standard keystone in the center of a round arch which creates its ability to stand free in space without direct support from below. The circle that surrounded the hole, once covered by a layer of gilded bronze, acted as a compression ring that resisted the forces in the dome that, if left unchecked, would cause it to fall. Carefully engineered, the dome has stood for centuries, working its affect on Ando and countless others.

Holding the dome up is a totally concealed structure of brick-faced concrete piers and arches that creates a continuous masonry drum from which the dome springs (Figure 9). Roman architecture is celebrated for its engineering prowess. Only in certain utilitarian structures, such as bridges and aqueducts, was that mastery allowed to show its true form and bulk. The meaning of an important building was constructed visually by an overlay, often of thin layers of stone revetment that mimicked traditional post and lintel construction consisting of vertical pilasters (flattened columns) and horizonal courses that the pilasters seemed to support (Figures 5 and 9).

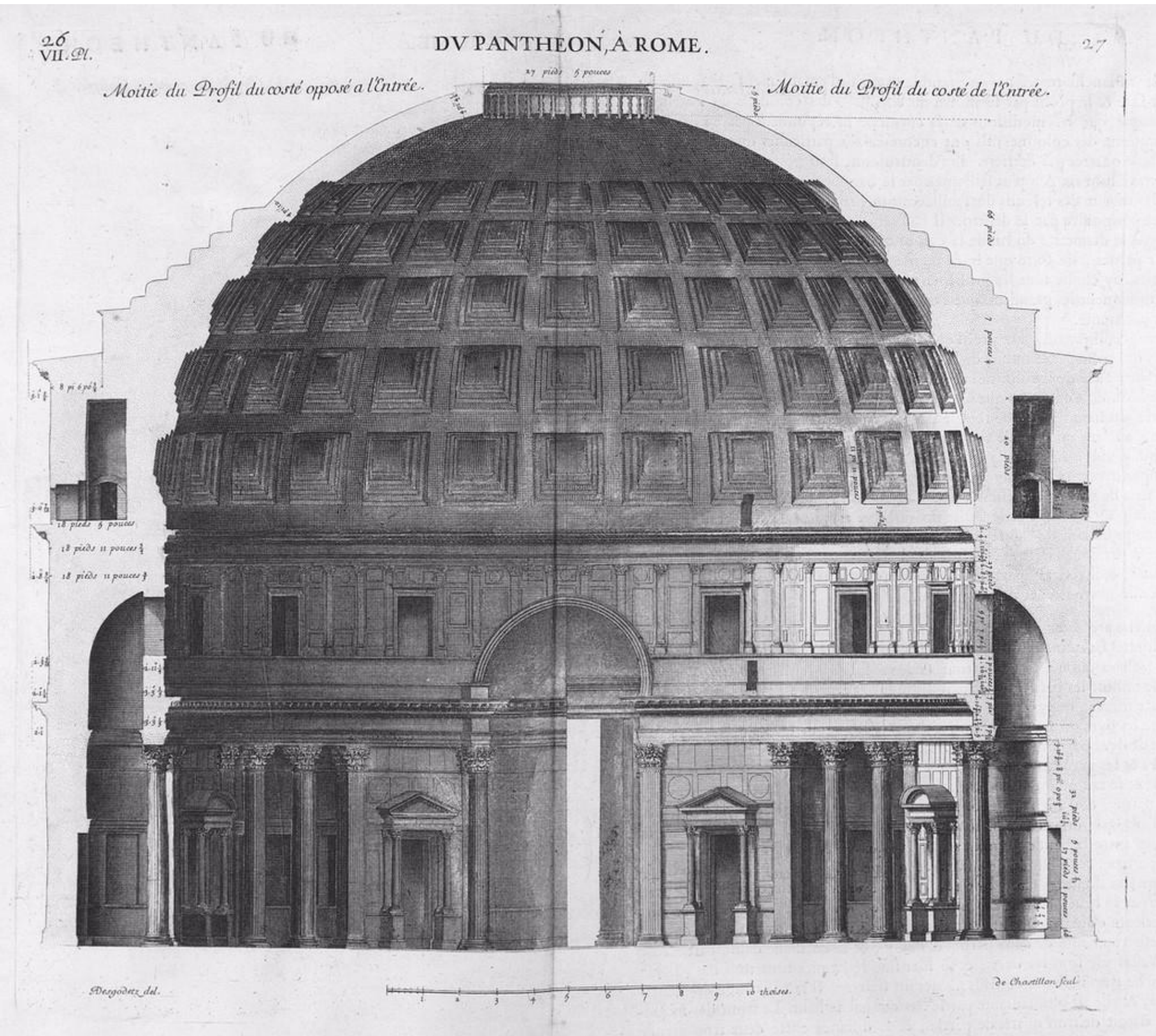


Figure 9. Antoine Desgodetz, half sections of the Pantheon, to the center left through the apse at the south end, to the center right through the entrance door at the north end. (From Les Edifices Antiques de Rome dessinés et mesurés très exactement, Paris, 1682).

The lowest level of the interior walls is articulated with marble pilasters that alternate with open space in the walls that define the edges of the hidden structural piers that rise from the ground and support semicircular vaults strong enough to bear the weight of the dome. These vaults are only visible on the interior over the entrance door and the semicircular apse that faces the entrance. All the others are hidden. The openings to the six other spaces that radiate from the circular center, known as exedrae, are screened by pairs of free-standing columns that join the pilasters to support visually the horizontal band of an encircling entablature, above which a second story, known as the attic, rises (Figures 7 and 10). The attic is faced with extremely slender pilasters that frame windows that receive sunlight from the hole in the dome and, in a seemingly contradictory, fashion act as exterior windows allowing sunlight to pass into the upper reaches of the dark exedrae.

Figure 10. Pantheon, Rome, interior from entrance. Note the attic story was remodeled under Pope Benedict XIV (r. 1740–1758). In the twentieth century a small section of the original attic, visible to the right, was restored.

The contradictory nature of the concealing revetment only increases as the walls rise higher. The attic pilasters, marching to their own rhythm, do not line up with the columns and pilasters below. They deny the existence of the continuous vertical support that the piers and vaults they hide provide. Above the attic lies another horizontal course from which the dome appears to spring. The dome is marked by six horizontal rows of twenty-eight indentations known as coffers, each framed by vertical ribs that do not line up with the pilasters below, another denial of vertical continuity. At the top a vertically neutral, flat ring surrounds the opening, or oculus, in the dome.

Why did the brilliant person who designed the Pantheon go to such lengths to hide the bold, innovative structure essential to the lasting stability of this epochal design? We have no preserved text to help answer this question. We do know Hadrian held court in it,[10] and that bit of information may help to hypothesize an answer. The interior of the Pantheon is an abstract depiction of the cosmos, or at least the heavenly bodies most easily seen from the vantage point of Earth. The rows of 28 coffers can be understood to represent the monthly cycle of the moon. The sun is trapped inside the building and daily moves in a reverse arc across the north wall of the entrance (Figure 5). The interior walls, masquerading as those of an exterior courtyard, over which the dome of heaven hovers,[11] deliberately invert the concepts of exterior and interior. Even rain falls inside.

If we begin to think of the Pantheon not so much as a temple, but rather as an "outdoor" imperial audience hall in disguise, then we may be getting somewhere in understanding the building's disturbing strangeness. The façade (Figure 6) was surely an oversized version of a standard ancient temple, as invented by the Greeks and then taken up by the Romans. Originally the Pantheon façade faced a rectangular open space lined by porticos, such as the open area in the earlier Forum of Augustus. Rising from the rear of its open area was the Temple of Mars Ultor (the Avenger), representing the vengeance that Augusts had visited on the assassins of Julius Caesar, whose Forum, with a similar plan, stood directly at right angles to the Forum of Augustus. An ancient visitor approaching the portico of the Pantheon through a space flanked by rows of columns would have registered the parallels.[12]

What might a visitor have felt upon encountering for the first time the shock of the largest, most astounding space that person had ever encountered? Across from the entrance, 150 feet away, Hadrian, holding court, would have sat enthroned on a raised platform in front of the apse (Figure 10). In the tabernacles and exedrae around the center stood statues of gods, in the presence of which the emperor ruled. The emperor himself had caused the Pantheon's representation of natural phenomena controlled by individual gods, such as those of the sun, the moon, the weather, and the planets. Because the structure that supported the dome was concealed, it appeared to float over the walls of an open courtyard, pierced by windows that "lit" the spaces of the exedrae. A supplicant's knees could not have helped but shake on entering. One doubts, however, he or she could calm down quickly enough to make sense of the conflicting information the architecture offers. Time is required to understand its affect. Hadrian himself must have responded emotionally to what he had caused to be completed, taking pleasure and pride in the way the apparent effortlessness of the huge structure made him seem divinely powerful. And, presumably he enjoyed the affect of wonder he must have read on the faces of his subjects.

3. Hagia Sophia, Istanbul

When Frank Gehry taught a course on the Hagia Sophia at the Yale University School of Architecture, he took his students to Istanbul to experience its affect. Hagia Sofia was built by the Byzantine Emperor Justinian (r. 527–565) as a Christian church in the astoundingly short span of five years, 532–537, as the principal church of his realm, the Eastern Roman or Byzantine Empire (Figure 11). In 1453, the Ottoman Turks seized Constantinople, changed the city's name to Istanbul and converted the Hagia Sophia to a mosque.[13] Gehry's choice of Hagia Sophia for his students' field trip demonstrated how much he admired it and underscored his desire to rival it in his Guggenheim atrium.

Justinian chose to design the church Anthemius of Tralles, a mathematician, and Isidorus of Miletus, a geometer and engineer, both of whom had no experience, as far as we know, with creating buildings as large and complex as Hagia Sophia, which enclosed more cubic meters than any other building then existing.[14] Their inventive plan placed a circular dome over a central square set between two half circles with radii as large as that of the central space. These half circles are covered by half domes. Off the half domes radiate smaller half circles, each capped by a smaller half dome (Figure 12).

The large church that previously stood on the site had been demolished in a violent insurrection that almost cost Justinian his throne and his life. Urged by his empress, Theodora, to put down the uprising, Justinian ordered his soldiers to slaughter the rioters, who had gathered in the nearby Hippodrome. The new church was to be the symbol of his resurrected power. He wanted it built fast, thus the perilously quick, five-year building period. Traditional Christian churches, developed from the fourth century on, generally had a simpler plan with a long rectangular space (the nave) flanked by side aisles separated from the nave by rows of columns and terminated at one end by a semicircular space (apse) covered by a half dome. The architects fused this traditional, longitudinally oriented Christian space of nave, aisles, and apse with a centralized, domed spaces such as the Pantheon in Rome, from four centuries earlier (Figures 12 and 13). The result is a building with diffuse, even contradictory historical origins that creates an ambiguous interior that is simultaneously centralized and longitudinal. The complex plan forced complex and not entirely successful structural solutions.

Figure 11. Hagia Sophia, Istanbul, exterior. The dome of the sixth-century church is flanked by Muslim minarets, the result of its being declared a mosque after the conquest of Constantinople in 1453 by the Ottoman Turks. The base of the building is surrounded by tombs of Ottoman sultans and by buttresses erected largely in the sixteenth century to steady the building during earthquakes.

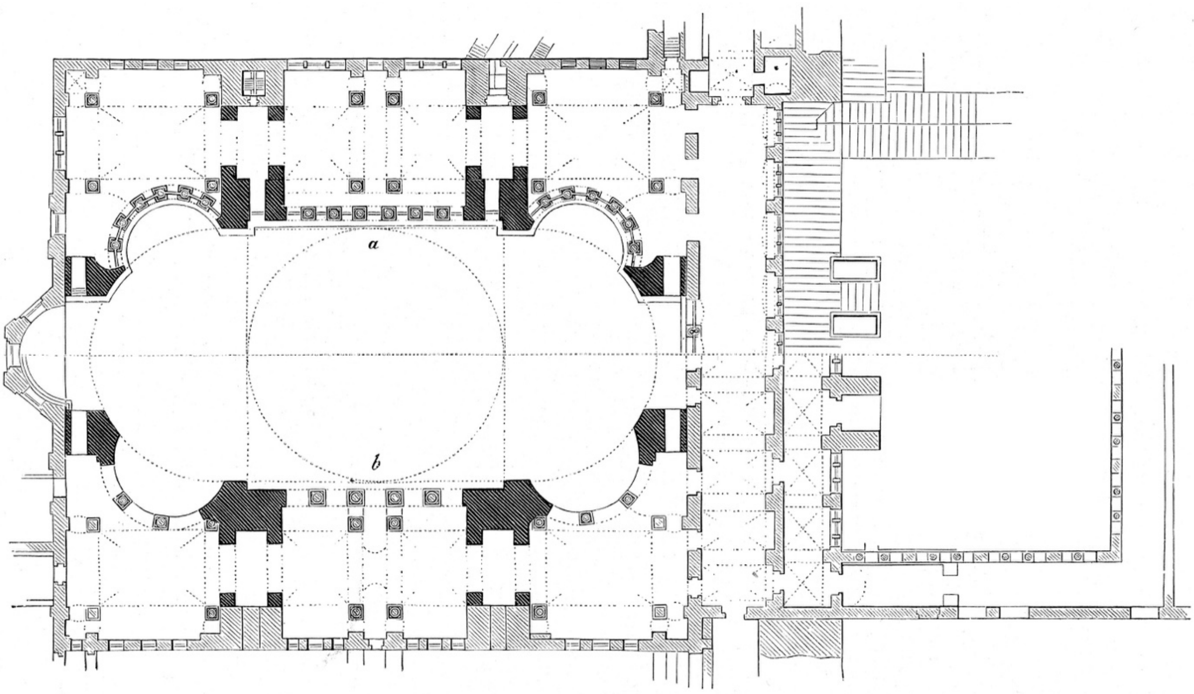


Figure 12. Hagia Sophia, Istanbul, plan at gallery level, *a*, and ground level, *b*. North is at the bottom.

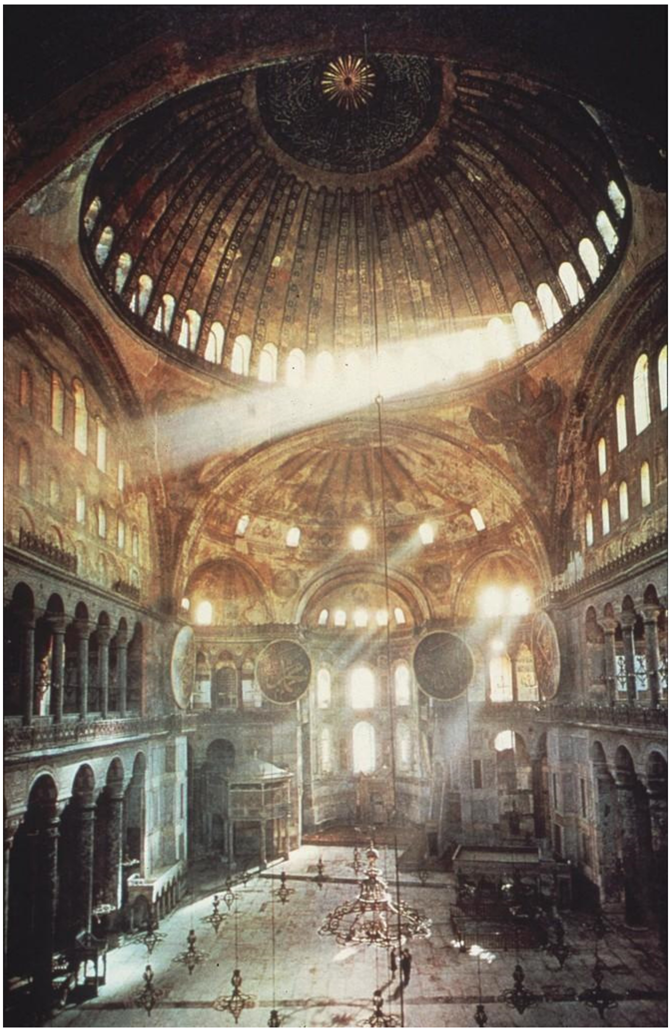


Figure 13. Hagia Sophia. Interior looking east. The large disks, covered with Arabic inscriptions, and the low-hanging lamps are Muslim additions.

Domes require specific structures to stabilize them, to support their weight, and to counter the continuous thrust, or outward push, created at their circular bases by the curved masonry of their surfaces. To hold up the dome, Anthemius and Isidorus built four great stone piers at the corners of the central square. From these rise four enormous, round, brick arches that support the circle of masonry from which the dome springs (Figures 13 and 14). The open corners between the arches were filled by spherical triangles called pendentives, to create the circular base for the dome. The original dome was very shallow, so that it created unusually great thrust. In the directions of the altar and the entrance the base of the dome was held in place, or buttressed, by the strength of the half domes, while to the sides the extremely heavy arches that spanned the openings between the central space and the aisles and galleries performed the same service. Buttressing on the diagonals extending from the great piers was tragically lacking. The piers began to lean out from the center of the dome. Eventually, after an earthquake, two of them gave way, and the dome collapsed. It was quickly rebuilt, with a steeper and more stable profile, but over the centuries two more earthquakes brought it down again. Finally, in the 16th century, the great Ottoman architect, Sinan, piled up so many huge, stone buttresses (Figure 11) that the dome has lasted until now, when recent earthquakes in tremor-prone Turkey forced the erection of stabilizing steel scaffolding that most unhappily spoiled the spatial effect of the interior. The affect depends on the total openness of the central space under the dome.

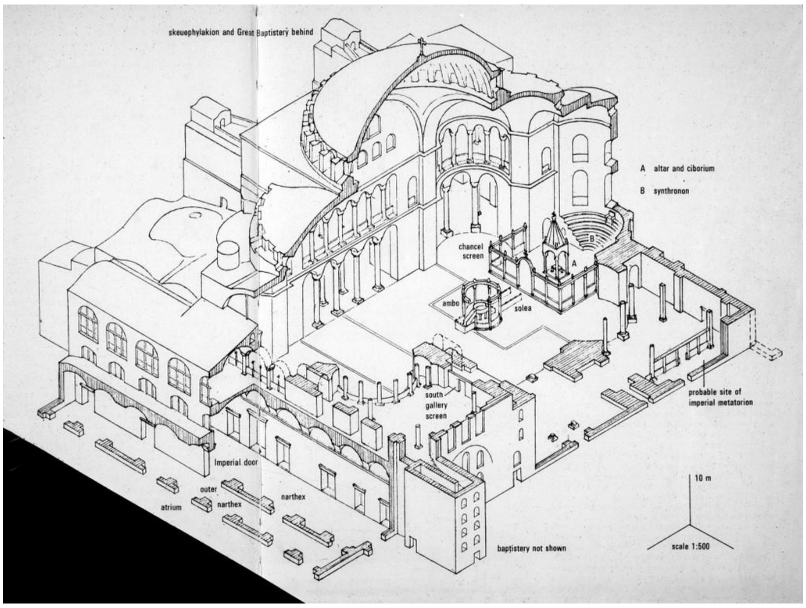


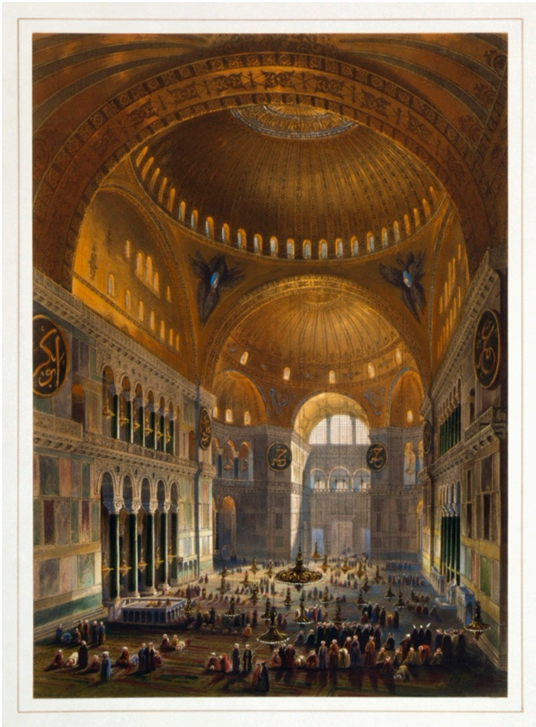
Figure 14. Hagia Sophia. Cutaway diagram. Bottom left, two narthexes, or transverse entrance halls, then nave under dome and half domes. At upper right, a column screen surrounds the area reserved for clergy, with semicircular seating for them. To right side of ground floor, spaces under the galleries.

Entering Hagia Sophia, visitors move through two low, transverse compression spaces, the outer and inner narthexes, before being forced to step up onto a stone threshold that creates awareness of entering a space that is newly experienced. And, what an experience! (Figure 13). Procopius, Justinian's historian, writes that on entering, there is so much to see that one doesn't know where to look first.[15] The ambiguous plan isn't the only disorienting detail. There is the astoundingly great size and height, c. 180 feet to the top of the dome. There is the light pouring in, in dramatic, search-light-like beams on many levels.

Multi-colored marbles slabs cover the walls and tend to deny the solidity of the four great piers that support the central dome (Figures 15a,b and 16). The columns that separate the central square from the aisles do not stand under the columns that line the galleries above, so that the sense of the vertical structure is visually disrupted. Originally the entire surface of the domes was covered in gold mosaic tiles that shimmered in sunlight and at night from the light of the flickering flames from hundreds of silver oil lamps suspended in the space.

The height and complexity of the vaulting astonishes (Figure 17). On first entrance, the eye is led up the tall, embracing walls to the trio of half domes that curve around to support the huge half dome that rises above them. In turn, that dome leaps up to the base of the central dome, punctured by a ring of 40 windows that crown the interior with light. Procopius wrote the dome seemed suspended by a golden chain from heaven.[16] In the 10th century emissaries from Kievan Rus' reported back to their ruler, after a visit to Hagia Sophia: *We were led into a place where they serve their God, and we did not know where we were, in heaven or on earth*.[17]. That is precisely the astonishment and confusion Justinian wanted. My first encounter with the interior of Hagia Sophia brought tears to my eyes, so great was the aesthetic exhilaration. No other building has produced the same reaction in a lifetime. All visitors are caught up in the wonder at the architecture of the church. Not least because its structure is so mysterious, its size so awesome, its rhythms so compelling.

(**a**)



(**b**)

Figure 15. (**a**) Gaspare Fossati, views of interior of Hangia Sophia from entrance (**left**) and from apse (**right**), color lithographs, 1852. (**b**) Fossati was in charge of a 19th century restoration of the church/mosque. His lithographs show the interior more inclusively than any photograph, limited by the capacity of a camera lens, can take in.

Figure 16. Gaspare Fossati, view from south side aisle across nave. Note the colored marble revetment that conceals the bulk of one of the great piers that support dome, located to the right just inside the colonnade. Across the nave are visible the superimposed rows of columns that do not align vertically.

Figure 17. Hagia Sophia, view from entrance into the dome and half domes. The dull painted surfaces of the vaults are no substitute for the gold mosaics that once sparkled overhead.

Procopius describes his understanding of the affect of the church on worshipers:

> *Whenever anyone enters this church. . ., he understands at once that it is not by any human power or skill, but by the influence of God, that this work has been so finely turned. And, so his mind is lifted up toward God and exalted, feeling that He cannot be far away, but must especially love to dwell in this place which He has chosen. And this does not happen only to one who sees the church for the first time, but the same experience comes to him on each successive occasion, as though the sight were new each time. Of this spectacle no one ever tires, but when present in the church men rejoice in what they see. . ..*[18]

The visual wonder and lavish decoration of the interior were all part of the church's propagandistic aims to be a simulacrum of heaven as well as a stage on which the relationship between church and state was acted out when the emperor and the patriarch, the head of the state church, met during services under the golden central dome and exchanged the kiss of peace in the sight of the assembled citizens of the empire. The gilded dome symbolized heaven,[19] while seven stripes of green marble in the pavement probably represented the seven rivers of Paradise. The confused wonder of the visitors from Kiev was appropriate.[20] On the day of dedication, Justinian, fused with pride, was reported to have exclaimed, "Solomon, I have surpassed thee".

4. Sant'Andrea, Mantua

The early Renaissance polymath, Leon Battista Alberti (1404–72), wrote around 1450 the first treatise on architecture of modern times, *de re aedificatoria* (concerning the art of building). In it, he may well have set down the earliest written statement of modern times on affect in architecture. Alberti wished a Christian church should be:

> *so beautiful that nothing more decorous could ever be devised. [He] would deck it out with every part so that anyone who entered it would start with awe for his admiration at all the noble things and could scarcely restrain himself from exclaiming that what he saw was a place undoubtedly worthy of God.*[21]

How splendidly these thoughts parallel those of Procopius.

Late in life Alberti had an opportunity to put this wish into practice, and on a grand scale. In October of 1470, he designed for his friend Lodovico Gonzaga, Marquess of Mantua in northern Italy, an enormous church dedicated to Sant'Andrea [Saint Andrew] that housed one of the principal relics of Christianity, two vases believed to contain the blood of the crucified Christ mixed with earth from Calvary, brought to Mantua by the Roman centurion, St. Longinus, who was martyred nearby. Construction of the church, which replaced an eleventh century Sant'Andrea, began in the spring of 1472, almost simultaneously with Albert's death. The first building campaign, which ended in the 1490s, was supervised by a Florentine stonecutter, Luca Fancelli, whom Alberti trained before his demise and to whom Alberti surely consigned a carefully made wooden model sadly lost to time.[22]

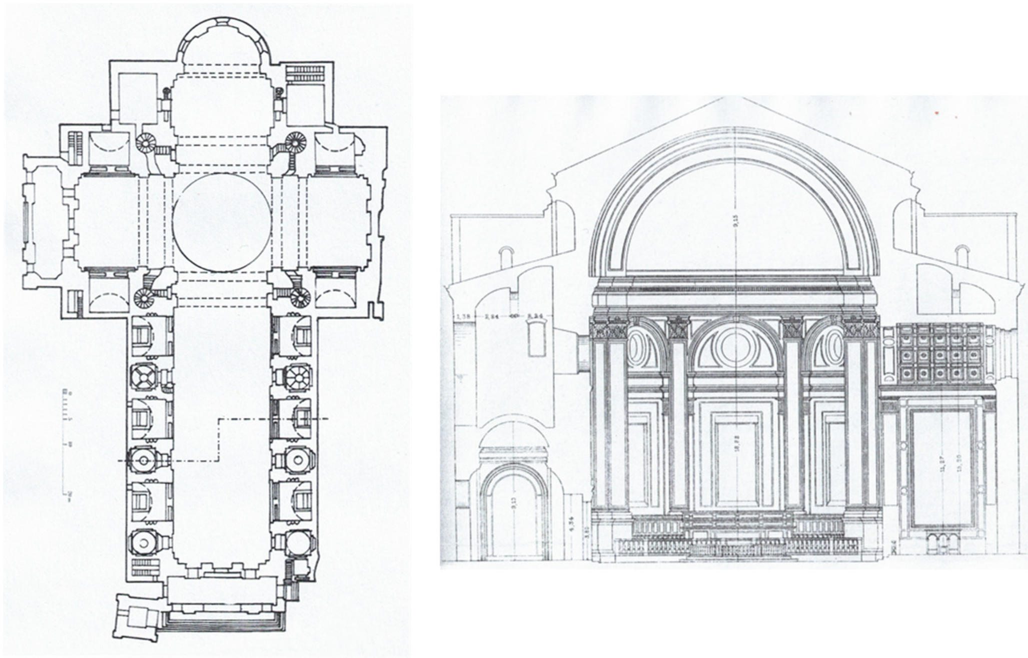
Alberti understood to produce a shock on entering his surprisingly large space that he would need to set up a compression effect. He would have to lead a visitor through an entrance space that would establish a sense of constriction in comparison to the urban space the visitor has just left (Figure 18). The visitor approaches a façade that combines two ancient architectural types, the Greco-Roman temple front and the Roman triumphal arch.[23] The flat giant pilasters, stand-ins for the columns of Greek temples or the Roman Pantheon, visually support the triangular pediment of a Greek temple. At the same time, they frame the single large arched opening of a triumphal arch and the flanking lower doors and niches of the same form.[24] The arch clearly tells one where to enter. Its barrel-vault covered space is flanked by two lower spaces covered by transversely set barrels.

Figure 18. Leon Battista Alberti, Sant'Andrea, Mantua, façade, begun 1472.

Through a relatively low rectangular door one enters the interior (Figure 19). Everyone I have engaged in conversation about the experience of entering this interior has had the same sense of overwhelming surprise at its great size. An enormous barrel-vaulted nave that is roughly sixty feet wide and ninety feet tall, flanked to each side by three side chapels whose widths and barrel vaulted heights are precisely equal to the dimensions of the central space of the porch through which the visitor has just passed. The nave walls between the chapels are marked by pairs of giant pilasters that imitate those of the porch. The central and largest space of the porch has become one of six smaller spaces serving the newly huge central vessel. Adding to the sense of correspondence between the designs of all the elements of exterior and interior is Alberti's use of mathematical proportions that one can intuit even without knowing precisely what they are. Constructed on the basis of the local measurement of the *braccio mantovano*, the nave is 40 braccia wide (18.6 m) and 60 braccia tall (27.9 m), in a simple proportion of 2 to 3. In the case of Sant'Adrea, the affect depends in part on this thoughtful use of mathematics.

Figure 19. Sant'Andrea, Mantua, interior from entrance. In the nave, Alberti abandoned the traditional model of the Christian church that featured a rectangular nave with a timber roof, flanked by side aisles separated from the nave by rows of columns, thereby providing a new model for churches subsequently built around the world.

Like that of the Pantheon, much studied and admired by Alberti, the sturdy masonry structure of piers and vaults of Sant'Andrea was partly hidden. (Figures 19 and 20a,b) The overlay of decorative elements that resemble structural forms fools the eye into believing the vertical supports are only as stout as they appear to be rather than the actual size they are required to be to support and stabilize the enormous weight and thrust of the barrel vault. The vertical pilasters at the corners of the entrances to the side chapels and the round arches that appear to rise from them are less than half as wide as the real structural piers and vaults they hide. The giant order of paired pilasters that line the nave walls are metonyms for the robust structure of the piers concealed behind them that separate the side chapels. Alberti had learned from the Pantheon how to design a building that visually belied its massive structure and thereby convinced the viewer that it was somehow beyond the possibilities of human creation. To put it another way, at Sant'Andrea Alberti lightened the appearance of the interior by making it seem the structure was largely effortless.



(**a**) (**b**)

Figure 20. (**a**) Sant'Andrea, Mantua, plan, with north to the left. The broken dotted line across the nave denotes the line along which the section, is taken. (**b**) Ernst Ritscher, Sant'Andrea, section across nave, 1899. Left side of section shows the thickness of the structure that supports the nave vault. Right side shows the slender applied pilaster that hides that thickness.

5. Etienne-Louis Boullée. Cenotaph for Sir Isaac Newton, 1784

Not surprisingly, unbuilt projects that emerge from fertile architectural imaginations can suggest affect. Étienne-Louis Boullée's Cenotaph for Sir Isaac Newton, destined to remain on paper in the safety of the Bibliothèque National, Paris, is one such.

Newton, a seventeenth-century scientist of close to unique importance in human history, was a great hero to French thinkers of the Enlightenment of the second half of the eighteenth century. Newton's insistence on placing scientific facts, derived from the observation of nature, before the importance of religious belief, underlay the Enlightenment's rejection of traditional thought. This was a revolutionary architectural design, with no hope of being built in the France of Louis XVI, only five years before the French Revolution of 1789.

To honor Newton, Boullée decided to *wrap him in his discovery*,[25] that is, in an image of the universe itself. He proposed a gigantic cenotaph, a technical term for a monument that did not house the body of the honoree (Newton is entombed in Westminster Abbey, London). From the exterior the cenotaph would have appeared as a fusion of geometric solids with bare surfaces rising to a height greater than 500 feet (Figure 21). Two concentric circular rings would have held in place a sphere. The tops of the rings would have offered platforms, reached by stairs or ramps, to circumambulate the sphere. Each ring would have been planted with double rows of cypresses, traditional arboreal markers of European cemeteries.

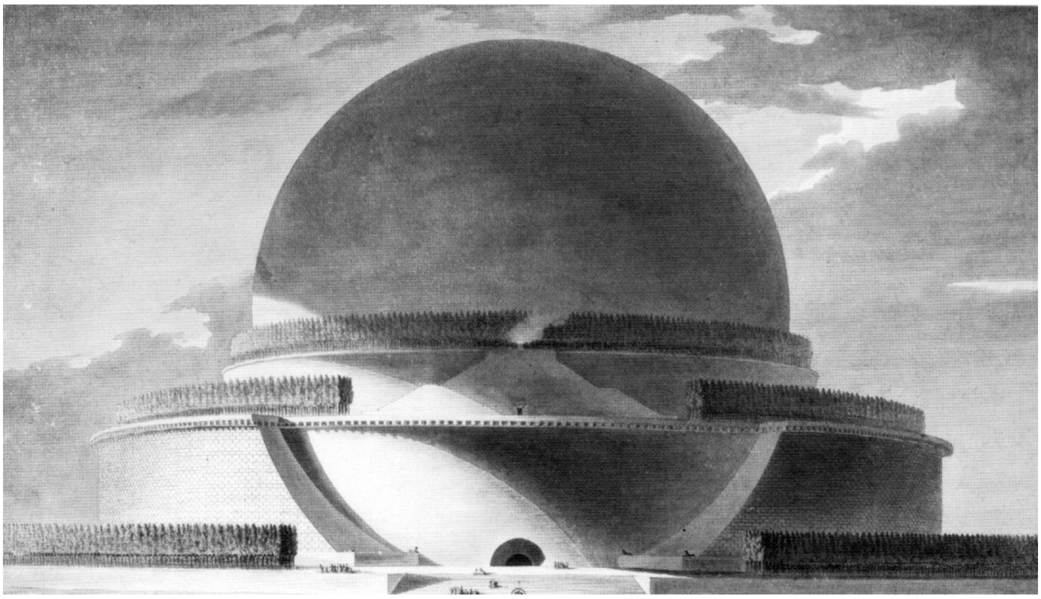


Figure 21. Etienne-Louis Boullée, Cenotaph for Sir Isaac Newton, exterior, pencil and ink drawing, 1784. Bibliothèque Nationale, Paris.

As impressive as the exterior is, the real surprise of the design is the interior (Figure 22). Entering through two round-arched, half-domed penetrations into the bottom ring, a visitor would have traveled down a long, low, dark compression corridor to ascend a ramp and emerge at the bottom of the sphere. From there, four stairs would have led to a square platform supporting a tomb-like monument to Newton. During the day, the dark interior walls of the sphere would have sparkled with natural light entering through holes drilled in its curved exterior. The holes are visible in the architect's daytime section, its overwhelming scale indicated by the scattering of tiny human figures around the platform. The pattern of heavenly bodies would have replicated the appearance of the night sky. Day literally would have turned into night. The dark walls of the sphere would have appeared as scaleless as the night sky itself.

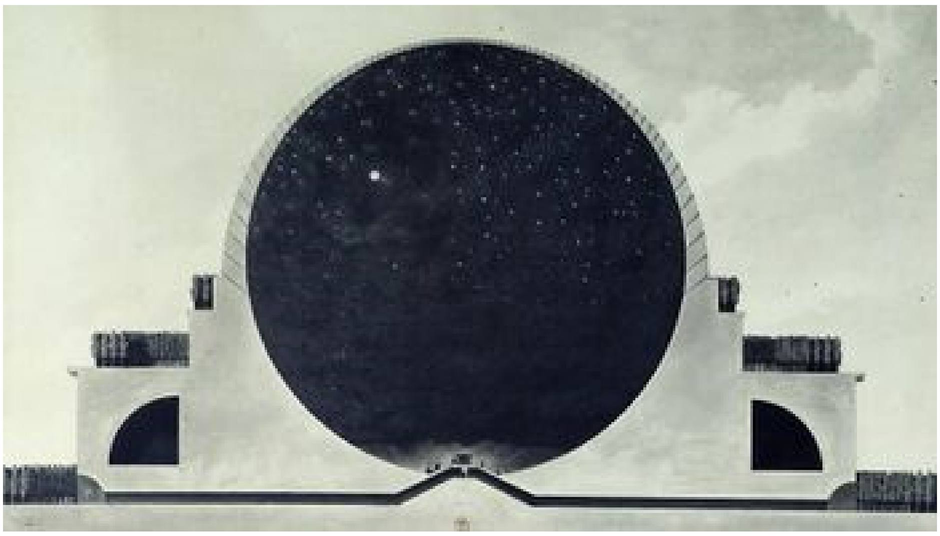


Figure 22. Boullée, Newton Cenotaph, section during the day.

At night there would have been light produced by an astrolabe suspended in the center of the space (Figure 23). Were this daring space ever to be created, one can imagine the gasps, smiles, and even tears it might elicit. Boullée's project recreates what the Pantheon and the Hagia Sophia attempt to suggest: the wonder of the cosmos. Its affect greatly would have depended on the sense of the unknowable immensity of its interior. As Boulée wrote:

> *In the Cenotaph of Newton I sought to realize the greatest of all images, that of immensity: it is through that we rise to the contemplation of the Creator and that we feel the oncoming of celestial sensations. . .*[26]

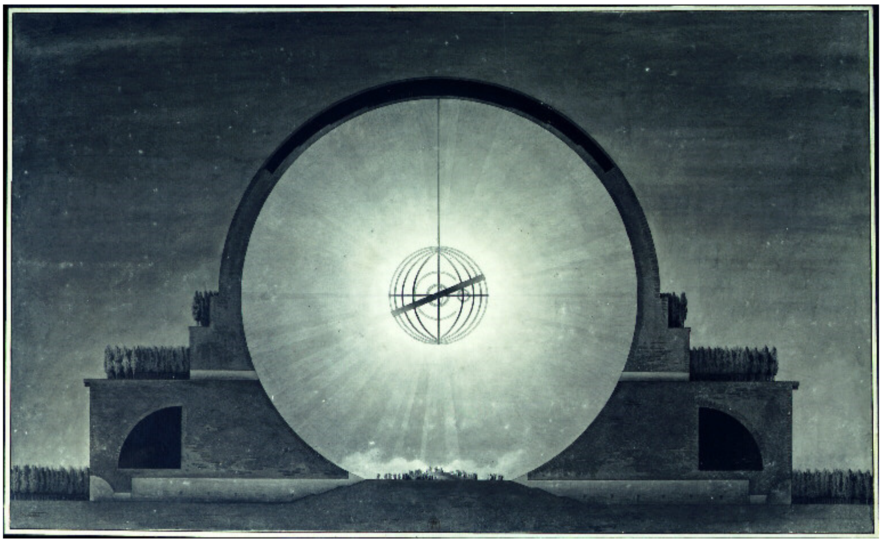


Figure 23. Boullée, Newton Cenotaph, section at night, with blazing astrolabe.

6. Salk Institute for Biological Studies, La Jolla, California

Louis I. Kahn's Salk Institute for Biological Studies at La Jolla, CA, for which he began his frequently modified design in 1961,[27] offered an echo of the Boullée project. Dr. Jonas Salk, the research biologist who invented the life-saving polio vaccine, approached Kahn to design an enormous project for a research institute to be constructed on a dramatic sea-side cliff provided by the city of San Diego. There were to be three architectural parts: laboratories and office facilities for visiting scientists, living quarters for them and their families, and a communal building where they could come together to discuss their work and learn from each other. This building would also include quarters for distinguished visitors, not scientists, who would serve Salk's purpose to bring together the sciences and the humanities. Salk famously said he wanted a building to which he could invite Pablo Picasso. Kahn's work was never cheap, and Salk did not have at his disposal the resources of Hadrian or Justinian. In the end, only the labs were built, and there was no evidence Picasso ever visited.

Kahn's first designs included four lab buildings enclosing two courtyards, but just before construction on the labs began, Salk changed his mind and asked Kahn for a pair of buildings flanking a single courtyard to give the project a greater sense of unity (Figures 24 and 25). The final design for the laboratories and offices consists of two rectangular buildings that enclose a rectangular courtyard, aligned on an east-west axis, that opens to an endless vista of the Pacific Ocean and the sky. The east-west axis is marked by a thin course of water that appears to empty into the ocean. Flanking the otherwise empty courtyard are planes of bare concrete, set diagonally to the water course, that serve as the rear walls of office/studies that face the sea. Their placement seems based on the diagonally set flats that enhances the illusion of spatial recession in seventeenth century European stage sets.

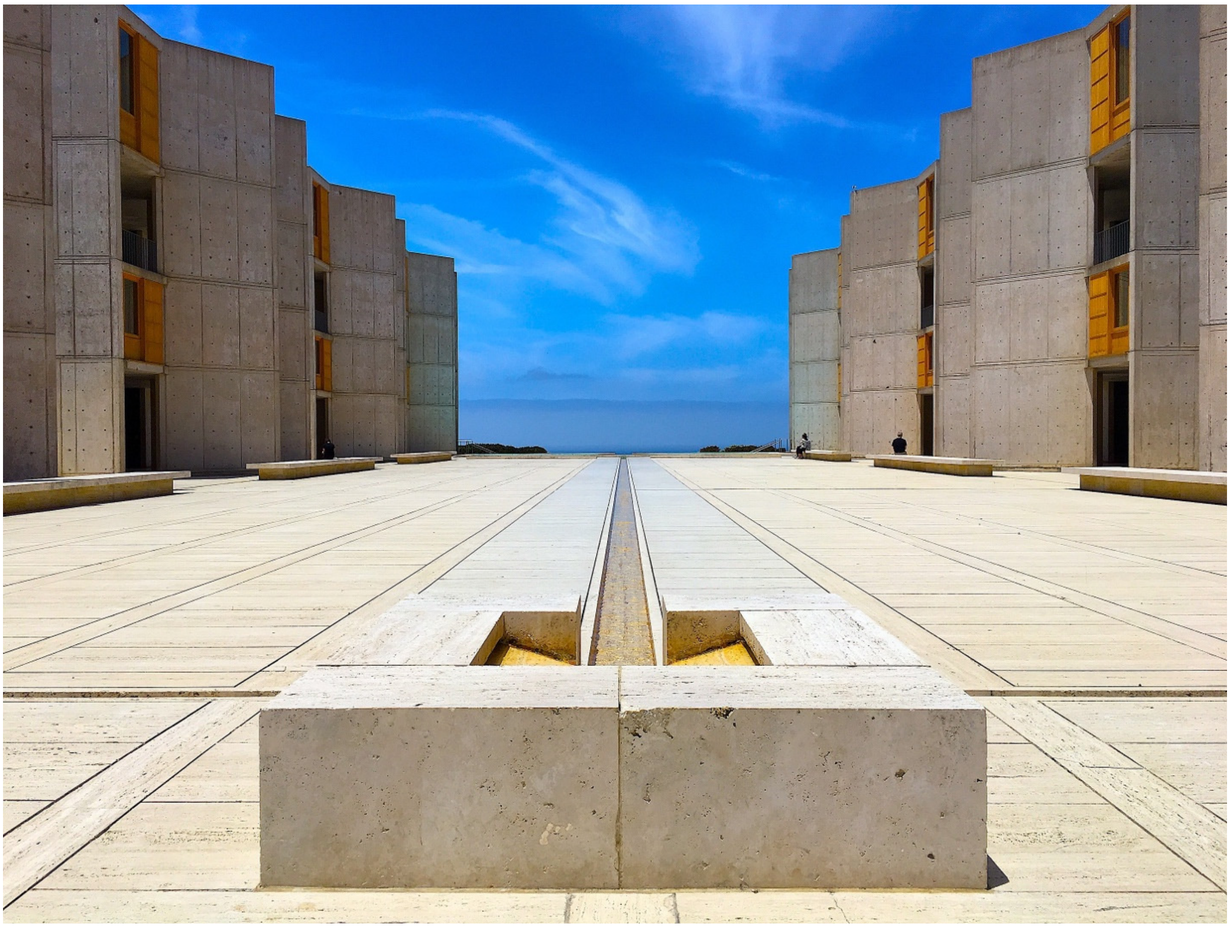


Figure 24. Louis I. Kahn, Salk Institute for Biological Studies, Laboratories, courtyard looking west toward Pacific Ocean, La Jolla, California, 1961–65. Note the lines in the stone pavement, parallel to the water course, that drive the view toward the sea.

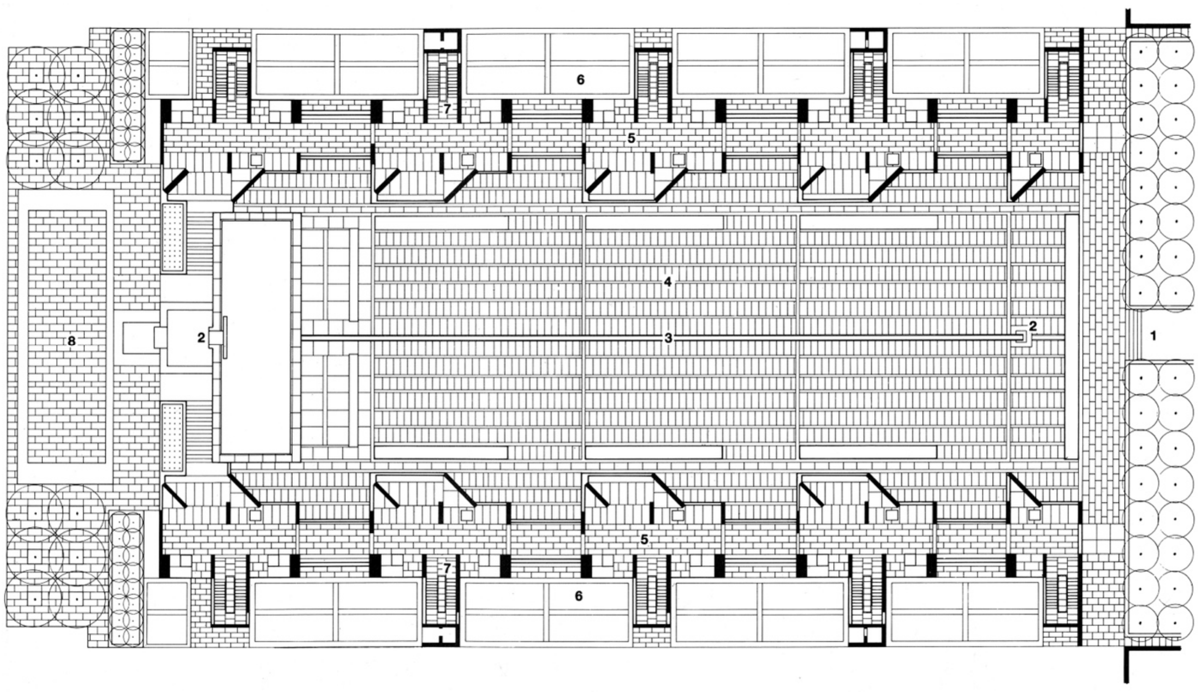


Figure 25. Salk Institute, plan only of courtyard and studies. The laboratories, located at top and bottom of the plan, are not shown. North is at the top.

A view of the courtyard from the ocean side (Figure 26) reveals a honeycomb-like structure of concrete-enclosed voids with alternating levels filled with inserts of glass and teak that create offices. Each scientist, with an individual retreat that faces the Pacific, has a 'viewing platform' of nature like those enjoyed by scholars in Chinese landscape paintings.

Figure 26. Salk Institute, Courtyard of Laboratory Building from the east. Note the water channel drains into pools that descend to a patio overlooking the Pacific Ocean that is hidden from the opposite end of the courtyard.

Earlier schemes for the courtyard included two rows of cypress trees marching toward the water. In 1966 the great Mexican architect, Jose Luis Barragán, invited to visit the completed building, praised the beauty of its bare concrete. He advised Kahn to take out the trees and treat the space as a plaza, as a "façade toward the sky." Harriet Pattison, a landscape architect and the mother of Kahn's son, Nathaniel Kahn, recalled: *Lou knew he was right and took it from there. Detailing the travertine [pavement] beautifully and filling it with just a single rille. . ..*[28]

Not visible from the courtyard are the actual laboratory spaces, separate structures connected by bridges to the studies. Each laboratory floor is a continuously open space set between the two planes of its floor and ceiling. Above each lab is a separate level, tall enough to walk in, that contains all the services needed for the laboratories below. These can be reconfigured for each newly arriving scientist. Structurally, the service floors consist of self-supporting Vierendeel trusses that make possible the totally open, flexible lab floors. The exterior walls on the north and south sides of the two buildings, with their blank concrete stair towers, resemble the walls of medieval fortresses, protecting the work of the scholars inside (Figure 27).

Figure 27. Salk Institute, La Jolla, exterior with staircase towers.

Salk's purpose for the institute was to create a place of research where scientists would make discoveries that would contribute to the ever-growing sum of human knowledge. Their work would begin with the observation of natural phenomena in the labs. In their offices, their stunning views of nature would underscore the importance of observing nature in the pursuit of science. The view from the land end of the courtyard would shift the emphasis from each scholar's private view of nature to the broader experience of looking into a theater of nature, in which the expansive ocean was a constant over which a blue sky, a stormy sky, a starry sky, or a brilliant sunset could constantly act out the changing events of the weather. Kahn used as the visual climax of his Salk Institute the actual cosmos instead of the model of which Boullée had planned to wrap Newton.[29] Into the vastness of the ocean would appear to flow the slim channel of water, a metaphor for the scientific discoveries taking place in the labs that would add to the totality of world knowledge (Figures 24, 25, 28 and 29). The affect here causes an additional, intellectual thrill, when one comes to understand what the architecture means.

Kahn achieved what the unknown architect of the Pantheon, what Anthemius and Isidorus at Hagia Sophia, and what Boullée had been unable to attain: make the actual affects of nature parts of the architecture (Figures 28 and 29).[30]

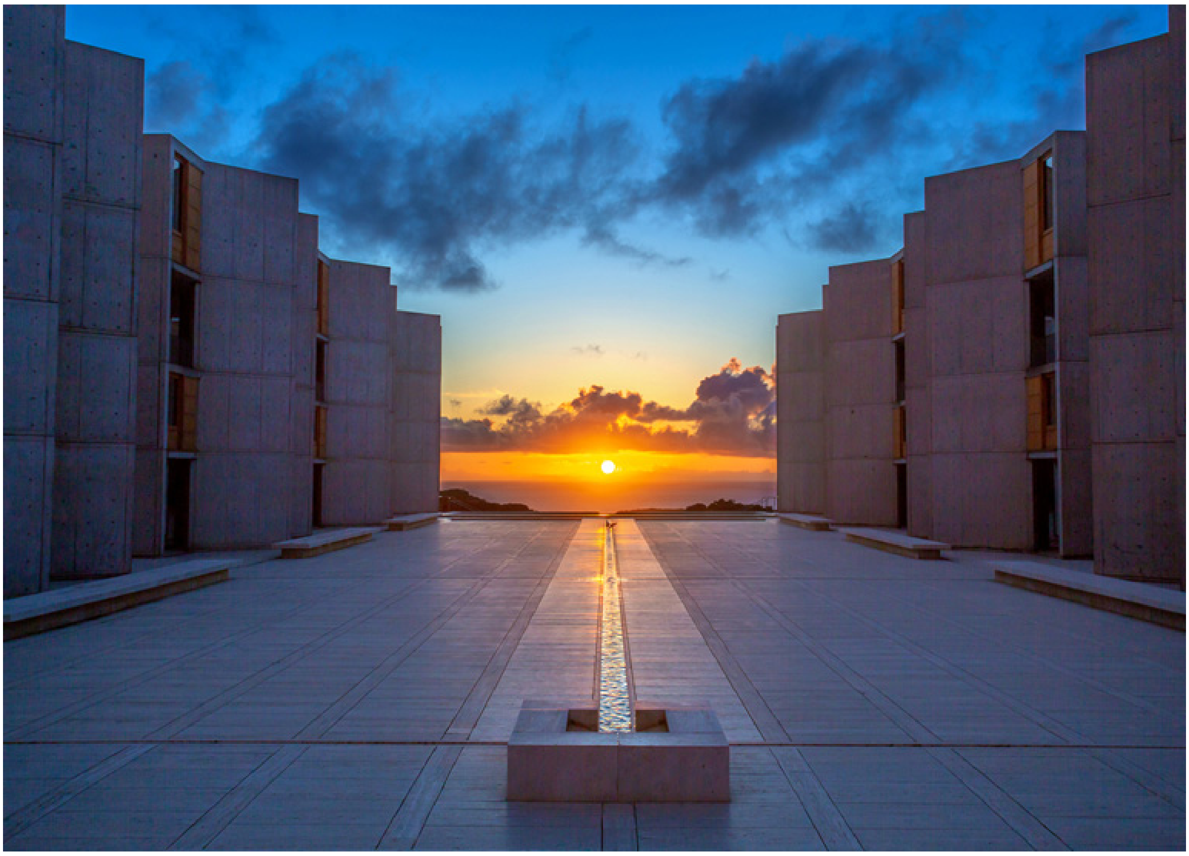


Figure 28. Salk Institute, courtyard at sunset.

Figure 29. Salk Institute, courtyard with full moon.

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Conflicts of Interest: The author declares no conflict of interest.

Notes

1. The selections of examples in this essay are deliberately drawn from a variety of periods and cultures in European and North American art with which the writer is acquainted. They also represent a variety of purposes that the affects serve, depending on the politics, religions, and technologies enjoyed in the respective times and places. The essay focuses, however, on the affects of interior spaces. A host of other examples, from any number of cultures, might well have been chosen.
2. (Rosenau 1953, p. 80). '*Temple de la mort! Votre aspect doit glacer nos coeurs*'.
3. Gehry began planning the project in the summer of 1991, when he won the contest for the commission. His early ideas are extensively chronicled in (Van Bruggen 1997, pp. 15–133). An enthusiastic early appraisal is (Muschamp 1997; Goldberger 2015, pp. 28–311), offers a more detailed account of the project.
4. For the Catia software, see Van Bruggen, "Appendix 1: On the Use of the Computer," 135–139.
5. This number was reported by a local architect supervising construction to a friend visiting the completed museum.
6. Ando (1990); quoted in (Co 1995). Ando is a master of architectural affect. See his three small Christian churches in Japan: *Tokyo cowboy. ELEMENTAL CHURCHES: Tadao Ando's holy trinity.* https://www.tokyocowboy.co/articles/elemental-churches-tadao-andos-holy-trinity, accessed on 25 December 2023.
7. Major studies of the Pantheon include: (Licht 1968; MacDonald 1976, 1982; Marder and Wilson Jones 2015). For an assessment of the structure of the dome made with more contemporary technology, (see Mark and Hutchinson 1986; Martines 2015).
8. Hetland (2007, pp. 95–112). A shorter version of Hetland's essay appears in Marder and Wilson Jones, 79–98. (Wilson Jones 2015, pp. 226–27), reasonably argues that work probably lasted from 114 to 124.
9. "M.AGGRIPPA.L.F.COS.TERTIUM.FECIT." (Marcus Agrippa Son of Lucius in his Third Term as Consul [or thrice consul,] Made it.)
10. Licht, 180–184, quotes all the known references to the Pantheon by ancient writer in Latin and Greek and in English translation. He notes, 184, Hadrian held court in the Pantheon "always seated on a tribunal so that whatever was done was always made public." In other words, people were inside the building, as witnesses to the proceedings.
11. See the seminal article by Lehmann, n.19 below.
12. (MacDonald 1982) MacDonald, 84–86, stresses the relationship between the Forum of Augustus and the space that once existed in front of the Pantheon. That space might well be considered the Forum of Hadrian.
13. After the World War I and the dissolution of the Ottoman Empire, in 1935 the secular leader of Turkey, Kemal Attaturk, turned the mosque into a public museum. In 2020, the current Turkish government, under Regep Erdogan, returned the building to its former status as a mosque, a decision that caused worldwide protests.
14. The literature on Hagia Sophia is as copious as one might expect. Three studies stand out: (Mainstone 1988; Mark and Çakmak 1992; Kleinbauer 2004). (Van Nice 1965–1986), is an oversized folio that contains forty-six plates of drawings made on site over a period of eight years. It is available at https://www.doaks.org/resources/rare-books/saint-sophia-in-istanbul-an-architectural-survey, accessed on 25 December 2023.
15. (Procopius 1940, p. 23). Available online: https://penelope.uchicago.edu/Thayer/E/Roman/Texts/Procopius/Buildings/1A*.html, accessed on 25 December 2023.
16. Ibid., 22.
17. (Rybczynski 2022, p. 45).
18. Procopius, 28.
19. (See Lehmann 1945; also Smith 1950).
20. The ceremonies of the Byzantine liturgy are reconstructed in the pioneering work of (Mathews 1971), and more recently in (Patricios 2014).
21. Alberti (1988): ". . .quidem templo tantum adesse puulchritudinis, ut nulla speties ne cogitari uspiam possit ornatior; et omni ex parte ita esse paratum opto, ut qui ingrediantur stupefacti exhorrescant rerum dignarum admiration, vixque se contineant, quin clamore profiteantur, dignum profecto esse locum deo, quod intueantur". (Alberti 1966), Libro 7, Capitolo 3, 544.
22. The bibliography on Sant'Andrea is vast. A particularly capacious list appears in (Carrer 2007, pp. 192–216).
23. The occurrence of the 600th anniversary of Alberti's birth in 2004 led to a spate of new studies of his work, particularly by Italian scholars. Noteworthy are: Massimo Bulgarelli, "Alberti a Mantova. Divagazioni intorni a Sant'Andrea," *Annali di architettura, rivista del Centro internazionale di studi di architettura Andrea Palladio* 15, 2003, 9–3; ibidem, "Architettura, retorica e storia. Alberti e il Tempio Etrusco," *Leon Battista Alberti Architetture e Committenti*, eds. Arturo Calzona, Joseph Connors, Francesco Paolo Fiore, Cesare Vasoli, Florence, Olschki, 2009, vol. 2, 663–684; Francesco Paolo Fiore, "La Faccciata della Chiesa di

Sant'Andrea a Mantova," *Leon Battista Alberti. Architetture e Committenti*, eds. Arturo Calzona, Joseph Connors, Francesco Paolo Fiore and Cesare Vasoli, Florence, Olschki, 2009, 2, 743–775; Francesco Paolo Fiore, "La Faccciata della Chiesa di Sant'Andrea a Mantova," *Leon Battista Alberti. Architetture e Committenti*, eds. Arturo Calzona, Joseph Connors, Francesco Paolo Fiore and Cesare Vasoli, Florence, Olschki, 2009, 2, 743–775; Livio Volpi Ghirardini, "À propos des deux églises mantouanes d'Alberti," *Alberti humaniste, architecte*, Françoise Choay and Michel Paoli, eds., Paris, École National Supérieur des Beaux-Arts—Musée du Louvre Editions, 2006, 206–211; ibidem, "Le scale a chiocciolla del Sant'Andrea di Leon Battista Alberti: rilievi e nuove osservazioni." *Reibungspunkt. Ordnung und Umbuch in Architektur und Kunst. Festschrift für Hubertus Günter*, eds. Hanns Hubach et al, Zurich, Michael Imhof Verlag, 2008, 302. Christof Luitpold Frommel, "Sant'Andrea a Mantova: storia, ricostruzione, interpretazione", (Bulgarelli et al. 2006).

24 Alberti's fusion of various typologies of Greek and Roman architecture at Sant'Andrea is discussed at length in a forthcoming article, Eugene J. Johnson, "Pagan Architecture Becomes Christian. Leon Battista Alberti at Sant'Andrea in Mantua," which has been submitted to an international art historical journal. The article rethinks some ideas that appear in the publication of my dissertation, (Johnson 1975).

25 Rosenau, 83. '*O Newton. . .j'ai conçu le projet t'enveelopper de ta découvert*'.

26 Ibid., 94. "Dans le Cénotaphe de Newton, j'ai cherché à réaliser la plus grande de toutes les images, celle de l'immensité: c'est par elle que notre esprit s'élève à la contemplation du Créateur et que nous èprouvons l'annonce des sensations célestes. . ." trans. author.

27 (Brownlee 1992), presents a concise account of the Salk project.

28 (Pattison 2023, p. 182). Kahn's own account of Barragan's visit is recorded in Brownlee and DeLong, 100.

29 (Sauter 2012). Sauter takes the title of his essay on Kahn from Boullée, whose influence on Kahn was long-standing. The first major scholarly discussion of Boullée and other French architects of the late 18th century, (Kaufmann 1952) was published in Philadelphia, Kahn's hometown. In an early sketch for the General Motors Exhibition at the New York World's Fair from 1960–61 Kahn placed a cylinder inside a cube in a clear reference to the Newton Cenotaph [Sauter, 197, Figure 305].

30 Sauter, 196, writes: "Kahn in his major works of the 1960s had targeted water, earth, light, and air on a . . .basis that enabled a silent, yet fundamental, meditation on how in the beginning one might have confronted the world with amazement and expressed with joy its dazzling beauty. Literally taking hold of Boullée's suggestion it was the architect's foremost task to make nature present—'*mettre la nature en oeuvre*'—Kahn conceived his edifices as monochromes that staged the wondrous unfolding of the elements".

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