A close-up, high-contrast portrait of Leonardo da Vinci's face, rendered in a style reminiscent of a classical oil painting. The face is the central focus, with warm, golden-brown tones on the left side and darker, more shadowed tones on the right. The texture of the paint is visible, giving it a tactile quality. The eyes are looking slightly to the right, and the overall expression is contemplative.

LEONARDO DA VINCI

BY THE AUTHOR OF THE *NEW YORK TIMES* BESTSELLERS

STEVE JOBS AND *EINSTEIN*

WALTER ISAACSON

N, Uni
lane, h
e, chair
gazine. I
n: His
n: An A
aphy. F
en: Six

Vitruvius,
en Collection / B

Vitruvian Man

A *TIBURIO* FOR MILAN'S CATHEDRAL

When Milan's authorities in 1487 were seeking ideas for building a lantern tower, known as a *tiburio*, atop their cathedral, Leonardo seized the opportunity to establish his credentials as an architect. That year he had completed his plans for an ideal city, but they had engendered little interest. The competition to design the *tiburio* was a chance to show that he could do something more practical.

Milan's cathedral (fig. 36) was a century old, but it still did not have the traditional *tiburio* on the roof at the crossing of the nave and transept. The challenge, which had defeated a few previous architects, was to conform with the building's Gothic style and overcome the structural weakness of its crossing area. At least nine architects entered the 1487 competition, approaching the task in a somewhat collaborative fashion, sharing ideas.¹

The Italian Renaissance was producing artist-engineer-architects who straddled disciplines, in the tradition of Brunelleschi and Alberti, and the *tiburio* project gave Leonardo the opportunity to work with two of the best: Donato Bramante and Francesco di Giorgio. They became his close friends, and their collaboration produced some interesting church designs. Far more important, it also led to a set of drawings, based on the writings of an ancient Roman architect, that

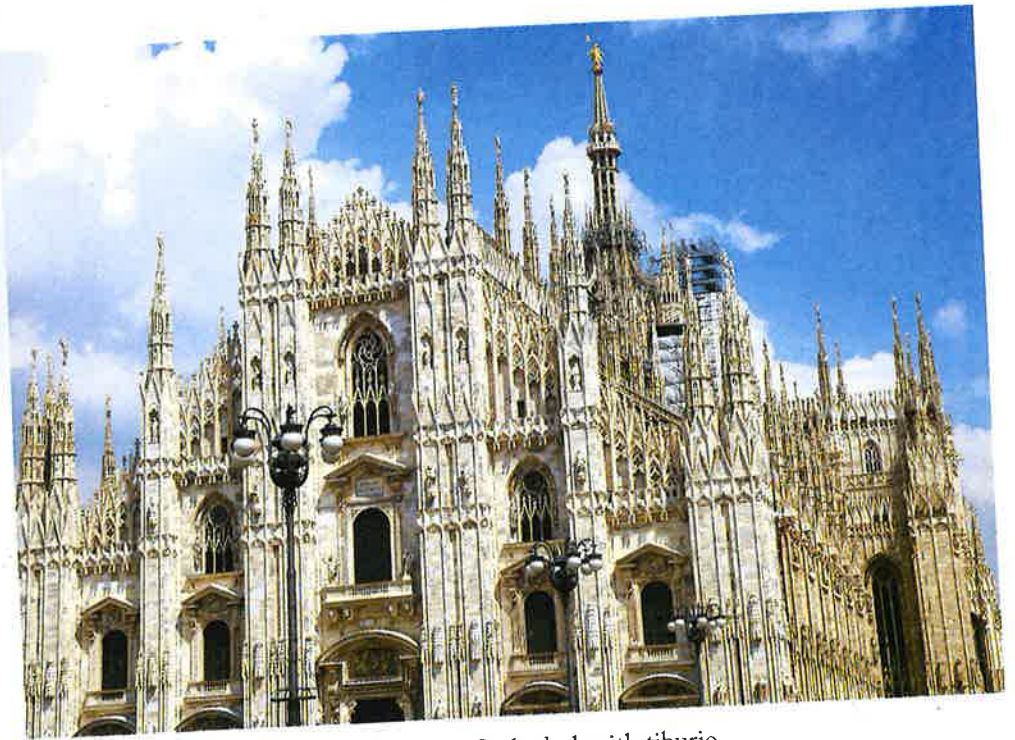


Fig. 36. Milan Cathedral, with *tiburio*.

sought to harmonize the proportions of a human to that of a church, an effort that would culminate with an iconic drawing by Leonardo that came to symbolize the harmonious relationship between man and the universe.

Bramante served as the initial expert judging the *tiburio* submissions. Eight years older than Leonardo, he was a farmer's son from near Urbino with grand ambitions and appetites. He moved to Milan in the early 1470s to make a name for himself, and he carved out roles that ranged from entertainer to engineer. Like Leonardo, he began his work at the Sforza court by being an *impresario* of pageants and performances. He also wrote witty verses, offered up clever riddles, and occasionally accompanied his performances by playing a lyre or lute.

Some of Leonardo's allegorical tales and prophecies were complements to Bramante's, and by the late 1480s they were working together on fantasias performed for special occasions and other effu-

sions of the Sforza entertainment industry. Both men displayed dazzling brilliance and effortless charm, despite which they became close friends. In his notebooks Leonardo affectionately called the architect “Donnino,” and Bramante dedicated a book of poems about Roman antiquities to Leonardo, calling him a “cordial, dear, and delightful associate.”²

A few years after he and Leonardo became friends,³ Bramante painted a fresco that featured two ancient philosophers, Heraclitus and Democritus (fig. 37). Democritus, known to be amused by the human condition, is laughing, while Heraclitus is crying. Round-faced and balding, the former appears to be a self-portrait of Bramante, while the portrait of Heraclitus seems to be based on Leonardo. He has a profusion of flowing, tightly curled hair, rose-colored tunic, prominent eyebrows and chin, and a manuscript book in front of him with the characters in right-to-left mirror script. Thus we can imagine how Leonardo, still clean-shaven, looked in his prime.

Bramante moved on from the role of impresario to being on retainer as an artist-engineer-architect of the Sforza court, thus shaping the role and paving the way for Leonardo. In the mid-1480s, when he and Leonardo were working together, Bramante displayed his combination of art and architecture talents by designing a fake apse, or choir area, behind the altar of Milan’s Church of Santa Maria presso San Satiro. Because space was cramped, there was no room for a full apse. Using the knowledge of perspective that was spreading among Renaissance painters, Bramante conjured up a *trompe l’œil*, a painted optical illusion that made it seem as if the space had more depth.

Within a few years, he and Leonardo would together work on a similar feat of engineering and perspective, when Ludovico Sforza commissioned Bramante to rework the convent of Santa Maria delle Grazie by adding a new dining hall, and Leonardo was hired to paint on its wall a depiction of the Last Supper. Both Bramante and Leonardo favored church designs that were based on strict symmetry. This led them to prefer central temple-like plans that featured overlapping squares, circles, and other regular geometric shapes, as can be seen in many of Leonardo’s church sketches (fig. 38).

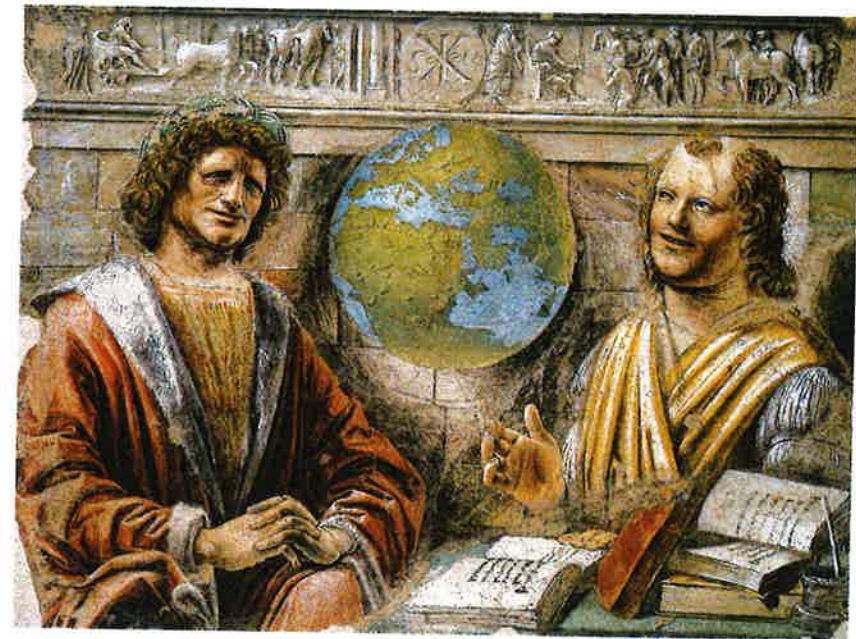


Fig. 37. Bramante’s *Heraclitus and Democritus*, Leonardo on the left.

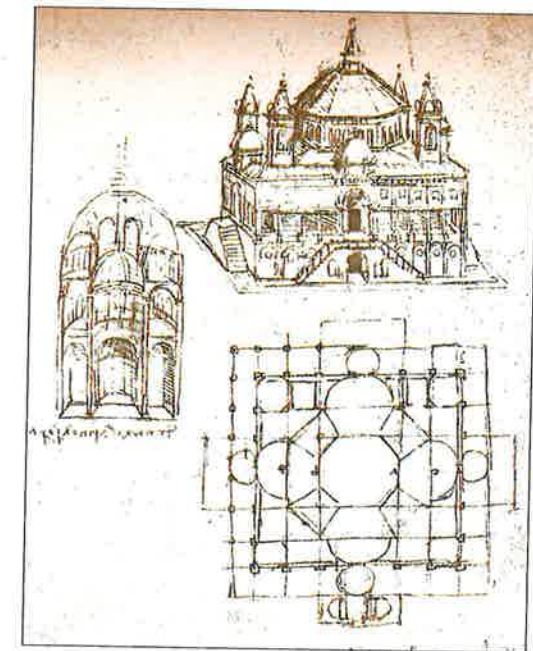


Fig. 38. Church drawings.

Bramante presented his written opinion on the tiburio design ideas in September 1487. One issue was whether the tower should have four sides, which would fit more securely on the support beams of the roof, or eight sides. "I maintain that the square is far stronger and better than the octagon, because it matches the rest of the building far better," he concluded.

Leonardo received six payments in July through September 1487 for his work on the project, which probably included consulting with Bramante as he wrote his opinion. In one of his presentations, Leonardo made a philosophical pitch that drew on the analogy, of which he was so fond, between human bodies and buildings. "Medicines, when properly used, restore health to invalids, and a doctor will make the right use of them if he understands the nature of man," he wrote. "This too is what the sick cathedral needs—it needs a doctor-architect, who understands the nature of the building and the laws on which correct construction is based."⁴

He filled pages of his notebooks with drawings and descriptions of what caused structural weaknesses in buildings, and he was the first to do a systematic study on the origins of fissures in walls. "The cracks that are vertical are caused by the joining of new walls with old ones," he wrote, "for the indentations cannot bear the great weight of the wall added on to them, so it is inevitable that they should break."⁵

To shore up the unsteady parts of the Milan Cathedral, Leonardo devised a system of buttresses to stabilize the area around his proposed tower and, always a believer in experiment, designed a simple test to show how they would work:

An Experiment to show that a weight placed on an arch does not discharge itself entirely on its columns; on the contrary, the greater the weight placed on the arches, the less the arch transmits the weight to the columns: Let a man be placed on a weighing-device in the middle of a well-shaft, then have him push out his hands and feet against the walls of the well. You will find that he weighs much less on the scales. If you put weights on his shoulders you will see for yourselves that the more weight you put on him, the greater will

be the force with which he spreads his arms and legs and presses against the wall, and the less will be his weight on the scales.⁶

With the help of a carpenter's assistant he hired, Leonardo made a wooden model of his design for the tiburio, for which he received a series of payments early in 1488. He did not try to have his tiburio blend in with the cathedral's Gothic design and ornate exterior. Instead, he displayed his inbred fondness for Florence's Duomo; his many sketches for a Tuscan-style cupola seem more inspired by Brunelleschi's dome than the Gothic flying buttresses of Milan's cathedral. His most ingenious proposal was to create a double-shelled dome, like Brunelleschi's. It would be four-sided on the outside, as Bramante had recommended, but on the inside it would be octagonal.⁷

FRANCESCO DI GIORGIO IS CALLED IN

After receiving Bramante's opinion along with proposals from Leonardo and other architects, the Milanese authorities seemed baffled about what to do, so in April 1490 they convened a meeting of all who had been involved. The result was to call in yet another expert, Francesco di Giorgio from Siena.⁸

Thirteen years older than Leonardo, he was another exemplar of an artisan who combined art, engineering, and architecture. He had begun as a painter, moved as a young man to Urbino to work as an architect, returned to Siena to run the underground aqueduct system, and was a sculptor in his spare time. He was also interested in military weaponry and fortifications. In other words, he was the Leonardo of Siena.

Like Leonardo, Francesco kept pocket-size notebooks of design ideas, and in 1475 he began collecting them for a treatise on architecture intended as a successor to the one by Alberti. Written in unpolished Italian rather than Latin, Francesco's was designed as a manual for builders rather than a scholarly work. He tried to ground design in math as well as in art. The range of his ideas was similar to those in Leonardo's notebooks. Spilling across its pages were drawings and

discussions of machinery, temple-like churches, weapons, pumps, hoists, urban designs, and fortified castles. In church design, he shared with Leonardo and Bramante a preference for a symmetrical Greek cross interior, in which the central plan has the same length for the nave and transept.

An official cultural diplomacy request was sent from Milan's ducal court to the council of Siena describing the importance of the tiburio project and asking that Francesco be permitted to come work on it. The response was reluctant acquiescence. The Siena councilors insisted that his work in Milan be done quickly, because he had many incomplete projects in Siena. By early June, Francesco was in Milan working on a new model for the tiburio.

A grand meeting was held later that month in the presence of Ludovico Sforza and the deputies of the cathedral. After inspecting three alternatives, they accepted Francesco's recommendations and chose two local architect-engineers who had been part of the competition. The result was an ornate, octagonal Gothic tower (fig. 36). It was very different from Leonardo's more graceful and Florentine approach, and he withdrew from the process.

Leonardo nevertheless remained interested in church design, and he made more than seventy other drawings of beautiful domes and idealized plans for church interiors at the same time that he was studying the transformations of shapes and ways to square a circle. His most interesting church designs featured floor plans that imbedded circles inside squares to form a variety of shapes, with the altar in the center, which were intended to evoke a harmonious relationship between man and the world.⁹

A TRIP WITH FRANCESCO TO PAVIA

While they were working together on the Milan Cathedral's tiburio project in June 1490, Leonardo and Francesco di Giorgio took a trip to the town of Pavia, twenty-five miles away, where a new cathedral was being built (fig. 39). The authorities in Pavia, knowing of the work that Leonardo and Francesco were doing in Milan, had asked Ludovico Sforza to send them as consultants. Ludovico wrote to



Fig. 39. Pavia Cathedral.

his secretary, "The building supervisors of this city's cathedral have requested that we agree to provide them with that Sienese engineer employed by the building supervisors of the cathedral in Milan." He was referring to Francesco, whose name he apparently could not remember. In a postscript, he added that "Master Leonardo of Florence" should also be sent.

Ludovico's secretary replied that Francesco could leave Milan in eight days, after his preliminary report on the tiburio was in hand. "Master Leonardo the Florentine," he added, "is always ready, whenever he is asked." Apparently Leonardo was eager to travel with Francesco. "If you send the Sienese engineer, he will come too," the

secretary reported. The expense accounts of the Pavia authorities list a hotel payment on June 21: "Paid to Giovanni Agostino Berneri, host of Il Saracino, in Pavia, for expenses he incurred because of Masters Francesco of Siena and Leonardo of Florence, the engineers with their colleagues, attendants and horses, both of whom were summoned for a consultation about the building."¹⁰

Their friend and collaborator in Milan, Donato Bramante, had given advice a few years earlier on the design for Pavia's proposed cathedral. In contrast to Milan's cathedral, the resulting plan was decidedly non-Gothic, which made it more to Leonardo's taste. It had a simple façade and a very symmetrical interior design based on the Greek cross layout, with both the nave and the transept having the same length. That produced a balanced and equally proportioned geometric elegance. Like the churches that Bramante designed, most notably Saint Peter's Basilica in the Vatican, as well as the ones that Leonardo sketched in his notebooks, the plan featured circles and squares forming very harmonious and balanced areas.¹¹

Francesco was at that time revising the manuscript of his treatise on architecture, and he discussed it with Leonardo as they traveled together. Leonardo would eventually acquire a lavishly illustrated copy. They also discussed another, more venerable book. In the thousand-volume Visconti library in the castle in Pavia there was a beautiful manuscript copy of an architectural treatise by Vitruvius, a Roman military officer and engineer from the first century BC. For years Francesco had been struggling to compile a translation of Vitruvius from Latin into Italian. There were many variations in the manuscript copies made of Vitruvius over the centuries, and he wanted to study the fourteenth-century copy that existed in Pavia. So did Leonardo.¹²

VITRUVIUS

Marcus Vitruvius Pollio, born around 80 BC, served in the Roman army under Caesar and specialized in the design and construction of artillery machines. His duties took him to what are now Spain and France and as far away as North Africa. Vitruvius later became an architect and worked on a temple, no longer in existence, in the town

of Fano in Italy. His most important work was literary, the only surviving book on architecture from classical antiquity: *De Architectura*, known today as *The Ten Books on Architecture*.¹³

For many dark centuries, Vitruvius's work had been forgotten, but in the early 1400s it was one of the many pieces of classical writing, including Lucretius's epic poem *On the Nature of Things* and Cicero's orations, that were rediscovered and collected by the pioneering Italian humanist Poggio Bracciolini. At a monastery in Switzerland, Poggio found an eighth-century copy of Vitruvius's opus, and he sent it back to Florence. There it became part of the firmament of rediscovered classical works that birthed the Renaissance. Brunelleschi used it as a reference when he traveled to Rome as a young man to measure and study the ruins of classical buildings, and Alberti quoted it extensively in his treatise on architecture. A Latin edition was published in the late 1480s by one of Italy's new print shops, and Leonardo wrote in a notebook, "Enquire at the stationers about Vitruvius."¹⁴

What made Vitruvius's work appealing to Leonardo and Francesco was that it gave concrete expression to an analogy that went back to Plato and the ancients, one that had become a defining metaphor of Renaissance humanism: the relationship between the microcosm of man and the macrocosm of the earth.

This analogy was a foundation for the treatise that Francesco was composing. "All the arts and all the world's rules are derived from a well-composed and proportioned human body," he wrote in the foreword to his fifth chapter. "Man, called a little world, contains in himself all the general perfections of the whole world."¹⁵ Leonardo likewise embraced the analogy in both his art and his science. He famously wrote around this time, "The ancients called man a lesser world, and certainly the use of this name is well bestowed, because his body is an analog for the world."¹⁶

Applying this analogy to the design of temples, Vitruvius decreed that the layout should reflect the proportions of a human body, as if the body were laid out flat on its back upon the geometric forms of the floor plan. "The design of a temple depends on symmetry," he wrote at the outset of his third book. "There must be a precise relation between its components, as in the case of those of a well-shaped man."¹⁷

Vitruvius described in great detail the proportions of this “well-shaped man” that should inform the design of a temple. The distance from his chin to the top of his forehead should be one-tenth of his whole height, he began, and proceeded with many other such notations. “The length of the foot is one sixth of the height of the body; of the forearm, one fourth; and the breadth of the breast is also one fourth. The other members, too, have their own symmetrical proportions, and it was by employing them that the famous painters and sculptors of antiquity attained to great and endless renown.”

Vitruvius’s descriptions of human proportions would inspire Leonardo, as part of the anatomy studies he had just begun in 1489, to compile a similar set of measurements. More broadly, Vitruvius’s belief that the proportions of man are analogous to those of a well-conceived temple—and to the macrocosm of the world—became central to Leonardo’s worldview.

After detailing human proportions, Vitruvius went on to describe, in a memorable visualization, a way to put a man in a circle and square in order to determine the ideal proportion of a church:

In a temple there ought to be harmony in the symmetrical relations of the different parts to the whole. In the human body, the central point is the navel. If a man is placed flat on his back, with his hands and feet extended, and a compass centered at his navel, his fingers and toes will touch the circumference of a circle thereby described. And just as the human body yields a circular outline, so too a square may be found from it. For if we measure the distance from the soles of the feet to the top of the head, and then apply that measure to the outstretched arms, the breadth will be found to be the same as the height, as in the case of a perfect square.¹⁸

It was a powerful image. But as far as we know, no one of note had made a serious and precise drawing along these lines in the fifteen centuries since Vitruvius composed his description. Then, around 1490, Leonardo and his friends proceeded to tackle this depiction of man spread-eagle amid a church and the universe.

Francesco produced at least three such drawings that were designed to accompany his treatise and translation of Vitruvius. One of them shows a sweet and dreamy image of a man in a circle and a square (fig. 40). It is a suggestive rather than precise drawing. The circle, square, and body do not attempt to show proportions and are instead rendered casually. Two other drawings that Francesco made (figs. 41 and 42) depict a man more carefully proportioned inside a design of circles and squares in the shape of a church floor plan. None



Fig. 40

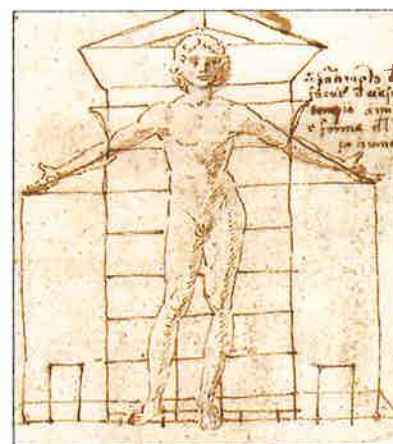


Fig. 42

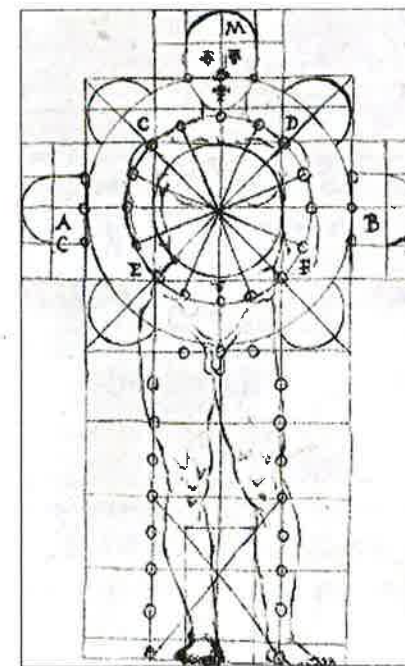


Fig. 41

Francesco di Giorgio's drawings
of Vitruvian Man.

of his drawings is a memorable work of art, but they show that Francesco and Leonardo, at the time of their 1490 trip to Pavia, were both enchanted by the image Vitruvius had conceived.

DINNER WITH GIACOMO ANDREA

Around the same time, another dear friend of Leonardo produced a drawing based on Vitruvius's passage. Giacomo Andrea was part of the collaborative circle of architects and engineers gathered by Ludovico at the court of Milan. Luca Pacioli, a mathematician at the court and another close friend of Leonardo, wrote a dedication to an edition of his book *On Divine Proportion* that listed the distinguished members of that court. After hailing Leonardo, Pacioli adds, "There was also Giacomo Andrea da Ferrara, as dear to Leonardo as a brother, a keen student of Vitruvius's works."¹⁹

We have met Giacomo Andrea before. He was the host of the dinner that Leonardo went to with Salai two days after the ten-year-old scamp had become his assistant, at which Salai "supped for two and did mischief for four," including breaking three cruets and spilling the wine.²⁰ That dinner happened on July 24, 1490, just four weeks after Leonardo and Francesco returned from their trip to Pavia. It was one of those priceless historical dinners that makes you yearn for a time machine. The conversation, when not being distracted by Salai's antics, was evidently about the manuscript of Vitruvius that Leonardo and Francesco had just seen at the university.

Andrea decided to try his own hand at illustrating Vitruvius's idea, and one can imagine him discussing it over dinner with Leonardo, hoping that Salai didn't spill wine on their sketches. Andrea produced a simple version of a spread-armed man in a circle and a square (fig. 43). Notably, the circle and square are not centered; the circle rises higher than the square, which allows the man's navel to be in the center of the circle and his genitals to be in the center of the square, like Vitruvius had suggested. The man's arms are stretched outward, Christ-like, and his feet are close together.

Andrea would end up being killed and brutally quartered by French troops when they captured Milan nine years later. Shortly

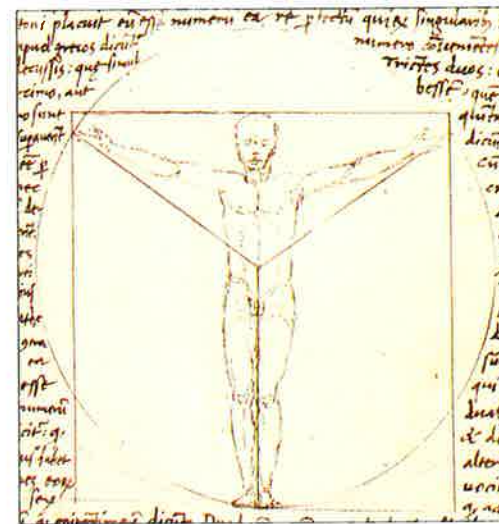


Fig. 43. Giacomo Andrea's drawing of Vitruvian Man.

thereafter, Leonardo would search for and find his manuscript copy of Vitruvius's work. "Messer Vincenzo Aliprando, who lives near the Inn of the Bear, has Giacomo Andrea's Vitruvius," he declared in a notebook entry.²¹

In the 1980s, Andrea's drawing was rediscovered. Architectural historian Claudio Sgarbi found a heavily illustrated manuscript copy of Vitruvius's tome that was languishing in an archive in Ferrara, Italy.²² He determined that manuscript had been compiled by Andrea. Among its 127 illustrations was Andrea's version of Vitruvian Man.

LEONARDO'S VERSION

There are two key differences that distinguish Leonardo's version of *Vitruvian Man* from those done around the same time by his two friends, Francesco di Giorgio and Giacomo Andrea. In both scientific precision and artistic distinction, Leonardo's is in an entirely different realm (fig. 44).

Rarely on display, because prolonged exposure to light would cause it to fade, it is kept in a locked room on the fourth floor of the Gallerie dell'Accademia in Venice. When a curator brought it out and

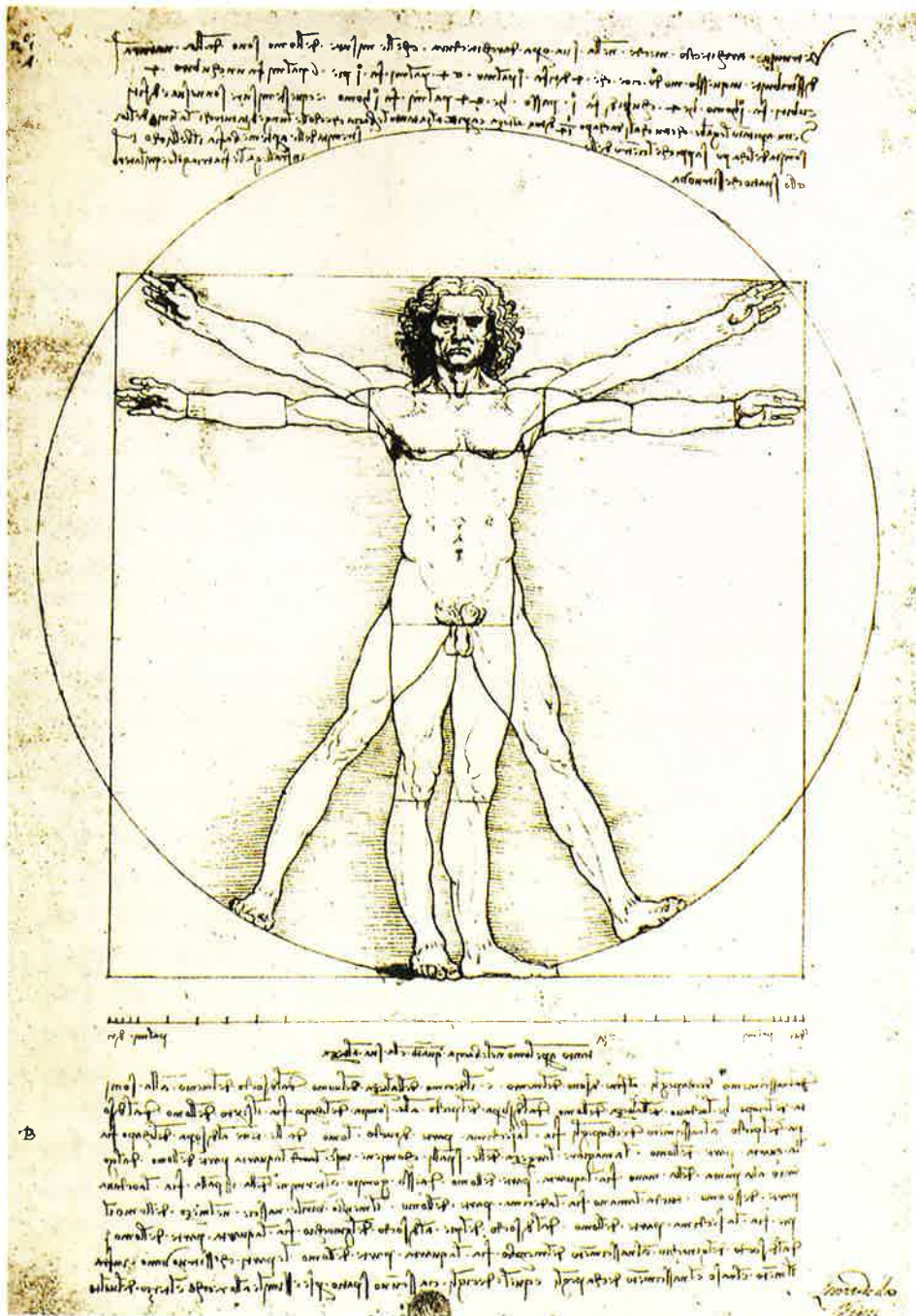


Fig. 44. Leonardo's *Vitruvian Man*.

placed it before me on a table, I was struck by the indentations made by the stylus of Leonardo's metalpoint pen and the twelve pricks made by the point of his compass. I had the eerie and intimate sensation of seeing the hand of the master at work more than five centuries earlier.

Unlike those of his friends, Leonardo's drawing is meticulously done. His lines are not sketchy and tentative. Instead, he dug hard with his stylus, carving the lines confidently into the page as if he were making an etching. He had planned this drawing very carefully and knew precisely what he was doing.

Before he began, he had determined exactly how the circle would rest on the base of the square but extend out higher and wider. Using a compass and a set square, he drew the circle and the square, then allowed the man's feet to rest comfortably on them. As a result, per Vitruvius's description, the man's navel is in the precise center of the circle, and his genitals are at the center of the square.

In one of the notes below the drawing, Leonardo described additional aspects of the positioning: "If you open your legs enough that your head is lowered by one-fourteenth of your height and raise your hands enough that your extended fingers touch the line of the top of your head, know that the center of the extended limbs will be the navel, and the space between the legs will be an equilateral triangle."

Other notes on the page provide more detailed measurements and proportions, which he attributed to Vitruvius:

Vitruvius, architect, writes in his work on architecture that the measurements of man are distributed in this manner:

The length of the outspread arms is equal to the height of a man.

From the hairline to the bottom of the chin is one-tenth of the height of a man.

From below the chin to the top of the head is one-eighth of the height of a man.

From above the chest to the top of the head is one-sixth of the height of a man.

From above the chest to the hairline is one-seventh of the height of a man.

The maximum width of the shoulders is a quarter of the height of a man.

From the breasts to the top of the head is a quarter of the height of a man.

From the elbow to the tip of the hand is a quarter of the height of a man.

From the elbow to the armpit is one-eighth of the height of a man.

The length of the hand is one-tenth of the height of a man.

The root of the penis [*Il membro virile*] is at half the height of a man.

The foot is one-seventh of the height of a man.

Despite what he stated, instead of accepting what Vitruvius had written, Leonardo relied on his own experience and experiments, as per his creed. Fewer than half of the twenty-two measurements that Leonardo cited are the ones Vitruvius handed down. The rest reflect the studies on anatomy and human proportion that Leonardo had begun recording in his notebooks. For example, Vitruvius puts the height of a man at six times the length of his foot, but Leonardo records it as seven times.²³

In order to make his drawing an informative work of science, Leonardo could have used a simplified figure of a man. Instead, he used delicate lines and careful shading to create a body of remarkable and unnecessary beauty. With its intense but intimate stare and the curls of hair that Leonardo loved to draw, his masterpiece weaves together the human and the divine.

The man seems to be in motion, vibrant and energetic, just like the four-winged dragonflies that Leonardo studied. Leonardo has made us sense, almost see, one leg and then the other being pushed out and pulled back, the arms flapping as if in flight. There is nothing static

except the calm torso, with subtle cross-hatch shadings behind it. Yet despite the sense of motion, there is a natural and comfortable feel to the man. The only slightly awkward positioning is of his left foot, which is twisted outward to provide a measurement guide.

To what extent might *Vitruvian Man* be a self-portrait? Leonardo was thirty-eight when he drew it, about the age of the man in the picture. Contemporary descriptions emphasize his "beautiful curling hair" and "well-proportioned" body. *Vitruvian Man* echoes features seen in many assumed portraits of him, especially Bramante's depiction of Heraclitus (fig. 37), which shows Leonardo still beardless at about that age. Leonardo once warned against falling prey to the axiom "Every painter paints himself," but in a section in his proposed treatise on painting called "How Figures Often Resemble Their Masters," he accepted that it was natural to do so.²⁴

The stare of Vitruvian Man is as intense as someone looking in a mirror, perhaps literally. According to Toby Lester, who wrote a book about the drawing, "It's an idealized self-portrait in which Leonardo, stripped down to his essence, takes his own measure, and in doing so embodies a timeless human hope: that we just might have the power of mind to figure out how we fit into the grand scheme of things. Think of the picture as an act of speculation, a kind of metaphysical self-portrait in which Leonardo—as an artist, a natural philosopher, and a stand-in for all of humanity—peers at himself with furrowed brow and tries to grasp the secrets of his own nature."²⁵

Leonardo's *Vitruvian Man* embodies a moment when art and science combined to allow mortal minds to probe timeless questions about who we are and how we fit into the grand order of the universe. It also symbolizes an ideal of humanism that celebrates the dignity, value, and rational agency of humans as individuals. Inside the square and the circle we can see the essence of Leonardo da Vinci, and the essence of ourselves, standing naked at the intersection of the earthly and the cosmic.

COLLABORATION AND *VITRUVIAN MAN*

Both the creation of *Vitruvian Man* and the design process for the tiburio of Milan's cathedral have engendered much scholarly dispute over which artists and architects deserve the most credit and should be accorded priority. Some of these discussions ignore the role that collaboration and the sharing of ideas played.

When Leonardo drew his *Vitruvian Man*, he had a lot of inter-related ideas dancing in his imagination. These included the mathematical challenge of squaring the circle, the analogy between the microcosm of man and the macrocosm of earth, the human proportions to be found through anatomical studies, the geometry of squares and circles in church architecture, the transformation of geometric shapes, and a concept combining math and art that was known as "the golden ratio" or "divine proportion."

He developed his thoughts about these topics not just from his own experience and reading; they were formulated also through conversations with friends and colleagues. Conceiving ideas was for Leonardo, as it has been throughout history for most other cross-disciplinary thinkers, a collaborative endeavor. Unlike Michelangelo and some other anguished artists, Leonardo enjoyed being surrounded by friends, companions, students, assistants, fellow courtiers, and thinkers. In his notebooks we find scores of people with whom he wanted to discuss ideas. His closest friendships were intellectual ones.

This process of bouncing around thoughts and jointly formulating ideas was facilitated by hanging around a Renaissance court like the one in Milan. In addition to the troupes of musicians and pageant performers, those on stipend at the Sforza court included architects, engineers, mathematicians, medical researchers, and scientists of various stripes who helped Leonardo with his continuing education and indulged his insatiable curiosity. The court poet Bernardo Bellincioni, who was more accomplished as a sycophant than as a versifier, celebrated the diverse collection that Ludovico curated. "Of artists his court is full," he wrote. "Here like the bee to honey comes every man of learning." He compared Leonardo to the greatest of the ancient Greek painters: "From Florence he has brought here an Apelles."²⁶

Ideas are often generated in physical gathering places where people with diverse interests encounter one another serendipitously. That is why Steve Jobs liked his buildings to have a central atrium and why the young Benjamin Franklin founded a club where the most interesting people of Philadelphia would gather every Friday. At the court of Ludovico Sforza, Leonardo found friends who could spark new ideas by rubbing together their diverse passions.