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The Humanist Brain

Alberti, Vitruvius, and Leonardo

> *first we observed that the building is a form of body* (Leon Battista Alberti)[1]

In most architectural accounts, Renaissance humanism refers to the period in Italy that commences in the early fifteenth century and coincides with a new interest in classical theory. The ethos of humanism was not one-dimensional, for it infused all of the arts and humanities, including philosophy, rhetoric, poetry, art, architecture, law, and grammar. Generally, it entailed a new appreciation of classical Greek writers (now being diffused by the printing press), whose ideas had to be squared with late-antique and medieval sources as well as with the teachings of Christianity. In this respect, Leon Battista Alberti epitomized the humanist brain.

In the case of architecture, humanism often had a slightly different connotation. It has not only entailed the belief that the human being, by virtue of his divine creation, occupies a privileged place within the cosmos but also the fact that the human body holds a special fascination for architects. I am referring to the double analogy that views architecture as a metaphor for the human body, and the human body as a metaphor for architectural design. In this sense too Alberti was a humanist, for when his architectural treatise of the early-1450s appeared in print in 1486 (alongside the "ten books" of the classical Roman architect Vitruvius) he promulgated a way of thinking about architecture that would largely hold fast until the eighteenth century. In this way Alberti became perhaps the first architect in history to construct a unified body of theory – what historians have referred to as the theoretical basis for a new style.

Born a "natural," or illegitimate, child into a wealthy family of merchants and bankers, Alberti came to this task with mixed blessings.[2] If his illegitimacy deprived him of legal inheritance, his family purse at least insured him of a good classical education at the University of Bologna, where he took his doctorate in canon law in 1428. By this date he had already begun to disclose his literary talent (his writings on a variety of subjects are prodigious) and interest in mathematics. Like many well educated men of the time, he gravitated into the service of the church, first as a secretary to the cardinal of Bologna. Four years after taking his doctorate, in 1432, he was living in Rome as a secretary to the head of the papal chancery, and therefore working indirectly for the pope. In 1434, however, civil unrest forced the papal court to leave Rome for Florence. It was here, where a new approach to architecture, sculpture, and painting was already taking hold, that Alberti formed a friendship with Filippo Brunelleschi and Donato Donatello, both of whom he may have met a few years earlier. Their shared interests were added to when Alberti began to paint, and within a year he wrote the first of his three artistic treatises, *De pictura* (On Painting, 1435). The date of his second artistic tract – *De statua* (On Sculpture) – is unknown, although it was quite possibly composed in the late 1440s. Meanwhile, around 1438, Alberti journeyed with the papal court to Ferrara, where he cultivated his interest in architecture. This pursuit intensified when Alberti and the papacy returned to Rome in 1443 and the scholar, once again following in the footsteps of Brunelleschi, began his investigation of Roman classical monuments. Out of these labors, and with his growing assurance, came his third and final artistic treatise, *De re aedificatoria* (On Building), which he presented in 10 books to Pope Nicholas V in 1452. With this task completed, Alberti devoted the next 20 years of his life to the practice of architecture, for which his fame surpassed that of his many literary endeavors.

De Pictura and *De Statura*

Although his treatise on architecture remains his largest theoretical undertaking, the two smaller studies on painting and sculpture already tell us much about his artistic outlook. *De picitura* is, first of all, a highly original work attempting to delineate the principles of linear perspective.

Its aim is to elevate painting above the status of artisanship, and it provides several useful pointers about how painters can curry the favor of generous patrons by cultivating good manners and practicing high morals.[3] In its dedication, Alberti exalts the inspired work of Renaissance artists by equating their efforts with the "distinguished and remarkable intellects" of classical times.[4] Chief among them is Brunelleschi, who had recently completed the dome for the Florentine cathedral – that "enormous construction towering above the skies, vast enough to cover the entire Tuscan population with its shadow, and done without the aid of beams or elaborate wooden supports."[5]

De pictura has two broad themes. One is Alberti's attempt to supply this new 'fine art' with the theoretical underpinnings of geometry, which for him is not a mathematical issue but rather a divine ideal that brings an imperfect human being into closer harmony with the divinely created order of the universe. Geometry, for Alberti, is the humanization of space, and in fact the treatise opens with his apology for invoking geometry "as the product not of a pure mathematician but only of a painter."[6] Alberti also bases the measure of his perspectival geometry on three *braccia* – "the average height of a man's body."[7] Thus the rules of perspective are corporeally embodied in human form.

The second theme is the concept of *historia*, the elaboration of which encompasses nearly half of the book. It does not mean "story," as Alberti makes clear, and he devotes page after page to discussing how to achieve "this most important part of the painter's work."[8] Collectively, this vital artistic quality resides in achieving grace and beauty in a work by displaying people with beautifully proportioned faces and members, possessing free will and appropriate movements, depicting a variety of bodies (young and old, male and female), abundant color, dignity and modesty, decorum, drama, monumentality, but above all, the animate display of emotion. *Historia* commands the artist, through his creativity, to produce a work "so charming and attractive as to hold the eye of the learned and unlearned spectator for a long while with a certain sense of pleasure and emotion."[9] It has therefore been said that just as Alberti's theory of perspective provides a visual link between the painter's eye and the objects within the spatial field, his notion of *historia* supplies an emotional link that should move the spectator to experience empathy. Quite naturally, he believed it to be an attribute favored in

antiquity, and thus it is entirely logical for Alberti to open the third book of his treatise by encouraging painters to become familiar with classical poetry and rhetoric.[10]

This humanist slant is also very apparent in his tract on sculpture, in which he provides an individuated proportional system based on the variable measure of six human feet (therefore fixed according to the person and not to a standard, differing for persons of different height or foot length). Vitruvius, of course, had opened the third book of *De architectura* with a similar proportional system, albeit with some notable differences.[11] Vitruvius's system of proportion, closely related to his notion of symmetry (*symmetria*), was based on a series of fractional relations of the body parts to the whole (the head, for instance is 1/10 of the body's height), whereas Alberti divides each foot into ten inches and each inch into ten minutes in order to give very precise measurements. Vitruvius had also presented his proportional system just before he described the human figure lying on his back with outstretched arms and feet, contained within a circle and square. Alberti, however, presents his system without metaphysical fanfare. His numbers are purely measurements, even if also derived from the human body.

De Re Aedificatoria

But this does not mean that Alberti did not have his rationale. We can see this by turning to his much lengthier treatise on architecture, *De re aedificatoria*, where his artistic ideas find their logical conclusion. And if there is one compelling metaphor that appears consistently throughout the exposition of his theory it is the idea of corporeality – architecture as the re-creation of the human body. "The Great experts of antiquity," as he informs us in one passage, "have instructed us that a building is very like an animal, and that Nature must be imitated when we delineate it."[12] Again,

> the physicians have noticed that Nature was so thorough in forming the bodies of animals, that she left no bone separate or disjointed from the rest. Likewise, we should link the bones and bind them fast with muscles and ligaments, so that their frame and structure is complete and rigid enough to ensure that its fabric will still stand on its own, even if all else is removed.[13]

This corporeal metaphor determines terminology. Columns and fortified areas of the wall are the "bones" of a building, the infill walls and paneling serve as muscles and ligaments, the finish of a building is its skin.[14] The roof, too, has its "bones, muscles, infill paneling, skin, and crust," while walls should not be too thick, "for who would not criticize a body for having excessively swollen limbs?"[15] Every house, moreover, should have its large and welcoming "bosom."[16]

Architecture for Alberti, more specifically, is not to be formed in the manner of just any human body, and thus his standard, or canon, demands a cosmological foundation. His opus on theory begins with the definition of a building as a "form of body," which "consists of lineaments and matter, the one the product of thought, the other of Nature."[17] In this duality, we have the raw materials of nature at human disposal, upon which the architect impresses a design, like the divine creator, through the power of reason. Book One is entirely given over to the issue of lineaments, which Alberti defines as "the precise and correct outline, conceived in the mind, made up of lines and angles, and perfected in the learned intellect and imagination."[18] Lineaments, as his larger text makes clear, are more than simple lines or the composition of a building's outline; they form the building's rational organization that is open to analysis through the six building categories of locality, area, compartition, walls, roofs, and openings. Area, the immediate site of a building, is where Alberti brings in his discussion of geometry, but compartition seems to be the essential term for him. It calls upon the architect's greatest skill and experience for it "divides up the whole building into the parts by which it is articulated, and integrates its every part by composing all the lines and angles into a single, harmonious work that respects utility, dignity, and delight."[19] It also encompasses the element of decorum in mandating that nothing about a building should be inappropriate or unseemly.[20]

Little that we have discussed so far departs from classical Vitruvian theory, which too is founded upon the belief that every composition of the architect should have "an exact system of correspondence to the likeness of a well-formed human being."[21] Neither is it especially at odds with the Stoic inclinations of Vitruvius, which allowed him to emphasize, above all, the primacy of sensory experience.

But Alberti will not be content with this resolution because he believed that Vitruvius never clearly disclosed how one could achieve this higher harmony of parts. Therefore he introduces a second duality

that mirrors his earlier one of lineaments and nature, which is the dialectic of "beauty" and "ornament." He introduces both concepts in Book Six, a point at which he resumes his treatise after a lapse of some time, in part, as Alberti himself acknowledges, because of the extreme difficulty of the task. In truth, he probably used his literary hiatus to consult a number of other classical sources.

We can surmise this, at least, when he proffers his first tentative definitions of his new duality: "Beauty is that reasoned harmony of all the parts within a body, so that nothing may be added, taken away, or altered, but for the worse."[22] This "great and holy matter" is rarely found in nature, which Alberti reports (with a typical corporeal metaphor) by citing a dialogue from Cicero's *De natura deorum* in which a protagonist notes that on a recent visit to Athens he rarely found one beautiful youth in each platoon of military trainees.[23] Alberti seeks to repair this general deficiency of nature by offering the idea of ornament, which, in a cosmetic sense, can mask the defect of someone's body, or groom or polish another part to make it more attractive. Thus, beauty is an "inherent property" of something, while ornament is "a form of auxiliary light and complement to beauty."[24]

But this tentative definition, as the reader soon learns, is entirely misleading. Ornament, in particular, is for Alberti a much broader concept. It, along with beauty, can be found in the nature of the material, in its intellectual fashioning, and in the craftsmanship of the human hand.[25] The notion of ornament can also be applied to many other things. For example, the main ornament of a wall or roof, especially where vaulted, is its revetment.[26] The principal ornament of architecture is the column with its grace and conference of dignity.[27] The chief ornament of a library is its collection of rare books (especially if ancient sources).[28] And the ornaments of a city can reside in its situation, layout, composition, roads, squares, parks, and individual buildings.[29] A statue, he notes on one occasion, is the greatest ornament of all.[30] If there would be one way to summarize Alberti's view of ornament, then, one might say that ornament is the material of building or design, either in its natural condition or with human labor applied to it – that is, it is material intrinsically attractive or impressed in some way by the human hand and brain. Such a definition is vaguely similar to but not coincidental with Vitruvius's conception of ornament as a formal vocabulary, a system of *ornamenta* or rules of detailing applied to architectural *membra* (members).[31]

Nevertheless, this is not all that Alberti has to say on the subject, for three books later (in Book Nine) he returns to this "extremely difficult inquiry," now armed with new terminology. Once again a corporeal analogy precedes his discussion, as Alberti considers the relative merits of slender versus "more buxom" female beauty. His objective is not to answer this human question, which smacks too much of subjectivity, but rather to provide beauty with a more solid or absolute underpinning. Hence beauty cannot be founded "on fancy," but only in "the workings of a reasoning faculty that is inborn in the mind."[32] And because reason is a human privilege specifically endowed by God, the brain and its reasoning power is invested with divine authority. This duality of beauty and ornament is then superseded by a new idea, the third mediating concept of *concinnitas*.

Deriving from the Latin, the English "concinnity" still perfectly expresses the concept that Alberti defined as "the spouse of the soul and of reason," and it has as its task "to compose parts that are quite separate from each other by their nature, according to some precise rule, so that they correspond to one another in appearance."[33] It is not a term that appears in Vitruvius, and Alberti seems to have taken it from the rhetorical theory of Cicero, where, under the attribute of ornament, the classical author defines it this way:

> Words when connected together embellish a style [*habent ornatum*] if they produce a certain symmetry [*aliquid concinnitatis*] which disappears when the words are changed, though the thought remains the same.[34]

Such a definition of classical rhetoric is concerned with oratorical style, but Alberti's thought demands a more absolute grounding and thus he offers a revised definition of beauty:

> Beauty is a form of sympathy and consonance of the parts within a body, according to definite number, outline, and position, as dictated by *concinnitas*, the absolute and fundamental rule in Nature. This is the main object of the art of building, and the source of her dignity, charm, authority, and worth.[35]

The translator's choice of the English term "symmetry" in the passage from Cicero underscores how close in meaning this term is to Vitruvian *symmetria*, the most important of his six principles of architecture.

Vitruvius defines symmetry as "the proportioned correspondence of the elements of the work itself, a response, in any given part of the separate parts to the appearance of the entire figure as a whole."[36] However, he uses a different word for beauty from Alberti. Whereas the latter employs the more traditional term *pulchritudo* (beauty as a high ideal of excellence), Vitruvius prefers the word *venustas*, which, on a more corporeal level, suggests a beauty known to the senses. As Cicero informs us, the Latin word was derived from the goddess Venus.[37]

For Alberti, however, beauty is imbued with a higher necessity as defined by the importance of number, outline, and position. These three requisites of good architecture, of course, allow him to raise the issue of harmonic proportions, which govern all things within the universe, including the parallel numerical harmonies of music and architecture. Alberti's discussion of these ratios is somewhat involved, but in general he prefers simple ratios such as 2:2, 2:3, 3:4, and 4:9, which apply both to music and architecture. These ratios are not arbitrarily conceived but are inherently in concordance with the unique reasoning powers of the human brain:

> For about the appearance and configuration of a building there is a natural excellence and perfection that stimulates the mind; it is immediately recognized if present, but if absent is even more desired. The eyes are by their nature greedy for beauty and *concinnitas*, and are particularly fastidious and critical in this matter.[38]

This biological nourishment, as it were, again shares a certain affinity with another passage of Vitruvius, which notes that "our vision always pursues beauty," and that if a building is badly proportioned for what the eye expects then it "presents the viewer with an ungainly, graceless appearance."[39] There is, however, one crucial distinction between these two viewpoints. For Vitruvius the matter of bringing proportions in line with the mechanics of the eye allows the architect to make "optical adjustments" where needed.[40] For Alberti the prescribed ratios rise to the level of cosmic necessity, and thus he at least implies that the architect has no leeway to adjust them. If there were to be one exception, it would be the three orders, which, metaphorically speaking, are based on the corporeal proportions of three different body types: the Doric male, the Ionic female, and the Corinthian daughter.

Alberti's theory of the brain can thus only be characterized as one of embodiment. Just as the body is the house for the human mind or soul, so is a building a house for the human body. Unlike a body, however, a building can elude the infelicities of imperfect nature, provided that it is invested with ornament and with that essential element of *concinnitas* that endows it with proportional harmony through the divine powers of reason. Such is the embodied perspective of a humanist architect.

Filarete and Francesco di Giorgio

The linkage of architecture to the well proportioned body by Alberti fixed this image for the Renaissance, but not without a few somatic explications before the end of the fifteenth century. Certainly one of the more enchanting Renaissance treatises equating building with the body was that of Filarete, who quite explicitly informed his fictional interlocutors "by means of a simile that a building is derived from man, that is, from his form, members, and measure."[41] Filarete, who was eight years older than Alberti, never acquired the educational background of a classical humanist. His treatise of the early 1460s nevertheless takes the form of a Socratic dialogue in Milan, in which he – the architect – convinces the resident prince and a few other proponents of the superiority of the new architecture (Florentine Renaissance) over the older Gothic style still employed in Lombardy. He does so by laying out his vision for the ideal city of Sforizinda.

The body/building analogy for Filarete goes beyond literary trope to frame a complete philosophy of architecture. A building should be based on the most beautiful part of the human anatomy, the head, and thus be divided into three parts. Its entrance is its mouth and the windows above are the eyes.[42] The building needs to be nourished regularly with maintenance, or else it will fall into sickness and disease. The most inventive part of this analogy is a building's design or initial conception. Because the patron of the future enterprise cannot conceive the building alone, he must follow the course of nature and hire an architect to conceive and bear the child:

> As it cannot be done without a woman, so he who wishes to build needs an architect. He conceives it with him and then the architect carries it out. When the architect has given birth, he becomes the mother of the

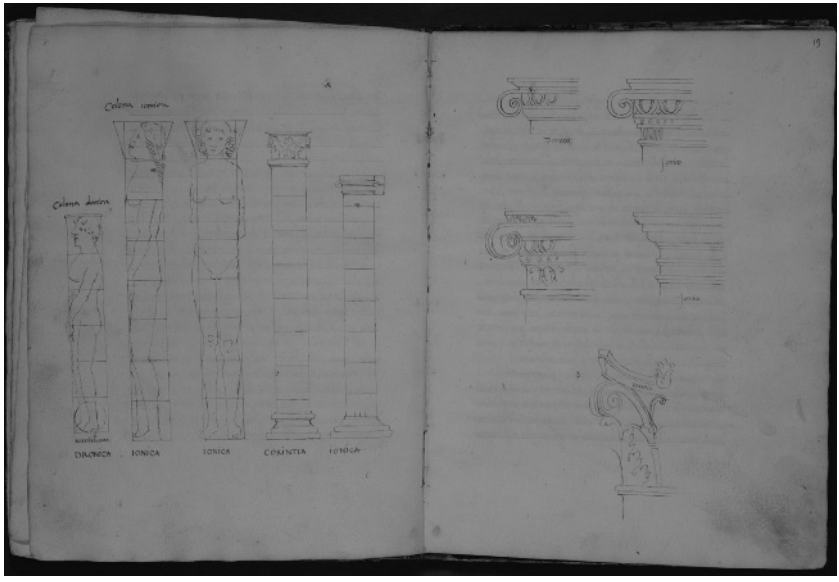

Figure 1.1 After Francesco di Giorgio Martini, *Opera di Architettura* (c.1479–80). Courtesy of Spencer Collection, The New York Public Library, Astor, Lenox and Tilden Foundations, Ms. 129, fol. 18v

> building. Before the architect gives birth, he should dream about his conception, think about it, and turn it over in his mind in many ways for seven to nine months, just as a woman carries her child in her body for seven to nine months.[43]

Just as, after labor, the good mother sees that her new son or daughter is properly attended to, so the architect goes out and finds the best tutors, that is, the most skilled carpenters and masons, to erect the edifice. Invoking another carnal metaphor that quite possibly might have offended Alberti's sense of decorum, Filarete concludes that "building is nothing more than a voluptuous pleasure, like that of a man in love."[44]

Filarete was of course familiar with the treatise of Vitruvius, as well as the writings of Alberti, and he may have met the latter when they both lived in Rome. His ideas seem to derive from both. Not only is the shaft of a Doric column – following Vitruvius – based on the proportions of a nude male (therefore "fuller in the middle" before tapering toward the top), but the fluting of the Corinthian column modestly

emulates the pleated dress of the maiden.[45] Similarly, when the first humans of the post-Edenic world felt the need to construct shelter, they took their proportions from Adam himself, who, indeed, had been created by God and therefore had a perfect body.[46]

The corporeal metaphors of Filarete's treatise are in some ways surpassed by those of his contemporary Francesco di Giorgio Martini, the Sienese architect, painter, sculptor, and engineer. Two codices of his treatise have survived – one in Turin (*Saluzzianus*, before 1476) and one in Florence (*Magliabecchianus*, 1489–91), as well as an intermediate manuscript (*Spencer*) relating to Vitruvius that Richard J. Betts assigns to the years 1479–80.[47] All three rely heavily on the Latin text of Vitruvius (although less in the case of the third one), and in fact the former two, as Betts also suggests, might be seen as the earliest attempt to translate the Roman author. What makes all three manuscripts especially appealing is the fact that they are profusely illustrated with dozens and dozens of drawings in which the human face or body are superimposed over measured capitals and cornices, columns, building plans, sections, and elevations. All point to his belief in the profound correlation between human proportions and architecture, which is evidently all-encompassing:

> And this [an order] has more beautiful appearance if, as has been said, the columns, bases, capitals, and cornices, and all other measures and proportions … [originate] from the members and bones of the human body. First we see that the column is of seven or nine parts according to the division of this body, the capital one thickness of the column, and the height of the foot half the height of the head, the base half of the thickness of the column. The flutes of the column, or channels, twenty-four as the human body has twenty-four ribs. And wanting to show the rules of columns or cornices, capitals, it is necessary to describe and demonstrate the measures of this body. And, as has been said, the compositions of temples and buildings is in commensuration, which architects must understand most diligently.[48]

Leonardo

One of the people impressed with Francesco di Giorgio's treatise was Leonardo da Vinci, who, in 1490, met his senior of 13 years in Milan. In June of that year, in fact, the two men traveled to Pavia to consult on the rebuilding of the cathedral there. One of the surviving Martini

manuscripts was owned by Leonardo (possibly a gift from Martini himself), and its various annotations attest to how carefully Leonardo studied the work.

Born in 1452, Leonardo, it must be stressed, was as much a scientist as an artist.[49] He was trained as a painter in the Florentine studio of Andrea del Verrocchio and was a mature, if still uncelebrated artist when he left the city in 1481 for an 18-year stay in Milan. Why he moved from the center of the Renaissance to the prosperous Lombard capital (at that time the third largest city in Europe) remains a mystery, but obviously he felt his economic prospects would be better served at the wealthy court of Ludovico Sforza – to whom he originally applied for a position as a military engineer. In any event, it was in Milan that he developed his interests in proportions, geometry, and architecture. In 1499, the arrival of French troops forced him to flee to Florence, but after several years of unsettled activities he returned to Milan in 1506 to work for the French court. When civil turmoil revisited the city in 1513 Leonardo shifted his base to Rome. In 1516 he moved once again, this time to France, to be the First Painter to the French king François I. He died in the Château de Cloux, at Ambroise, in 1519.

The key to understanding the brain of Leonardo is his own life-long interest in human anatomy and the brain. On a visit to Florence in 1507 he famously dissected a corpse at the hospital of Santa Maria Nuova (a practice strictly frowned upon by the church), but his interest in the human body and its operation is clearly evident during his first residence in Florence, when he was instructed in drawing human forms. This interest thrived even more in Milan, and by 1489 Leonardo had prepared an outline for an anatomical study to be entitled "Of the Human Body." For this venture he seems to have prepared hundreds of anatomical studies, perhaps the more interesting of which were several of the brain itself. He was the first artist to do so, and since knowledge of this organ at this time was miniscule, Leonardo followed the medieval tradition of assigning its activities to three pouches or ventricles aligned in a row behind the eyes: the first the receptor for sensory impressions; the second the seat of the intellect, imagination, and judgment; and the third that of memory. Later sketches, from around 1508, after his dissection in Florence, show the same ventricles in an ever so slightly more accurate rendering of the brain's organic complexity, but the gray matter of the cortex remained for Leonardo little more than

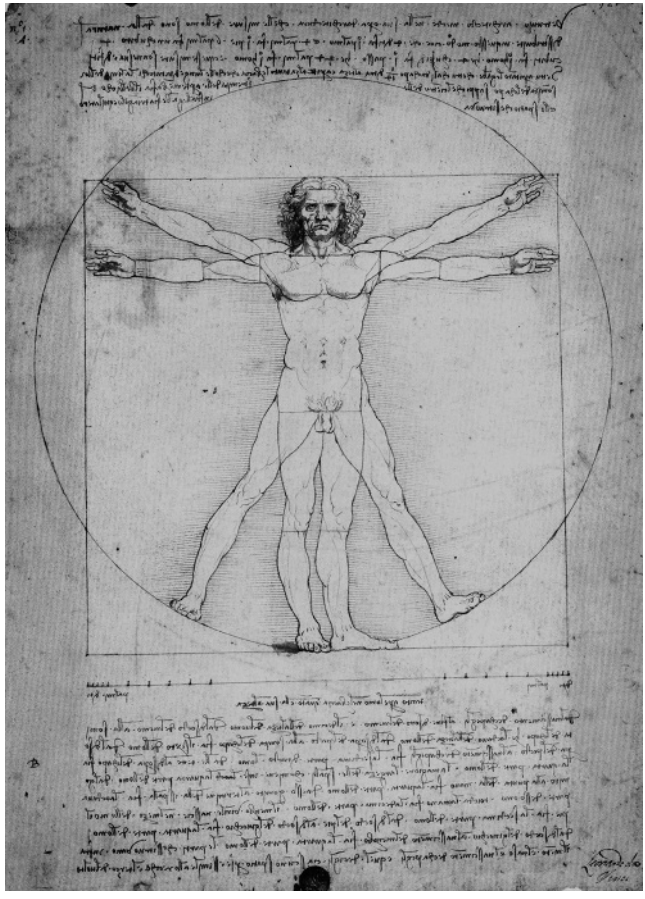

Figure 1.2 Leonardo da Vinci, Vitruvian Man (c.1490).

a wrapping for the essential areas below. Medieval anatomical notions stressed that all thinking took place in the *sensus communis* or "common sense," located in the very center of the brain.

These studies are also interesting because it was during these same years – the second half of the 1480s – that Leonardo developed his interest in architecture and its dependence on human proportions. His study and sketches of this time were probably inspired, at least in part, by the publication of the treatises of Vitruvius and Alberti, as well as by his access in Milan to the local manuscripts of Filarete and Martini. His well-known image of the Vitruvian man within a circle and square

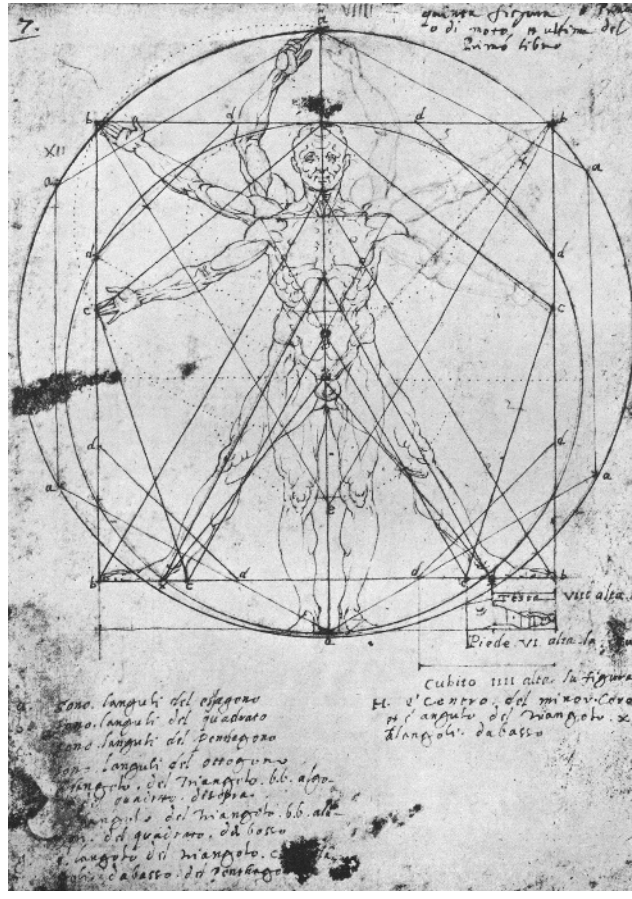

Figure 1.3 Carlo Urbini (after Leonardo da Vinci), from the *Codex Huygens*. Courtesy of The Pierpont Morgan Library. Manuscript 2006.14, fol. 7

(now residing in Venice) dates from around 1490 and it – as we can surmise from the tracings found in the Codex Huygens – was not an isolated drawing but part of larger group of anatomical studies.[50] The tracings of this codex, which were made in the sixteenth century by the Milanese artist Carlo Urbino, were presumably copied from original sketches of Leonardo (some known, some lost), although some may also derive from sketches of his disciples.

Perhaps the most fascinating are those based on the Vitruvian man, which exploit the movements implied in the Venice drawing but with

other geometries. One, for instance, records a three-fold movement of a male within a series of circles, polygons, triangles, and a square.[51] Leonardo was evidently searching for geometrical validations to support the divine connection between the human figure and the macrocosmos, and this hypothesis is supported by the fact that, as Martin Kemp notes, the centerline of the Venice drawing is pockmarked with compass points, especially around the face.[52] Kemp refers to these images as the quintessential "Ptolemaic vision of the cosmos," by which he means that the navel and penis of man (the differing center points of the circle and the square) remain the constant around which the universe and its motion revolves.[53] Leonardo apparently said the same thing, as we find translated in an early eighteenth-century set of engravings made from the Codex Huygens:

> So it happens in our Scheme, that y^e^ Motion which is attributed to the *Members*, will be found to be y^e^ first Cause & its proper Center, which turning in y^e^ form of a *Circle*, the *Compas* will trace y^e^ Stability of what Actions one will, of Natural Motion, alloting to several one and diversified Lines in one, turning its Center according to our first Order of y^e^ Heavenly *Bodies*, constituting this Body formed upon y^e^ Natural Plan of our Great *Masterpiece*, whereby we rayse up & turn our selves: this is Demonstrated upon y^e^ first *Figure*, and the Whole Scheme with all its variety by a single *Line*.[54]

It should also be noted that many of Leonardo's architectural sketches, such as his design for a centralized temple, also date from this period. His muscular sketches of interior domes and apses, which won the approbation of his fellow engineer in Milan, Donato Bramante, are from this time too.[55] The latter, of course, would, within a few years, become the architect for Saint Peter's in Rome.

Certainly contributing to Leonardo's fascination with proportional ratios and geometry at this time was his friendship with the mathematician and Franciscan monk Luca Pacioli, who arrived at the Sforza court in 1496. Two years earlier, Pacioli had published his *Summa de arithmetica, geometria, proportioni et proportionalità*, which exalted the divine creative spark behind the mathematically perfect universe. In 1498 Pacioli had completed his manuscript for *De Divina Proportione* (published in 1509), for which Leonardo had contributed a number of geometric drawings. Pacioli was quite explicit on his cosmic view of

things: "First we shall talk of the proportions of man, because from the human body derive all measures and their denominations and in it is to be found all and every ratio and proportion by which God reveals the innermost secrets of nature."[56]

Perhaps the first artistic demonstration of this interest for Leonardo was his mural for the Refectory of Sta Maria delle Grazie, *The Last Supper*, which he completed in 1497. The painting was apparently laid out on a grid of mathematical intervals that differ from the rules of perspective. Speaking of the tapestries along the two side walls, Kemp makes the following observation: "The tapestries appear to diminish in size according to the ratios 1:½ :1/3:¼ or to express it in whole numbers, 12:6:3. In musical terms 3:4 is the tonal interval of a fourth, 4:6 is a fifth and 6:12 is an octave. The consequence of these ratios is that the tapestries would actually have been different in width if this were a real room."[57]

Such interests did not diminish when Leonardo returned to Florence in 1500, where he was soon joined by Pacioli. Among his new interests were the geometrical transformations first explored by Archimedes. Patrons and admirers of his paintings, in fact, were dismayed that "mathematical experiments had so distracted" him to the point that he was no longer painting.[58] Again, it was also during this period in Florence that his scientific pursuit of human anatomy intensified. Leonardo was obviously obsessed with solving what he believed to be the ageless problem that lay at the heart of the humanist worldview. In a way similar to Alberti, he had reinstated classical antiquity's anthropomorphic understanding of the universe, albeit with much greater empirical or scientific rigor. And he did so with a seriousness that would not allow the next generation of Renaissance architects to operate outside of the theoretical framework of this metaphor. Even his arch-rival Michelangelo, who returned to Florence in 1501 to work on *David*, could not break the seductive hold of this legacy. In a letter written to an unnamed cardinal in 1550, Michelangelo matter-of-factly reported that "it is therefore indisputable that the limbs of architecture are derived from the limbs of man. No one who has not been or is not a good master of the human figure, particularly of anatomy, can comprehend this."[59] Twenty years later, the great Andrea Palladio expressed the same position when he defined beauty in terms strikingly similar to Alberti's notion of *concinnitas*:

> Beauty will result from the form and correspondence of the whole, with respect to the several parts, and the parts with regard to each other, and of these again to the whole; that the structure may appear an entire and compleat body, wherein each member agrees with the other, and all necessary to compose what you intend to form.[60]

It is such a compelling vision that it is difficult to believe that the eyes of Renaissance architects did not actually see these harmonic relations in their buildings with equal certainty. Palladio's cultural cognition (the configuration of his brain's visual circuitry) was arguably informed and conditioned by what he deemed to be divine ratios, and his brain – as his "body" of architecture makes clear – could not conceive of design outside of them. He perceived the essential beauty of such proportions, even if our brains, in the twenty-first century, are in most cases no longer able to do so.