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At the end of each chapter, there are books and papers mentioned, which have directly influenced the author's point of view. A generic bibliography is not given, since it is constantly renewed and complemented with new, important contributions.

This book talks about architecture, about the concerns, the pursuits and the achievements of its people, and about how their work has been perceived.

Just as any other narrative, however, this account is by its very nature unfair—not only because Western architecture is overrepresented in it, but also because it leaves out of the picture thousands and thousands of buildings in which real people were born, brought up, lived, and died. Small jewels, monuments of vanity, or simply ordinary—all were the product of toil and the receptors of dreams; for that reason alone, they do not deserve the oblivion into which they are pushed deeper with each new reference to other, seemingly slightly better, slightly more important, or slightly more celebrated contemporary buildings.

With the unkindness and arrogance associated with our power to choose, to remember, and to forget, this book looks at the past through the lenses of someone who—in the chaotic complexity of the universe of edifices—seeks to understand why and how people build.

The past emerges unexpectedly in its proximity. This is probably the best vindication of those who devoted their time and efforts to create day by day, stone by stone, the environment in which we live today.

This book is a guide for reading architecture of yesterday with our eyes focused on tomorrow. It is written with the hope that it will spur the reader to search for other views and to complement his/her knowledge with further reading and the examination of other sources; and to look around him/her once more at the magic of the world surrounding us.

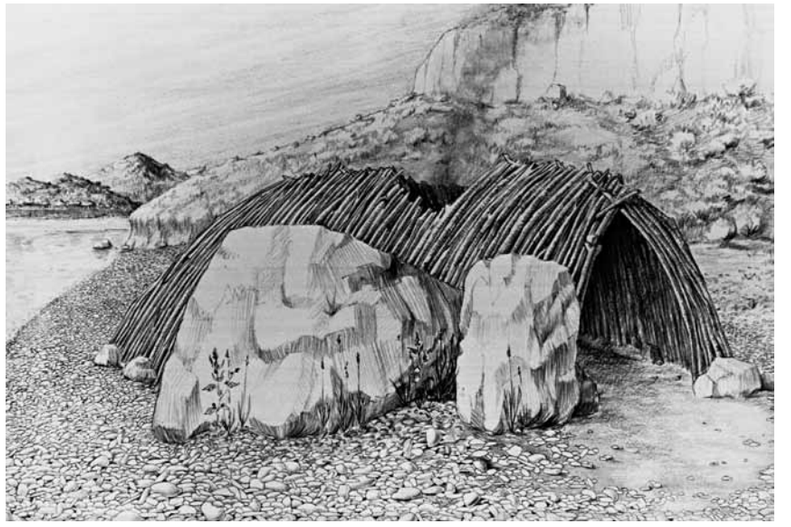
ARE THERE ARCHETYPES IN ARCHITECTURE?

The Terra Amata Huts

Unlike clothes, buildings cannot be squeezed into the back of our closet or taken to the local charity shop when no longer in fashion; they are meant to stay. Not having the chance to design new ones for the upcoming season, architects would like their buildings to withstand the test of time and not be seen as obsolete the day after; owners who pay good money to have the buildings erected expect their investments to have value for as long as possible; and users insist that certain things be done the way they "should" be done, no matter how fascinated by innovative ideas they might be. This is why the question "are there archetypes in architecture?" has been central to architectural theory throughout the ages, and still retains, to some extent, its validity. An archetype in architecture is a form that we keep reproducing, more or less deliberately, acknowledging therein an irrefutable wisdom and an appeal that may never perish. "Form" is used here in the original sense of the term: as the structure, organization or essential character of something, rather than merely its appearance. An archetype, then, is a paradigm that incorporates what is important and perennial, and as such one that can adapt to specific contemporary requirements over changing times, while maintaining all its primary qualities.

Watching children drawing pictures of their dream homes in the almost stereotypical shape of a small house complete with roof and smoking chimney, one feels as though he/she is witnessing an archetype in architecture. This might well be so. In the remote past, humans evidently used to build huts fairly similar to our own perception of an essential dwelling: the simplest imaginable shelter with a smoking chimney.

In the nineteen-sixties, a team led by Henry de Lumley discovered at the site of Terra Amata in Nice, southern France, vestiges of large huts erected 400,000 years ago—although other scholars doubt his interpretations completely or date the finds tens of thousands of years later; 400,000 years is a long time. The human species, to which the individuals



Hut, Terra Amata, France, circa 400,000 years before today; reconstruction by Henri Puech/Musée de Terra Amata/Ville de Nice

who built the huts belonged, was extinct long ago. Modern humans came to Europe from Africa about 40,000 years ago. The Parthenon was built 2,500 years ago; Leonardo da Vinci conceived his flying machines 500 years ago; and the first underground railway line began operating in London 150 years ago.

De Lumley's excavations revealed that several meters beneath the current surface of the ground, earth and sand were thinner in texture in some places. He interpreted this as dirt accumulated in holes born by tree branches pinned to the ground; the wood disintegrated over time, but left traces on the walls of the holes, providing further evidence to support his assumptions. The holes, clustered in several groups, were not perpendicular, indicating that the branches converged together forming real roofs. The huts, erected along what would have been the seaside at that time—to offer temporary shelter to humans coming to the area to hunt or fish—were oblong, measuring approximately eight to twelve by four to five meters. At the center of each hut, traces of fire were found; probably at the top an opening was left to let the smoke out. Also uncovered here and there were clusters of similar objects—fragments of stone, animal bones, food remains, etc.—suggesting that the space inside each hut had been organized so that different activities (preparing and cooking food, tool making, sleep, etc.) should take place in distinct zones, similarly to modern dwellings.

Traces of a more recent but still very early dwelling—150,000 years old—were discovered inside a cave only a few kilometers away from Terra Amata. At Grotte du Lazaret, a number of large stones circumscribed an

ARCHITECTURE AND PLACE

Mesopotamia: The Oval Temple

Without humans settling down more or less permanently at specific locations, the erection of large and complex edifices would have been an unimaginable feat; the toil required would probably have been pointless, if people would not occupy them for many years and had to abandon them before their completion. Moreover, without permanent settlement in situ and involved with construction only occasionally, it is doubtful whether people would accomplish even that. Nomads never built pyramids, stadiums, skyscrapers, or theaters. Nomads have no need for architects—for better or for worse.

Nothing, therefore, contributed to the development of architecture in the long run more than the invention of agriculture, a technological achievement that radically changed the fate of the human species. The cultivation of land is an investment that yields returns after several months of hard work. Moreover, because plants have roots and cannot travel, people become attached to their land along with their crops. It is estimated that modern hunter-gatherer societies spend about three to four hours daily to secure their food supplies and a total of five to six hours daily on all tasks required to sustain their living standards. They are constantly on the move following their food sources. Unable or unwilling to store more than a minimal food surplus lest they compromise their mobility, they make do with little material wealth, but, unlike the overwhelming majority of modern people, they gain considerable spare time. Admittedly, nowadays these societies are using technologies and knowledge developed by farmer societies they usually associate with. Still, the required amount of work to meet their needs in the past, before people learned how to cultivate land, must not have been all that different, at least while there was no overpopulation and climatic conditions were favorable.

Agriculture was most probably invented independently in at least five or six separate regions worldwide, when local human populations had risen to such levels that naturally renewable food sources were no longer sufficient. Thus, they were forced to find other ways to increase food production. Possibly after other survival strategies—such as increased mobility or decreased population density—proved ineffective, or were unattainable or not employed for reasons we are not aware of, they opted for a radical innovation. Evidence suggests that for the first time, about 11,000 years ago, in the region known as the Fertile Crescent (an area extending from modern Israel to north Syria and from southeast Turkey to modern Iraq), humans discovered that they could grow plants bearing edible fruit. Almost simultaneously, people (initially more often in mountainous terrains) started breeding goats for meat and much later for milk and skin; and used dogs—an animal species that had just emerged—for herding as well as for hunting.

Slowly but steadily, the cultivation of land expanded into increasingly remote areas exercising its dramatic charm to the greater part of the planet. Up to that point, people used to live in small groups (called clans) of usually twenty to fifty individuals based on kinship. These clans formed part of bands and tribes and moved from one place to another, securing their food supply, which was not difficult while the land was thinly populated. They were able, however, to settle down permanently in areas rich in sources of food, water, and abundant in raw materials.

While not imposing permanent settlement, the invention of agriculture (a "delayed return" activity) strengthened the tendencies for it—some groups probably still moved to nearby areas once a productive crop cycle was completed. Settled communities tended to be quite populous. Complex power balances were formed, which seem to have allowed for or directly led to the establishment of some kind of social stratification. By 5000 BCE in arguably one of the most developed areas of the world, the southeast part of the Fertile Crescent in modern Iraq—an area known by its Greek name, Mesopotamia, the land between rivers Tigris and Euphrates—the need to organize production, irrigate farming land, and transport its fruit became more pressing. It was now possible to accumulate surplus. The possibility to control and manage this surplus as a defense mechanism against poor harvests ensued; writing, which was invented much later, around 3000 BCE, arguably the most important tool in spreading the benefits of civilization, was perhaps born out of the need for systematic record keeping. The need for specialized labor began to multiply. Tasks were probably no longer differentiated by gender alone, as seems to have been the case in much less complex societies, in which—based on modern ethnographic data—all men and all women had the knowledge and skills to perform most required actions for their own and their families' subsistence. Specialization increased productivity, but also intensified interdependencies.

Humans now lived in large permanent settlements (cities) with rules on cohabitation, which everyone accepted or was subjected to. The allocation of different roles in these complex societies allowed differentiation in power, authority, and prestige between its members and systematically undermined the relatively egalitarian relations inherited from the past.

prominent Pharaohs in the afterlife: they were the deified kings of Egypt, Khufu, Khafre, and Menkaure, until recently known by their Hellenized names Cheops, Chephren, and Mycerinus. The people who labored to build them were more likely "free citizens" than slaves, who were probably charged with a type of *corvée*, as was often the case in many preindustrial societies; no matter how harsh their working conditions were, they must have taken great pride in their work, as indicated by graffiti found in their communal lodgings.

The pyramids of Khufu in the foreground circa 2530 BCE, Khafre, circa 2510 BCE, and Menkaure, circa 2485 BCE, Giza, Cairo

The first, the pyramid of Khufu, was built within twenty years around 2530 BCE. This period is known as the Old Kingdom—i.e., the first period of unified Egypt, lasting from the twenty-seventh to the twenty-second century BCE (experts disagree on the exact dates of key incidents in Egyptian history). Similar to the other two, its base is oriented with great precision to the four cardinal directions, a fact among many suggesting that designing the pyramid relied partly on the vast, remarkably advanced insights of Egyptian priesthood into astronomy.

Astronomical phenomena were taken seriously into account in the design of monumental buildings, already from earlier on in Mesopotamia, and would continue to do so for many years across the globe. They included both phenomena that were intrinsically important as markers of crucial turning points (such as the summer solstice and the movement of the point of the horizon where the sun rises or sets as the days become longer or shorter), or were attributed rather arbitrarily great importance (such as the appearance in the night sky of a constellation, a group of seemingly neighboring stars billions of kilometers apart). The great rock-cut temple of Abu-Simbel (built around 1265 BCE), for instance, was configured so that

twice a year, on significant dates, rays of sun would penetrate the inner sanctum at dawn to shine on all the statues at the far end of the temple except that of Ptah, god of the Underworld. Similar but independently developed astronomical considerations are attested at the Temple of the Sun in Machu-Picchu, Peru, and at the Fatehpur Sikri Jami in India, both built more than 2,500 years later; and Christian churches built even today normally conform to the rule that requires them to be oriented to the east—i.e., the point in the horizon where the sun rises on the equinoxes.

The pyramid of Khufu was built of large stone blocks, and measured 2.5 million cubic meters in total mass and 5.9 million tons in weight. Its height was approximately 146 meters and the length of each side of its square base was 230 meters. Its surfaces were polished and its apex shone under the rays of the sun. Its external proportions and those of the chambers—height to length of side, etc.—conform to special geometric relations. Typically, in a cross section, the proportions of the pyramid of Khufu correspond with what is known as the golden ratio; those of the pyramid of Khafre generate a 3:4:5 Pythagorean triangle, whose properties were known to the Egyptians.

The Egyptians manifested their affection for geometry in almost every edifice of importance they built. They were not the only people to do so. Regular geometrical shapes have often been used in architecture in the course of history, far and wide. From medieval cities in India, such as Madurai, to Renaissance towns in the West, such as Palmanova; from ziggurats in Mesopotamia to the seventeenth-century gardens of Versailles; from the Revolutionary Architecture of E. L. Boullée to the Neo-Rationalism of A. Rossi in the nineteen-eighties, easily recognizable, regular, shapes have been employed to indicate that the form before us is the result of deliberate choices aimed at conveying complex meanings and sophisticated

The "bent pyramid" of pharaoh Sneferu, Dahshur, Egypt, circa 2570 BCE

THE MAGIC OF THE CITY

Ur: Igmil-Sins's House

Today, one in two people live in cities in a world shaped by the civilization created within them. Most probably, all readers of this book know that in order to cross a highway safely they have to use the pedestrian overpass. They know how to complete their tax return statement with its hundreds of boxes. They have developed criteria to choose between fifty different types of pasta in the neighborhood supermarket. And they can calculate with relative precision what time they will arrive in a location 100 or 1,000 kilometers away from their homes. It is doubtful, though, whether they can survive more than a few days, if they find themselves alone in a forest or on the beach for which they are longing so much during their daily routine.

Since when do people feel more comfortable in cities than away from them? Since when do they become so familiar with the man-made environment that they project it in their hopes for a good life? Since when do their fears derive from it?

The answer could be very simple: probably since specialization and the division of labor led people to develop only some skills and knowledge, enabling them to live in complex social environments but not in nature. Although, as we saw in Chapter 2, specialization existed long before the creation of cities, it was in the complex and stratified urban societies in which it was developed in the fullest extent. According to all indications in southern Mesopotamia, urbanization began about 7,000 years ago. Within a few hundred years, a new way of life, and eventually a new civilization was created.

The *Epic of Gilgamesh* speaks with admiration about Uruk, whose walls in the third millennium BCE had a length of nine kilometers.[1] *The Sumerian Temple Hymns*, probably composed shortly before 2200 BCE, refer to thirty-five cities of south Mesopotamia. If Eridu was the oldest—the first city in the world according to the *Sumerian King List*[2]—Ur was probably the most famous. Its population according to Sir Leonard Woolley, the most

prominent excavator of the site, reached 200,000 people or maybe half a million around 1900 BCE, and this despite its destruction a few decades earlier and its subsequent subordination to neighboring Larsa. Only with difficulty can we realize today how great this number is for a city without cars and metro railway systems, phones, and the Internet. However, we can surely imagine that the problem that all these people had to face was not how to protect themselves from wild beasts or how to trap a boar for its meat and skin as their ancestors did several hundred years ago. They were probably preoccupied with how and at what cost they would be supplied with food every day and how they would dispose of their garbage; and if they were artisans or craftsmen, how they could acquire raw materials and where they could sell their products.

THE AH SITE: PLAN OF LARSA HOUSES

Residential quarter of the Larsa period, Ur, south Iraq, circa 1900 BCE; courtesy of the University of Pennsylvania

It was a colossal change in the daily lives of people, in the most fundamental characteristics of their self-image; in the way they perceived themselves. Possibly some may have realized, as we do today, that life in the cities enabled them to live in them, and only in them, and that the urban environment was their new natural habitat. It is no coincidence, therefore, that the city foundation occupies such a large part of the literary production of the people of Mesopotamia, but also of their art, even three millennia after the first cities emerged.

seal of the society within the context of which it was created. Consequently, the question of whether the building is a vehicle of collective choices and therefore represents each society as a whole (and the ruling class in particular), or whether it is a vehicle of personal choices and therefore represents the person, resurfaces each time a foundation stone is laid.

We saw in Chapter 3 the great importance attributed by ancient Egyptians in preserving the bodies of the dead pharaohs, and what they were willing to do in order to ensure the best conditions for their afterlife. However, even that was not enough. Although the pharaohs' souls were hovering between their luxurious tombs and the skies, they were still supposed to be constantly present among their former subjects, even if the latter lived crammed together in two- and three-story mud-brick residential buildings in the cities, or in huts made of mud and straw in the fields—i.e., in places that probably the pharaohs had never visited. The dead kings should not be forgotten. Oblivion was tantamount to actual death and if that occurred, the preservation of their bodies would somehow lose its meaning. Clearly, the Egyptians had to use any means possible to prevent this from happening. Architecture was called to play its part in this effort.

From early on, the Egyptians built the pharaohs' tombs—which represented the dead kings in their godly status—to be as visible as possible. A key feature of the Great Pyramids was that ordinary people could see them from afar. Thus far away, but forever etched in the memory of those who set their eyes on them; the more the better. From this point of view, a location near a large urban center was ideal. This made certain that the impression would pass down by word of mouth to an even larger audience and would ensure the pharaohs' presence among the living. Let us remember that in the case of Djoser's mortuary complex Imhotep made his Pharaoh's tomb visible from the Nile, and similar considerations evidently prevailed throughout the Old Kingdom.

Nevertheless, even in Egypt times changed. Gradually, the pharaohs' main concern became preventing the looting of their tombs. In the New Kingdom, and after two periods of dissolution of central authority, the tombs were built underground, cut inside the rock, guarding in the bowels of the earth the precious remains of the deified kings. Ineni, the confident of Tuthmose II, regarded as his badge of honor that he arranged the digging of his king's tomb with absolute secrecy—"no one seeing, no one hearing"—in a modern rendition of the hieroglyphics inscribed in his own tomb.[2] This ongoing pursuit for secrecy created a shortcoming in the public image of the pharaoh, which had to be compensated. This could not be done through erecting particularly impressive palaces, as would happen later in other parts of the world, since the pharaohs did not have to be remembered necessarily as living beings. As a result, it seems that they invested in these kind of earthly projects as much money and as much human energy necessary to ensure simply their comfortable stay. Typically, the Egyptian palaces built mainly with bricks, not granite, are rather poorly preserved, and in most cases, only their foundations remain. It was the

construction of temples that could counterbalance the shortcoming in pharaoh's public image.

The first temples of Egypt are at least as old as the first royal tombs, and some of them were of considerable dimensions; but it was in the New Kingdom when temple building peaked, which may also reflect a shift of power in Egyptian society. We know that pharaoh Akhenaten clashed with the priesthood when he attempted to introduce a new religion in the middle of the fourteenth century BCE, and that he was defeated. That the personal promotion of the pharaohs was not conducted with the construction of huge personal burial monuments, but eventually with the erection, renovation, and expansion of temples on a scale never before seen in Egypt, and with the building of mortuary temples completely detached from their graves, may be seen as a visualization of the power-sharing between the two most prominent institutions of state authority.

Things do not always proceed in linear sequence. The top priority of Ahmose I, the founder of the New Kingdom in the middle of the sixteenth century BCE, was the restoration of the throne's prestige. Ahmose's military successes had brought about the unification of Egypt and had filled the treasuries of the state, a prerequisite of every ambitious building program. Ahmose proceeded in a highly symbolical political act accomplished through architecture: he reconstructed several ruined royal tombs and pyramids. After over 150 years of polyarchy and the expulsion of the Hyksos conquerors, Egypt was again under the scepter of an absolute ruler, and the continuity of authority was demonstrated with the most visible way. Ahmose himself appeared as the heir and successor of a glorious past; assuming the old tradition he built a pyramid, albeit as his cenotaph. Perhaps the best indication that his efforts were not in vain is that princes and senior state officials began to visit Giza more often to pay homage to the deified pharaohs of the Old Kingdom, and to admire their monuments.

The entrance to the temple of Amun, Karnak, ancient Thebes, south Egypt, mainly 1500 BCE–380 BCE

weight falls on one leg, a posture studied by the sculptors of that era. The *Doryphorus* (Spear-bearer), a statue by sculptor Polycleitus dating back to 450 BCE, rests firmly on its right leg, while the left is merely used to maintain balance. The right hip of *Doryphorus* is higher than the left. The exact opposite occurs with the shoulders: the right shoulder "falls" lower than the left. Polycleitus' work was widely known; his theories on art and the numerical ratios that existed between the members of the body were topics of discussion. The architecture of this period obviously quite consciously adopted the principles with which the *Doryphorus* was created.

A range of other features also keeps the eye of the observer focused on the Parthenon. Each column is an architectural member linear in shape (a property highlighted by the fluting, i.e., the streaks along its shaft), positioned vertically. In the colonnades, however, the individuality of each column disappears, and the image emerges of a horizontal array of similar elements. The corner columns are four centimeters thicker than the rest, which makes their lower diameter 1.93 meters instead of 1.89 meters. Although the columns are generally placed at equal distances, specifically at 2.36 meters, the four corners appear denser, as the corner columns are only 1.74 meters apart. The result of these violations of the geometric regularity is that the corners of the Parthenon are clearly defined and the horizontality is limited decisively by vertical elements—the reinforced corner columns positioned too close to the columns adjacent to them. This "dynamic" balance between horizontality and verticality, between the unit and the whole, makes the Parthenon more than an accumulation of architectural elements: a body with inner tension and cohesion.

This large temple rests partially on a filling that is eight meters high in places. The top of the uneven hill was converted to approach the ideal flat surface. The sculptures of the Parthenon depict the city's foundation myths—an idealized version of its "history." A few meters away lay the (contrived) relics of these myths: the point where water gushed out when Poseidon struck the ground with his trident while fighting Athena for the patronage of the city; the olive tree planted by Athena; the burial site of the first king of the city. A few years later, a smaller temple, the Erechteion addressed the circumstances: it was built in an irregular shape, which appears to have resulted from the juxtaposition of separate halls housing the randomly scattered (but conveniently adjacent) relics. Located opposite, the perfect, balanced Parthenon was clearly the antithesis of the Erechteion, the product of the transfer into matter of a pure mental concept free of any circumstantial limitation.

Once the construction of Parthenon was well under way, construction began on the new Propylaea of the Acropolis in 437 BCE. This was the gateway to the complex of temples, monuments, and public buildings on the hill overlooking Athens, the Parthenon being the most renowned among them. The Propylaea is a distinct, elaborate structure. First, it is a building with no interior space in the conventional sense. Visitors to the Acropolis coming through its long covered passageway, which is open

The Parthenon, Athens' Acropolis, 447 BCE

Erechteion, Athens' Acropolis, 421 BCE

on both ends, would nonetheless get the impression of walking along an enclosed space. The two front sides of the Propylaea—the western facing outward to the city and the eastern facing inward to the Acropolis—look very much like the narrow sides of the Parthenon, complete with Doric columns, architraves, friezes, and pediments, similar in size and proportions with those of the great temple. Still, two smaller side wings at its entrance, parallel to the axis of the incoming visitors to the Acropolis, render the Propylaea virtually inconspicuous at first glance. In this respect, the Propylaea seem to be in breach of the Classical tradition of making edifices immediately and easily perceptible. This design imposes what was later called an "experiential" relationship between the visitors and the building,

In order to cross a valley, the water was sometimes driven into pipes to descend a steep slope, tread a short distance horizontally, and then climb the opposite slope—a method not commonly used after the middle of the first century CE, since the inverted siphon's maintenance was particularly difficult. When the terrain rose between the spring and the city, a large part of the route was underground. This required surface digging, an ancient version of the cut and cover method that is often used today for constructing metro lines; in mountains and hills, this method was not feasible, and they had to be pierced. The most striking feature of the aqueducts, however, is the elevated water conduits. Around Rome, the arches of ancient aqueducts are still visible for miles and miles. Where the conduits crossed deep valleys or ravines, bridges had to be constructed: twenty-nine meters high in Segovia, Spain; and close to fifty meters in Pont du Gard, in southern France.

Pont du Gard, southern France, circa 40 CE

Pont du Gard, built in the mid-first century CE, is remarkable because it is an immense structure. Stones weighing a total of 50,000 tons—utilized in the most efficient manner—form three rows, one above the other, of arches passing over a relatively small but turbulent river. The largest of them has a twenty-five-meter span and is nineteen meters high, and all to support at the desired height a conduit—1.25 meters wide and 1.85 meters deep—which supplied an insignificant town in a province of the huge empire with water.

Pont du Gard summarized the Roman way of thinking. Under their rule in the period of Pax Romana, the peace they imposed in a geographical area extending from Scotland to Persia, the world changed. Not by new ideas, not by new scientific advances, but by the systematic and widespread application of the existing technology. With pragmatism, the Romans set as their ultimate goal the proper and effective function of the state, which treated its subjects with old-style paternal affection and severity. The improvement of the daily life for the denizens of the empire was, therefore, a source of pride for state officials. The aqueducts gave the world a commodity much less questionable than the entertainment offered by gladiator fights in large arenas built for this purpose. Sextus Julius Frontinus, Water Commissioner of Rome in 97 CE, urged the readers of his book: "With such an array of indispensable structures carrying so much water, compare, if you will, the idle Pyramids or the useless, though famous, works of the Greeks!"[3]

Via Appia in Minturno, Lazio, Italy

The work of architects and engineers was the key to achieving this goal. There were few obstacles considered insurmountable. Drainage works improved the hygienic conditions. Roads, partly wide enough to allow at least the passage of two carriages, traversed the empire from one end to the other, crossing through mountains and over rivers. Military forces could be moved quickly to any province needed, and the transportation of people, goods, and ideas was facilitated. The quality of construction was so good that many of the bridges of the Roman road network were in use until recently. Harbors and canals completed an infrastructure network of unprecedented scale.

For the construction of several of these projects, a material was used without which their financial cost would be probably prohibitive. Roman concrete was a mixture of volcanic sand, lime, and irregularly shaped stones, which when mixed with water and then left to dry became solid—*opus caementicium*. The Romans began to use this material systematically in the first century BCE. Initially, they usually built the irregularly shaped stones as if they were building with squared stones or bricks—i.e., placing them one by one by hand, but using plenty of mortar. Simultaneously, they

tional" one- and two-story houses of the lower classes, built one next to another, underwent constant additions and extensions in order to meet the housing needs of the families. Larger houses were dissected, and shops and workshops were installed on the ground floor toward the roadside. Often, the homesteads expanded to adjacent properties. As a result, the building blocks were transformed gradually into a chaotic jumble of constructs of all kinds—initially the word insula denoted a group of individual, but not clearly distinct properties—with low housing capacity. A society that wanted to be called rational, a society addicted to standardization—how else could this large and multitudinous dominion be administered?—came up with a radical solution to the housing problem.

Many wealthy Romans invested in urban properties and in the erection of insulae. Although the quality of construction was usually poor and the sanitary conditions bad as a result of overcrowding, there were also better-built insulae containing spacious apartments for the upper class.

More than 1,500 years had to pass for this region to experience such an organized and systematic construction of infrastructure works—roads, harbors, and canals. It was manifested in the country where the concentration of power had advanced the most: in the France of Louis XIV and Jean Baptiste Colbert, Superintendent of Finances, in the second half of the seventeenth century. Two hundred years thereafter the railroads would decisively defeat the mud, which had held down the transportations in the European plains—until 1850, 6,000 kilometers of railway tracks had been laid in England alone—and after another hundred years, power lines would cross over mountains and plains to illuminate the nights in the cities and power our televisions and factories.

An environment without infrastructure belongs to the region that now we call the wilderness—39 percent of the planet's surface, of which about one-third is permanently covered with ice. On the rest of Earth's surface, the works that allow mankind to survive beyond the capacity of its immediate environment are now ubiquitous. Among them, the aqueducts always stand out as monuments of the human ability to respond to every challenge using their minds and their hands.

Notes

1 Vitruvius: *De Architectura* II.1.5.
2 Willoughby, Michael: "Mayor Slams Foster's GLA building—Then Hands over an Award." *building.co.uk*, February 25, 2009.
3 Frontinus: *De Aquis* 1.16.

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ARCHITECTURE TAKES CONTROL

Inventing Interior Space

At the beginning of the nineteenth century, panoramas were particularly popular in large European cities. Panoramas were specially built circular halls, which received their name from the huge paintings—measuring up to ten meters in height and one hundred meters in length—created specifically to hang inside. These paintings usually depicted a famous city, a significant historical event, or a beautiful landscape, and were often the work of an artist or a young architect with limited professional opportunities; Karl Friedrich Schinkel, one of the major architects of classicism, painted panoramas at the beginnings of his career. The audience, typically several dozen people, sat or stood at the center of the hall and was surrounded by an impressive 360-degree image.

The basic idea behind the panoramas was similar to the basic idea behind the eighteenth- and nineteenth-century opera houses, and is similar to the basic idea behind twenty-first-century multiplex halls with Dolby surround sound systems: any other sensory stimulus is excluded so that the audience could immerse itself undisturbed in the offered spectacle.

Today, we are fully reconciled with the idea that architecture is trying in its own way to materialize an equivalent concept, to create fully controlled environments; environments in which almost all of the visual stimuli that people receive are prearranged. But this was not feasible in the remote past: it would not be off the point to argue that this was achieved for the first time in ancient Rome with the construction of large dimensions interior space. Indeed, if one would want to summarize in one sentence the evolution of architecture in the 900 years between the Parthenon and the final collapse of the Western ancient world one could only mention this achievement. These were spaces in which the attendees surrendered gladly in a guided sensory game. Seneca recounted in the middle of the first century CE that, "in this bath of Scipio's there are tiny chinks—you cannot call them windows—cut out of the stone wall in such a way as

pending on the needs of each family, thus also demonstrating lack of order over time. The houses of the officials and the palace were more orderly and larger; the temples were constructed with resilient materials and were absolutely symmetrical and tidy, like the city itself. This image was reinforced by the dressing etiquette and the overall appearance of the members of different castes in daily life and in official ceremonies. The intended meaning was clear: we pass gradually from the ever changing sordid world of daily life—where people are condemned to the perpetual struggle to overcome mistakes of the past—to an increasingly stable, organized, and clean world, and from there to the world of the divinities; from the world of illusory sensations to the world of universal truth.

Managing the distilled knowledge and traditions of centuries, the monarch constructed what was perceived as a replica of the world. By appearing to tangibly reproduce the structure of the universe, he affirmed in the eyes of the community his status as the intermediary between the divine—or the absolute—and mankind, a *bodhisattva*, as Buddha described himself as being prior to his full enlightenment.

Angkor Wat, early twelfth century CE

Jayavarman VII's city offered the ideal transition from the non-significant—from the small and the chaotic to the large and orderly—leaving to each its particular physiognomy. It accurately visualized the coexistence of the fundamental features that make up the city: the structures serving daily life, which was characterized by chaotic disorder, and those representing the state and cosmic order.

The coexistence of different qualities made feasible through the meditation of symbols is typical for Angkor.

Angkor Wat, early twelfth century CE

The construction of what is probably the largest religious building in the world began a few decades before the Khmer capital's reformation. Despite its massive dimensions Angkor Wat—possibly the mortuary temple of king Suryavarman II—was not the only large temple in the area for long: the equally colossal Preah-Khan broke ground in 1191 CE (during the reign of Jayavarman VII) a short distance to its immediate north. Angkor Wat's low outer wall forms a rectangular measuring about 1,000 by 800 meters and it is surrounded by a moat nearly 200 meters wide. The main temple, with a total height of about sixty-five meters, is arranged in three main levels forming a stepped pyramid. This is a common temple layout in the region and is perceived to reproduce the form of Mount Meru, as stated in inscriptions. Meru is the world's axis and unites the different cosmic levels—i.e., our world with the heavenly, where the gods of the Hinduism Pantheon reside. Its five peaks are heavenly worlds—part of the level or the world of desire, *Kama*—inhabited by lesser gods. The world's axis is visualized through a trench, (in theory) as deep as the building's height above the ground; the mountains and the ocean surrounding Meru are visualized through the walls and moats, respectively. The temple is crowned by five towers, one in the center and four at the corners of the upper tier, corresponding to the five peaks of the holy mountain.

Not everyone, of course, can ascend the sacred mountain: as we can see repeatedly in history, controlling the access is, and has always been, a medium of affirming a strict social hierarchy. Ordinary people seemed to have had access only to the lower tier of the temple, in order to pay tribute to the temple's resident, whoever he/she was, by moving around it.

Galleries and porticoes gave a functional and visual complexity to the otherwise very simple geometry of the temple, a set of squares and

REGULARITY AND IRREGULARITY

Medieval Cities and Gothic Cathedrals

In the context of our neat and predictable world, we may find attractive what defies regularity and appears to be a product of procedures with unpredictable outcomes. Walking in medieval European towns, we appreciate the geomorphic non-rectangular street grid, the warmth of the unpretentious, the constant refutation of the expected, the imperfections, and the many phases of buildings' construction and retrofitting—each of which has left visible traces. These qualities are the very opposite of the classical ideals, namely the principals of symmetry and the more or less immovable in time order. Symmetry in Greco-Roman antiquity meant the balanced, harmonious, synthesis of distinct architectural elements; while order meant the rank in the magnitude, positioning, and succession of the elements or parts that constituted a whole—whether it was a building or the speech of an orator. Perhaps medieval cities' only feature that corresponds fully to the classical ideals is the clarity of their boundaries in contrast to modern dispersed cities. We should keep in mind, though, that Hellenistic and Roman cities didn't have clearly defined boundaries either, since mansions and gymnasia, theaters and odea were often built where there was available land, namely outside the walls.

As seen in Chapter 4, cities in ancient Mesopotamia, as well as several Greco-Roman cities developed without a preconceived plan. Their layout was the result of a rather cumulative build up. It did not follow a blueprint—but was not unreasonable or disorderly—and was the result of action by a multitude of agents and the balance of opposite forces. The inconvenience caused by building a new house or adding a new room had to be minimized by shaping it to avoid friction among neighbors, rather than according to some inflexible ideas translated into a strict comprehensive building code. Respecting the family hearth limited the ability of central authority or the ruler to shape the city according to his/her desires—although the expropriation of property and the demolition of houses were

taking place, as we have seen in Chapter 2, at least from the Oval Temple's era. In medieval Europe, the walls defined the boundaries that constricted the expansion of the cities. The pressure to occupy the unbuilt space for housing was counterbalanced by the necessity to ensure free access to everyone and to maintain the functional width of the streets.

Throughout history, "organic growth" was often not left completely unchecked, but was delicately regulated with the enactment of appropriate legislation or through customary law. From what we know from the Roman eastern provinces of the late imperial period, for example, it was forbidden to build a new edifice in way that prevented the lighting and insolation of existing neighboring buildings. Undoubtedly such provisions—which were adopted by the Byzantine empire and helped shape the medieval European legislation—were vague enough, allowing a wide range of interpretations. Frequently, more precise provisions existed: for example, that cantilevered overhangs of newly erected buildings could not be located closer than ten feet to respective overhangs of existing neighboring buildings. In ancient Athens, such overhangs were banned altogether around 500 BCE; in medieval Rome, in 1452 CE.

"Allegory of Good Government," Ambrogio Lorenzetti, circa 1340 CE, Siena, Palazzo Pubblico

Such provisions complemented a body of moral practices and customs that were formed over time; they regularly defined the position of a new building in relation with the existing ones and not each building's position regardless of the others in a Cartesian coordinates system. The resulting cityscape is very familiar to us because its structural logic unfolds slowly before our eyes. The buildings' sequence corresponds to our walk and is not governed by principles better understood when looking on the map. In Ambrogio Lorenzetti's frescoes (painted around 1340) in the Palazzo Pubblico (the town hall) of Siena, at a time when it was governed by the democratic oligarchy of the Nine, the ideal city is depicted, as a metaphor for the Good Government; this is very different from the perfect, orderly Renaissance city we see 150 years later in the paintings at the Pallazo Ducale in Urbino, attributed to Piero della Fransesca's circle. In the medieval

The Great Mosque, Cordova, 785–987 CE

The application of mathematics in architecture and arts occurs more or less in every region of the world and every cultural context. The ancient Egyptians, as we know, often used the elementary geometrical shape of the pyramid—with very particular size ratios—for some of the most important buildings they constructed: the tombs of several pharaohs and high-ranking officials. Some of the most famous ancient Greek sculptors produced statues with strictly predetermined proportions in the body limbs' sizes and invested their practice with a full-fledged theory. Several centuries later, Vitruvius conveyed to us that the Dorian, Ionian, and Corinthian orders represented the male and female genders and young girls, respectively. Therefore, the buildings that were built in these styles were constructed on the basis of different proportion systems: the Dorian order was more robust with ratio of height to columns' diameter smaller than that of the Ionian order; the Corinthian order had the most delicate proportions, corresponding to the virgins' grace and beauty. On the other side of the world, in the Indian subcontinent, the proportions of the moldings and friezes and tiers on Hindu temples were also strictly prescribed—the list is virtually endless.

The social status of architects has varied greatly during the course of history, and it was not unusual—as was the case in classical Greece—that their trade was considered to some degree vulgar, unlike, for example, music or rhetoric. In this context, mathematics offered architecture more important services than just providing assistance in solving practical design problems: it helped to upgrade it. Mathematics always excited peoples'

imagination; the notion that this abstract system, founded only in axioms, could describe in a simple and explicit way, the laws governing the seemingly chaotic complexity of the world, was "fascinating,"[2] and the people who knew their secrets enjoyed respect.

Architects quite often resorted to geometry and to specific numerical ratios to configure and decorate their buildings in order to bestow them with prestige and beauty: prestige, since the affinity of the produce of architecture with the creations of God or Nature would supposedly be manifested; beauty, since something of the World's harmony could be transferred to the buildings. Is this not also the case with music from the time of Pythagoras, who discovered that harmonic sounds were produced from chords whose lengths have simple numerical relations between them?

In the West, architects regularly incorporated simple numerical ratios in their buildings. Prime numbers were imbued by philosophers and occultists with metaphysical qualities in line with a tradition of eastern or Pythagorean origin, until at least the seventeenth century. In many instances, the first integers were considered to correspond to structural units of the universe; some other numbers—such as 6, 10, 256—were regarded for various reasons to express perfection. Rather less frequently, architects in the West used simple geometric shapes, such as circles, quadrangles, or octagons. Geometry itself had a special place in cosmology: Plato believed that "God is always doing geometry"[3] and that the world—spherical in shape, since the circle is the perfect shape—consists of the five regular solids corresponding to earth, water, air, fire, and ether. Aristotle had vigorously opposed this point of view and Averroes had written a lengthy commentary on this topic, which was later translated into Latin. Buildings

Po-i-Kalyan Mosque, Bukhara, 1172 CE

ARCHITECTURE AND UTOPIA

The Forbidden City

Since Thomas More used the word "utopia" to name the imaginary commonwealth that he devised somewhere in the middle of the sixteenth century, this word has become synonymous with something ideal, which, however, does not have a place in our world. The word utopia is made up from the Greek words for "no" and "place," and it means: a reality that does not exist anywhere, i.e., a reality outside the real world; a reality that we would wish to exist, but we acknowledge that it cannot.

Architects flirted frequently with utopia, carving there a refuge for their proposals, which were doomed in advance not to be built. Utopian architecture might be unbuildable for a whole range of reasons. The technology to support it might not exist, the money to materialize it might not be available, the society to accept it might not be there; or a combination of the above. Nevertheless, utopian architecture has a great advantage: it is not subjected to the limitations of architecture intended to be conveyed into matter; and it is emancipated from the obligation to serve its usual audience directly. So it can often express with great clarity thoughts and intentions; thus it can eventually have a huge impact on future applied architecture.

In the West, utopian architecture became a separate branch of architecture virtually from the time of Romanticism in mid-eighteenth century. At that time, the artists became increasingly independent from the mighty, who used to commission the works, and produced art regardless of whether there was already a predetermined recipient. Needless to say, utopian architecture has existed in some form since antiquity. Vitruvius informs us about the story of Dinocrates, a story whose details may be fabricated, but educational.[1] Dinocrates was an architect who wanted to present his ideas to Alexander the Great, but he could not find a way to approach him. After all his attempts failed and not knowing what else he could do, he dressed himself in a lion's skin, took a club in his hand, and stood among the crowd. Everyone turned toward him—including Alexander, who asked him who he was. Thus Dinocrates found the opportunity to talk about his plan to carve a huge statue of the king in Mount Athos, holding in his arms a new city. Alexander was flattered, but he asked calmly how this city would be supplied. After he found out that there were not enough fields in the region to feed its inhabitants and that its provisioning would depend exclusively on imports, he declined politely Dinocrates' proposal. Nevertheless, Alexander kept Dinocrates by his side and he assigned him, among other things, an equally ambitious project: the design of a city in Egypt bearing his name, Alexandria, which was to become the center of the Western world for the next two centuries. The city in Mount Athos was marginally feasible from a technical perspective; however it was not sustainable, since other cities would have to support its survival.

Sometimes, plans completely feasible from a technical perspective, plans not intended to remain on paper, were labeled utopian by those who were opposed to their implementation. When in 1834 Karl Friedrich Schinkel proposed building the palace for King Otto of Greece on the Acropolis, directly adjacent to the Parthenon, the advisor of the king of Bavaria and father of Otto, Ludwig I, the architect Leo von Klenze, described the plan as "a wonderful Midsummer Night's Dream." At that time, the Romantic movement and the worship of ancient Greece were in full bloom, and preserving the ancient monuments free from any modern admixture, no matter how brilliant, was of outmost importance; only thus could they offer the opportunity for unobstructed and undistracted contemplation. The plans for a palace on the Acropolis turned out to be ideologically non-viable in the early nineteenth century—the emphasis is on the early nineteenth century: Demetrius the Besieger, one of Alexander's successors had turned Parthenon itself in his palace somewhere around 300 BCE.

Forbidden City, Beijing, 1420

TRADITION AND INNOVATION

Sant'Andrea in Mantua

According to literature theorist Hans Robert Jauss, some of the most important works are those that are completely outside the horizon of the expectations of the public, but in the long run contribute decisively in changing this horizon.

If this also holds for architecture, then few buildings would seem as important as the Basilica of Sant'Andrea in Mantua. In contrast with the Gothic cathedrals, Sant'Andrea did not aspire to give the impression that it was reaching the sky. Neither did it seem, due to its daring static, to be standing by god's will, nor did its walls evoke lace. It did not have a portal decorated with hundreds of statuettes depicting saints, people, and animals. Sant'Andrea—a huge church one hundred meters in length—was distinguished by its serenity. The overwhelming robustness of its massive piers, the huge barrel-vaults, the Corinthian pilasters, the cornices and coffers—all gave it the majesty of Roman buildings of similar size, many of which were still preserved in rather good condition. A few years later Michelangelo would convert the *frigidarium* of Diocletian's thermae in Rome into a church, the Santa Maria degli Angeli; only the painting and the chanting during the mass would have reminded worshippers that this magnificent space was devoted to religion. Sant'Andrea, erected only fifty meters from the medieval town hall, differed most decisively from the buildings that surrounded it, in that its façade was clearly inspired by Roman triumphal arches. The typical Gothic cathedral front, with its one central and two side entrances had been transformed into a statement of intentions for a new architecture anchored in the past.

Although it was a period for admiring the Ancient World and seeking in it the support for a new beginning—a Renaissance—the very idea that a Christian church could unreservedly adopt Roman buildings forms, was if nothing else, original. Half a millennium earlier, the attempted revival of Roman architecture, the Romanesque, remained a world apart

Sant'Andrea, Mantua, Leon Battista Alberti, 1470

from its ideal and soon, in the twelfth century, developed into a clearly distinct direction, leading to Gothic architecture. The decades required for Sant'Andrea's construction—which commenced in 1470—gave the public the time to accept this completely unusual building. As Rem Koolhaas points out, architecture is slow.[1] In Sant'Andrea's case, this might have been a good thing. Architecture is lacking compared with the activities it has to accommodate, not to say it is inconsistent with them in regards of time. When the marble tiers of the theater of Dionysus were constructed in the southern slope of the Acropolis hill at Athens, the major theatrical writers—Aeschylus, Sophocles, Euripides—were already names of the past; their plays were still performed along with the current ones, which were of a much inferior quality by contemporary standards, as well as those of today. If we expect the various arts to be on the same pace, then this marvelous building appeared with a delay of approximately one century.

Leon Batista Alberti was Sant'Andrea's architect. He was born in Florence in 1404 and among other things he wrote a treatise on painting, *De Pictura*, and one on architecture, *De Re Aedificatoria*. Although Alberti's treatise followed Vitruvius' *De Architectura* in its division into ten sections ("books"), one can discern the Renaissance author's sense of superiority toward his predecessor. This probably derived from the fact that Alberti had more extensive knowledge of ancient Greek and Roman literature than Vitruvius, who was an army officer; Alberti resorted to it at every opportunity to substantiate his arguments. Moreover, Vitruvius seemed to miss the point in identifying the essential features of Roman buildings, because he primarily referred to Hellenistic architecture, which he admired; an architecture that was nevertheless absent in fifteenth-century central and northern Italy. In the Renaissance, ancient Greece existed only in the writings of Aristotle and Plato, Aeschylus and Herodotus, Euclid and Galen. At the time, Athens, Delphi, and Olympia were practically inaccessible to

THE BUILDING AND ITS SURROUNDINGS

The Villa Rotonda

According to Massimo Montanari, an expert on culinary history: "… spices, which for a millennium had distinguished the cuisine of the rich and had been desired perhaps above all other things, slowly began to disappear from culinary use, just at the moment when their abundance would have allowed more widespread use (as in fact for a period it did). The procurement of the spices directly from their sources in order to supply this demand had been among the goals of the globe-circling voyages of exploration and conquest. But the inundation of aromas and flavors that assaulted sixteenth-century Europe quickly brought fatigue. When saffron, cinnamon, and 'fine spices' came within the reach of everyone, the wealthy looked elsewhere for signs of distinction. Preferences even turned to indigenous and (in some respects) "peasant" products: in the seventeenth, century the French elites gave up spices and replaced them with chives, shallots, mushrooms, capers, anchovies and the like, more delicate flavors and certainly better suited to the richer cuisine then coming to fashion. Another element was the satisfaction experienced by those who from the lofty height of their wealth could allow themselves to enjoy even 'poor' foods, a sentiment which today is fortunately widespread."[1]

The world of the rich has always been miles away from that of the poor, in both urban and rural areas. What is interesting though from the history of architecture's point of view is how this social and economic gap between the privileged and the non-privileged has materialized. On many occasions, boundaries have been literally impenetrable: the residence of a ruler within a walled city was often protected by a second wall. In other instances, boundaries were not physical, but symbolic, and yet just as impenetrable—dictated, for instance, by the seating etiquette in a church or a parade. Quite often, the rich chose to distance themselves from commoners by adopting a clearly distinct aesthetic taste. In medieval European societies, the figurative distance between the "haves" and the "have-nots" became a reality; the wealthy few literally contrived a way to keep their distance from the masses and the environment in which they lived. "Our Princes and Signori, in order to separate themselves from the great noise of the crowd, make beautiful Villas [i.e., country houses] in their Villas [i.e., farms] … which are near or far from the Cities, whichever pleases their Excellencies,"[2] wrote Anton Francesco Doni in his book *Le ville del Doni*, published in Bologna in 1566.

Since the spatial segregation between higher and lower classes was hardly achievable in the city, the advantages of moving to the countryside, at least for some months of the year, were not only ideological or aesthetic but also practical. That the popular sport of hunting could not be practiced easily if one lived in a city was only one reason. City air reeked of mold, urine, and animals, and the chances of catching a disease were significantly higher than in the countryside. "The benefits [of living in the countryside] are so rewarding that I stay there joyfully and willingly. And first of all because of the air, the chief sustainer of our existence, which in those places I find purer and much superior and more beneficial to my complexion than that of Ferrara, which is … filled with malignant vapors,"[3] wrote another author around about the same time as Doni. If one was not unremittingly undernourished, as was often the case among the rural population, the living conditions in the countryside were clearly much better than those in the city; the rich of Florence took to their countryside houses, when the outbreak of plague reached their city in 1348, killing two-thirds of its citizens.

Throughout the world, moving away from the cities was of course a practice that dated back much earlier than the period in question, and to escape from the masses was clearly not its only motive.

In Classical Greece, the basic distinction people made in perceiving their surroundings was between cultivated and uncultivated land: fields and vineyards and the homesteads of the people who tended them, on the one hand; forests and untamed nature, on the other. It was hundreds of years later that the perception of the environment shifted toward the distinction between the city and the countryside—a shift that can be largely attributed to the repercussions of living in densely populated cities.

With the establishment of peace under the Roman rule, life in the countryside—at least for a considerable minority—definitely became a source of joy, rather than a constant struggle for survival in a hostile milieu, in a domain of irrational and menacing powers that had to be subdued. In an excerpt from the ninth book of his *De Re Aedificatoria*, which deals with private buildings in the countryside, Alberti cites Martialis: "we receive joy from the simplest everyday activities, such as eating, singing, taking a bath, or reading."[4]

The affinity of Roman elite for life in the countryside is also reflected vividly in Cicero's writings, especially his letters to Atticus. The desire of this prominent scholar to retreat to his villa in Tusculum away from the noise of the city had a strong moral dimension: the city was

Great Wall, circa 1600

of Altan Khan shot an arrow into the camp of the Chinese general Weng Wan-ta—the main architect of the Great Wall—with a note warning that if commerce were not allowed, they would attack Beijing in autumn (when their horses would have been stronger after summer grazing).

The hardliners insisted that it was not proper for the Chinese state to negotiate and trade with the nomads, and that the only appropriate policy against them was that of their complete subjugation or expulsion. More or less equal trade relations with them would be equivalent to a betrayal of the political and moral principle that China was the center of the civilized world and all other people owed allegiance. In order to support their opinion they resorted to a rather narrow interpretation of the classical texts: China was clearly bounded, culturally cohesive, and historically continuous. "Barbarians" had no place in it because they did not follow the Way of the Heaven, i.e., they did not share the same set of values with the Chinese. In this context, the analogy of the walls as the fence of a house—the house represented China—made perfect sense.

This idealized worldview, which was supported by various groups—including ambitious generals, eunuch officials, or the literati of the south—was not compatible with the military and political situation, but it was often predominant in the Court. The ability to organize campaigns that would have brought the decisive victory proved to be increasingly out of reach as years went by. However, the governors of border provinces who helped or tolerated transactions with nomadic tribes were severely punished.

Therefore, the only solution for the impasse was to keep the nomads away. New military camps were established and the system of transmitting messages was completed. Mainly, though, older fortification walls were repaired and reinforced and new large sections were constructed. By the end of the sixteenth century, a cohesive barrier 6,500 kilometers in length, the Great Wall, was created. In areas, this barrier consisted of double or triple walls dozens or even hundreds kilometers from each other, and often had branches connecting the main wall with isolated towers.

The Great Wall is more firm and resilient than the walls that had been built until then. The construction of most of its sections demanded a much larger workforce than those manufactured only from rammed earth; China's population, though, having probably surpassed 150 million by the late sixteenth century, was a dozen times larger than in the era of the Wall of 10,000 li. The standard structure consisted of a core of firmly rammed local loess mixed with coarse sand, gravel, and rubble faced with walls made of stone slabs and—more usually—bricks. These bricks were approximately four times larger than those we use today and were produced by the thousands from numerous kilns along the construction site. Aside from the chemical composition of clay, the key to the bricks' resilience is the baking procedure. The temperatures achieved in these furnaces reached 1150°C and the baking lasted up to seven days: today the best ceramic tiles are baked in these temperatures for only a few hours. Moreover, the mortar used to hold the bricks together not only had abundant lime, but also a "secret ingredient." This was recently proved to be a type of rice flour rendering the mortar especially strong—in some cases the mortar is preserved, while the bricks themselves have long eroded. The

The Great Wall where it meets the Yellow Sea at Shanhaiguan, circa 1600

audience for whom showing off was not a priority. Only with the great square in front of Saint Peter's Basilica, designed by Gian Lorenzo Bernini a century later in the mid-seventeenth century, did the theatricality of the faithful's congregation to the cathedral rise to prominence. In this respect, Saint Peter's Square constitutes the "democratic" version of Paris' royal squares; before God's representative on earth, the differences between the social classes ought to lose their sharpness.

Place Vendôme was Paris' most impressive royal square. After the settlement of several ownership issues and some changes in its design, it acquired in early eighteenth century the form it has today: a rectangle with chamfered corners. Initially, just the lavish stone façades, adorned with half-columns and pediments, were constructed. Whoever wanted and had the king's approval and the money, could buy as many bays as he wanted and build his mansion. As in the other royal squares, the property owners waived the right to partake in defining the city's image, by giving to their house the form they considered appropriate. They did so in exchange for the great prestige of owning property in an ensemble representative of the king himself; prestige that was enhanced by the uniformity of its luxurious buildings and the festive character of their architecture: a well ordered urban cohort. Ortega y Gasset, an early twentieth-century Spanish thinker, held the opinion that "more than anything else, the city is the square, agora, discussion, eloquence. In fact, the city does not need to have houses: facades suffice."[1] The Place Vendôme might not have been an agora or a medieval town hall square with a multitude of activities taking place in it, but the façades of the houses surrounding it were enough to create an urban environment that accomplished the function demanded by the times: to highlight the insignia denoting high position in the social hierarchy, and to give those who carried them the opportunity to meet and converse with each other.

This was the baroque era. The forms of buildings, although based on classical principles, tended to subvert all rules. The three-part organization (base, shaft, and cap) was still visible, though the confidence of the horizontal and vertical lines of "beam on post" classical architecture was shaken by the curved ceilings that were conceived as continuation of the walls. The calmness of the straight lines has given its place to vibrating surfaces. The simplicity of the distinct architectural members constituting the buildings—the column, the epistyle, the pediment, the cornices, the walls (which was to resurface in the early nineteenth century as we will see in the next chapter)—was lost behind an runaway decoration unifying all the individual elements of each building to an intoxicant whole.

Baroque was the era of grand compositions. The building complexes unfolded in hundreds of meters in length, constituting the setting of a stylized behavior in public space. The show of presenting one noble to others started in the *cour d'honneur*, the yard in front of the entrance to a mansion or a palace, where the carriage arrived—a sculpture mounted on wheels. The entrance of the guests into the building was an event on

its own, as one can imagine seeing the ceremonial staircase leading from the entrance at the ground floor to the piano nobile in the palace of the prince bishop of Würzburg. The construction of the palace—designed by Balthasar Neumann—began in 1720. Its ceremonial staircase occupies 540 square meters and is covered by a domed ceiling measuring eighteen by thirty meters, reaching twenty-three meters in height and is painted by Giovanni Battista Tiepolo.

This was the environment corresponding to the visual appetites of a class that had few moral inhibitions (in the narrow sense of the term), and had placed aesthetic enjoyment on a very high pedestal. The various objects, even the most utilitarian ones, were not the only ones being primarily evaluated on how satisfying they were to the eye. The various activities—from the most routine ones (such as a walk), to the most formal (such as an audience at the palace or attending a concert)—were executed by the elite in a way highlighting their aesthetic quality. Knowledge itself was associated, to an extent unprecedented until then, with visual perception. The Wunderkammer, collections of rare natural objects from corals to

The central staircase of the Residenz, Würzburg, Balthasar Neumann, 1720/1737

Altes Museum, Berlin, Karl Friedrich Schinkel, 1823

its peak this architecture of geometric simplicity and functionality, realized with architectural members of ancient Greek appearance.

Boullée's designs expressed in a way the heroic spirit of French Revolution and its great visions. The reality of the late eighteenth and early nineteenth centuries proved to be somewhat different. Effectiveness was the predominant value in the ideology supporting the Industrial Revolution, and this is the thread that runs through Adam Smith's work. One of Boullée's students—an architect working for him—attempted to implement it to architecture.

J. N. L. Durand became a professor of the École Polytechnique in 1796. The institution, which received this name in 1795, was founded a year before by the National Assembly, the legislative body of the French Revolution. Its purpose was to train engineers who would conserve, improve, and expand the aging infrastructure network inherited by Louis XIV for the benefit of the people and the glory of the nation.

Durand developed a strictly rational system of design based on a simple idea, impressive in its power of abstraction. Buildings are comprised of a limited number of architectural components: walls, columns, pillars, doors, stairs, and roofs or domes—a full-fledged modular system. Their successful combination has created buildings for every use and of every character. It is obvious that people have very different requirements of a private house than a church. But in both cases, the columns and the walls were placed at equal spacing from one another in a grid—the use of grid is featured in Egyptian and later in Hellenistic architecture, but it was never the morphogenic principle Durand envisioned it to be.

Durand's buildings were distinguished by their symmetry and the repetition of their constituent parts, and they were predominantly square or circular. The ratio of enclosed area to perimeter was therefore optimal: the outer walls were expensive to build. This layout contributed to the buildings' structural integrity without the use of bulky walls and columns;

on top of that, it supposedly rendered them beautiful, since order as well as good and effective organization of their components responded to our deepest expectations as rational beings.

Durand arrayed a number of designs to demonstrate the superiority of his theory. The most characteristic ones are those featuring in the opening pages in the 1819 edition of his book, *Précis des leçons d'architecture données à l'École royale polytechnique*. In the first one, the mid-eighteenth-century French Pantheon, Ste. Genevieve—a highly ambitious and well-know building by J. G. Soufflot in the shape of a Greek cross—is juxtaposed with his own proposal for a circular building of the same surface recalling the Pantheon of Rome and Villa Rotonda. The illustration is inscribed as an "example of the benefits that would bring in the society the knowledge and application of the true principles of Architecture." Below Soufflot's Pantheon the caption reads: "… this building which is fairly narrow has cost eighteen million"; while below his building: "… it would cost only nine and it would be huge and magnificent."[3]

The second design reveals confidence approaching arrogance—a character quality that often seems to be an asset for architects in their professional lives. In several arts, what we call progress is often motivated by the rather unjustified disdain of what is handed down. Quatremère de Quincy, secretary of the Académie des Beaux-Arts from 1816 to 1839, argued that, "the word Modernism does not seem to mean anything else than opposition to what exists."[4] In this second design, Durand juxtaposed Saint Peter's of Rome with a church of his own with the same surface; his church is a five-aisled basilica with a rectangular plaza in front of it, corresponding to Bernini's oval square in front of Saint Peter's. The illustration is inscribed as an "example of the fatal consequences resulting from ignorance or non-application of the true principles of Architecture." Below Saint Peter's the caption reads, "this building has cost more than 350 million at the time"; while below his church, "design, which if had been applied it would have saved three quarters of Europe from centuries of calamities." It is clear that here Durand referred to the appeal of Luther's preaching to a Central European public frustrated by the constant financial bleeding caused by the funding of the construction of Saint Peter's miles away. The religious wars that followed caused huge calamities in three quarters of Europe.

Durand declared economy as the philosopher's stone of architecture. He thus approached an industry, which in the previous centuries obeyed the demands of the spectacle, from a positivist perspective. But Durand's economy was restricted to the optimization of responses to given programs. Which building would be appropriate for each occasion was not an issue. Durand did not question the need to construct a huge French Pantheon or a colossal Saint Peter; he opted to criticize vehemently the configuration of these edifices as they were being built.

Should architecture be limited to only these duties? Must the architect act in the capacity of a consultant and raise questions regarding the

means is visible. The walls had to be so thick that the lower floors were no longer usable.

The incentive, though, for using structural steel in buildings was not initially to save space and materials. In 1796, Charles Bage constructed the Ditherington Flax Mill facilities in Shrewsbury, England. Because of its iron columns, and floors of successive low arches made of shallow brick arches supported on joists and coated with sand and ceramic tiles, this building was less vulnerable to fire than the wooden structures that were common then. Consequently, this construction found many imitators—though not in America where the mills were still built with thick timber, equally resistant to fire. A few years earlier (1779), cast iron was first used in the construction industry. The bridge over the Severn River became an instant landmark and prompted the creation of the Ironbridge village. Does Bilbao not owe its modern rebirth to some extent to Frank Gehry's Guggenheim Museum?

Empire State Building, New York, Shreve, Lamb & Harmon, 1930

In the course of the nineteenth century, numerous innovations helped improve the quality of steel and drop its price considerably. Thus, steel gradually replaced cast iron, although for some years mixed construction—steel and cast or wrought iron—was the norm. The volume of the steel frames was a small fraction of the walls made of bricks and stones of comparable strength. Lower floors of tall buildings were usable. The path to conquering the skies was now open.

As usual, the solution to an array of problems is required for developing a new technology—in our case, the construction of tall buildings. One of these was protecting steel from fire; soon many reliable solutions were suggested. Another was the safe and fast vertical transportation of people and goods: tall buildings are inconceivable without elevators. In 1854, Elisha Otis presented his invention at New York's World Fair. He entered the cabin of the elevator he had built and cut the wire rope holding it in check. Its brakes activated instantly and the cabin immobilized instead of

Downtown Athletic Club, New York, Starrett & van Vleck, 1927

falling to the void. The sigh of relief breathed was a strong indication that the public would soon overcome its reluctance and trust these machines. The first steam-powered lifts were installed in multistory buildings around 1860, and electric elevators were invented two decades later. Within a few years their speed was increased to the point that they could serve real skyscrapers: electrical motors offer much higher accelerations than the steam or combustion engines. The Empire State Building had sixty-four of them.

The available technology—or what was developed to solve a specific problem—has always defined largely the form of the buildings. The roofs of the ancient Greek temples, for example, initially had very high gradients to drive rainwater away, approximately 1/1. The Corinthians in the first half of the seventh century BCE developed a highly advanced technology allowing them to construct completely flat, large tiles with complex interlocks that made them fit together watertight. This allowed for the creation of roofs (and, consequently, pediments) with gentle gradients as seen in the Parthenon; much later, Roman temples held to the Etruscan tradition of high-gradient roofs and pediments, also adopted by Palladio two millennia later. The change that had occurred with the Corinthian invention was not radical, but it was enough to mark the aesthetics of classical Greece. On the other hand, the Romans who remained attached to the traditional roof and pediment layout developed the *opus caementicium*, the revolutionary material that allowed them to build edifices like the Pantheon, which could do without pitched roofs altogether. Moreover, a few hundred years later, the dome of the Florence cathedral may have been very different if the Pisano shipbuilders—commissioned by Filippo Brunelleschi—had not developed the expertise enabling them to construct ropes hundreds of meters long and strong enough to meet the requirements of this major project.

And we all know that architecture would be completely different today if it were not for computers and advanced software, which allow us to design complex geometric forms with the ease we once drew a straight line with a pencil ...

Notes

1 Sullivan, Louis: "The tall office building artistically considered". In: *Lippincott's Magazine*, 57 (March 1896).

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AN ARCHITECTURE FOR ORDINARY PEOPLE?

Modernism

Richard Rogers mentioned in a lecture in 1979 that the Centre Georges Pompidou in Paris—the Beaubourg, which had just been completed—is erroneously considered to have been designed by Renzo Piano and himself; it would more appropriate to say that it is "a work of Piano, Rogers and the Fire Brigade."[1] With this typical British humor, Rogers pointed out that the Fire Department's requirements decisively influenced the shaping of the building. The most significant change requested was to reduce its height in order to allow rapid evacuation of the upper floors in case of fire. The architects devised an ingenious solution. They submerged the building's entrance below grade and placed the emergency staircases at its ends so that they exit in the street level. They gave a slightly downward gradient to the large square in front of the building, similar to that of the square in front of Siena's town hall. The visitors descend toward the building's entrance effortlessly. The hi-tech façade, with the red escalator, is revealed in all its glory. When the visitors exit, they face people swarming in the square, whose theatricality is pronounced because of its gradient toward the building. Fortunately, cases like this one—when a restriction becomes the cause for good architecture— are not rare.

Beaubourg's design was adapted to the requirements of ensuring adequate escape routes for visitors, just in case they are needed (hopefully never). Today, safety regulations in almost the entire world prescribe in detail many features of buildings—from the number of classroom exits to the shaping of the handrails on a staircase. Ensuring adequate movement space alone often determines the layout and the configuration of buildings. Let us consider, for example, that Shinjuku Station in Tokyo serves two million passengers on a daily basis—not a novelty of today, though, as architects faced similar problems in the Colosseum or Saint Peter's Square.

Modern architecture made its goal to serve the general public, not only in the sense of crowd management. It upgraded ordinary people from

this without having to apologize to any tenant for the lack of privacy that he/she probably felt behind the large sliding glass doors, or for the expensive marble walls that made it practically impossible to even hang a painting of one's choice.

Le Corbusier played two angles at the same time: the certainty of strict positivism on the one hand, and the thrill that art can offer on the other. His aggressive functionalism—the belief that form should result from function—was counterbalanced by his position that architecture lies beyond successful response to the given tasks in the engineer's spirit of rationality and effectiveness. "Architecture is the learned game, correct and magnificent, of forms assembled in the light," he stated poetically.[5] Perhaps he had a third angle; having carefully studied advertisement, he used image juxtaposition as a powerful argument that impresses even today's readers of his immensely influential *Vers une Architecture*, first published in 1923.

Generally speaking, authorities worldwide were not extremely impressed by modernism. The architecture of the future, as it eventually turned out to be, was an architecture for the marginalized and

UN Headquarters, New York, Le Corbusier et al., 1949

Barbican Center Housing, London, Chamberlin, Powell & Bon, 1965 and later

under-privileged. Modernist public buildings were rather rare, and many of them were erected in the colonies, which became test fields for innovations. From early on, though, modernism offered its services to the members of the upper classes who wanted to be distinguished among their peers for their taste—indeed many iconic buildings of modern architecture are expensive villas. Things changed radically after World War II. Many governments, in an attempt to disengage from images reminiscent of the past, began to adopt modernism; the building of the newly established UN in New York, designed in 1947 by an international committee, with Le Corbusier as its most influential member, marked the beginning of a new era. Large companies also saw the opportunity to break free from the tight grip of the forms of the past—cornices, cornerstones, and Corinthian pilasters. The new visual culture, being recent, was open to appropriation.

Modernism was soon well established. It is difficult to overestimate its impact. If anything, what characterizes the man-made environment today is that the daily life of ordinary people is considered worthy of being imprinted on space more strongly than abstract ideas. Because what else do the vast tracts of commercial and industrial land surrounding the nuclei of our cities denote? They are home to mega-stores and the parked cars in front of them—and to warehouses and industries producing soft drinks, refrigerators, televisions, and software for our PCs. Being substantiated in space the trivial was monumentalized.

From the nineteen-twenties, modernism was dedicated into shaping this new reality. It called for architects not to hide facilities such as supermarkets and gas stations behind columns, epistyles, gabled roofs, and regular geometric solids—i.e., symbolically loaded forms. Moreover, it invented an aesthetics that gave these humble activities the right to appear as what they were. Adoption of Luis Sullivan's motto "form follows function" helped modernism to justify the forms of buildings it created; first and foremost, though, it helped architecture redefine its very purpose, in order to be allowed to serve ordinary people, to expand its scope, and to exonerate its occupation with ordinary things not expected to last for eternity.

It seems that the most typical recording of this turn of architecture toward the daily life of the common people is the quote of Le Corbusier: "architecture can be found in the telephone and in the Parthenon."[6] The mere comparison of an ordinary, dispensable, object to a building inhabited by the gods of an exceptional society is almost blasphemous. However, it was characteristic of the new evaluation of things, which was fated to shape the man-made environment and its image for at least one century—perhaps for much longer, time will tell. Furthermore, it gave those practicing this art the impression that they could be considered close associates of Phidias, even if they were designing just one more nice, but trivial, building destined for a limited life span, to be built somewhere in the vast suburban sprawl.

Notes

1 Author's personal notes.
2 *Minutes of a War Cabinet Meeting, March 3, 1919*. PRO CAB 23/9/539, National Archives, 5.
3 Le Corbusier: *Vers une Architecture*. Crès et Cie 1923, 89.
4 Adorno, Theodor: "Asyl für Obdachlose". In: *Minima Moralia: Reflexionen aus dem beschädigten Leben*. Surhkamp 1951, 38.
5 Le Corbusier: *Vers une architecture*. Crès et Cie 1923, 16.
6 Le Corbusier: *Vers une architecture*. Crès et Cie 1923, 7.

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ARCHITECTURE WITHOUT ARCHITECTS

The Age of Motorization

A building cannot be "wrong," as a theory in physics or a medical diagnosis may prove to be, since it is judged by a public that is far from homogeneous, and one whose priorities change with time and circumstances. Hence, architecture can boast that it offers almost anyone who practices it the certainty of recompense: there will always be someone who will say something good about an architect's work.

Is it possible for architecture to make the public see a building with a different view without changing a single brick? Art has been posing a similar question for nearly a century. From Marcel Duchamp's time at the latest, we know that changing the context of an object can reveal aspects that remained hidden to us, or make us feel emotions that we did not suspect the object could stimulate. In this sense, deliberate changes of the conditions and the context in which the public perceives an object can be art, provided that the changes are accomplished with means that the senses can perceive—rearranging the matter surrounding the object, for example, or with images or sounds—although even this is open for debate. Changing our mind through a text belongs marginally to the realm of art. If it is written or presented in the way common for artists—what exactly this means is a topic of another discussion—then it can probably be considered art. If it is written in the style of an art critic, then probably not. And we all generally agree that the use of hallucinogens, which change our view of the things around us, is also not art. The same questions are equally legitimate in architecture.

Often, the image we have for some buildings changes, even if the buildings themselves do not. This typically occurs with the construction of other buildings that make us revisit the existing ones. Did Seneca not recount in the passage quoted in Chapter 8 how dismissive the Romans were of the old baths when the new ones with large windows and high ceilings were built? Is it not obvious that Sant'Andrea made the Mantovese reappraise their Late Medieval town hall?

HUMANS AND ENVIRONMENT

From Vitruvius to Green Architecture

The ancient Greek writer Plutarch records an incident from the Spartan king Leotychidas' visit to Corinth. The king was led to a room for dining and entertainment. He was impressed by the coffered ceiling and he asked, apparently with some irony, if square trees grew in the area.[1] Although a king, he considered squared logs to be a blatant display of wealth and luxury.

Often in history, societies have modified their environment in an ostentatious way to demonstrate their might and particularly the power of central authority—or have resorted to the display of modifications to the environment motivated by responses to rather practical needs. The huge and perfectly joined granite boulders forming the fortification wall of Osaka Castle, built in the sixteen-twenties, visualized the power of the Tokugawa Dynasty through the display of their builders' ability to handle with absolute accuracy weights 1,000 times heavier than that of their own body. And during Nikita Khrushchev's visit to the USA, as related in Chapter 7, President Eisenhower showed his guest the motorways leading to the suburbs of Washington, the utilitarian and popular equivalent of the geometric gardens and walkways of Versailles built by Luis XIV three centuries earlier.

When does a human construct stop being primarily a liberation tool from the constraints of nature and become first and foremost a symbol of strength? Are the huge infrastructure projects that dot the earth's surface today outrageous demonstrations of power or, on the contrary, simply necessary?

The fact that without them, the survival of large groups of people and life in cities would be impossible does not offer sufficient legitimation to any technical project, either today or in the past. Alexander the Great rejected Dinocrates' proposal, mentioned in Chapter 12, to construct a city in the bosom of a huge statue resembling him because the city would not be sustainable. Long before climatic change and global warming caused

by human activity, the voices calling people to live in harmony with nature were many. We find one of these in the oldest surviving treatise on architecture. Vitruvius echoing the Stoic philosophers' views—later summarized by Seneca—regarded construction activity an integral part of humanity, and placed it in historical perspective:

"It was the discovery of fire that originally gave rise to the coming together of men, to the deliberative assembly, and to social intercourse. And so, as they kept coming together in greater numbers into one place, finding themselves naturally gifted beyond the other animals in not being obliged to walk with faces to the ground, but upright and gazing upon the splendor of the starry firmament, and also in being able to do with ease whatever they chose with their hands and fingers, they began in that first assembly to construct shelters. Some made them of green boughs, others dug caves on mountainsides, and some, in imitation of the nests of swallows and the way they built, made places of refuge out of mud and twigs. Next, by observing the shelters of others and adding new details to their own inceptions, they constructed better and better kinds of huts as time went on.

And since they were of an imitative and teachable nature, they would daily point out to each other the results of their building, boasting of the novelties in it; and thus, with their natural gifts sharpened by emulation, their standards improved daily. At first they set up forked stakes connected by twigs and covered these walls with mud. Others made walls of lumps of dried mud, covering them with reeds and leaves to keep out the rain and the heat. Finding that such roofs could not stand the rain during the storms of winter, they built them with peaks daubed with mud, the roofs sloping and projecting so as to carry off the rainwater.

That houses originated as I have written above, we can see for ourselves from the buildings that are to these days constructed of like materials by foreign tribes….

Furthermore, as men made progress by becoming more expert in building, and as their ingenuity was increased by their dexterity so that from habit they attained considerable skill, their intelligence was enlarged by their industry until the more proficient adopted the trade of carpenters. From these early beginnings, and from the fact that nature had not only endowed the human race with senses like the rest of the animals, but had also equipped their minds with the powers of thought and understanding, thus putting all other animals under their sway, they next gradually advanced from the construction of buildings to the other arts and sciences, and so passed from a rude and barbarous mode of life to civilization and refinement.

Then, taking courage and looking forward from the standpoint of higher ideas born of the multiplication of the arts, they gave up huts and began to build houses with foundations, having brick or stone walls, and roofs of timber and tiles; next, observation and application led them from fluctuating and indefinite conceptions to definite rules of symmetry. Per-

Osanbashi International Port Terminal, Yokohama, Foreign Office Architecture, 2000

impasses of the allegedly sterilized formal thinking developed in the West in recent centuries. The architecture of deconstruction destroyed the purity of geometric shapes, the rigor of their composition, their metaphysics. It replaced them with the confused lines of the draft drawing and the uncertainty of the layers.

Later on, parametric design started to be increasingly used for generating forms; although many do not look like it, such forms are in fact the product of the strict logic of mathematics and not of some more or less arbitrary decisions of the conventional "creator"—although computer programming probably resorts to as many personal choices as the design of decorative elements in the Beaux Arts buildings. Curved and twisted to this or to that direction, mysterious but legible, contemporary buildings talk to us about our agony to create something special, something different from the sea of trivial constructions surrounding us, but also something not establishing its identity on the display of humans' superiority over (the rest of) nature.

One of the most interesting buildings of the new era is the Osanbashi Port Terminal in Yokohama, designed in the mid-nineteen-nineties. Its architects, Foreign Office Architecture, developed their concept on the program's requirement to fully separate the movement of departing and arriving cruise ships passengers, their luggage, staff, and visitors. Passen-

Quai Branly Museum, Paris, Jean Nouvel & Patrick Blanc, 2004

gers are led via gently sloping ramps from the entry level to the check-in level. The visitors taking their stroll—usually people living nearby—without really noticing their ascent end up on the decked roof where they are offered a unique view of the impressive harbor, while beneath their feet, the level zero of the wharf is dedicated exclusively to serving ships. The floors, the walls and the ceilings form a continuum, a radicalization of the baroque aesthetics when the walls evaporated into the curved ceilings; thus, the configuration of the building undermines the rigor of the statement that it is an artifact constructed on clear principles conceived by human mind and by human hands, and make it appear as born from the ground.

The idea to use plants and earth for building insulation is an old one. While green roofs have been around since the time of the Hanging