It is time to rediscover Renaissance perspective

by Warren A.J. Hamerman

The Heritage of Giotto's Geometry: Art and Science on the Eve of the Scientific Revolution
by Samuel Y. Edgerton, Jr.,
Cornell University Press, Ithaca, N.Y., 1991
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The greatest disproof of the Enlightenment's assertion that Christianity, science, and art are incompatible—an assertion fallen to the level of cynical slogans among cultural relativists, modernists, and the "political correctness" mafia today—is the creative discovery and application of Renaissance perspective from Giotto through Leonardo and Raphael. Renaissance perspective, the happy child of classical geometry and Christian theology, has the proven power to inspire and transform individual human beings through their interaction with beauty.

According to one of the world's leading Renaissance art historians, the Christian artist-scientist has become one of the prime targets of the political correctness crowd:

"In the current debate about critical theory and methodology there is increasing insistence that linear perspective and chiaroscuro be understood only as artificial symbols with a linguistic-like sign system expressing the peculiar values of Western civilization. Radical supporters of this latest relativism ('multiculturists,' as they now like to call themselves) argue that during the renaissance, upper-class patrons championed linear perspective because it affirmed their exclusive political power. Single-viewpoint perspective, after all, encourages the 'male gaze,' thus voyeurism and the denigration of women, police-state surveillance, and imperialist 'marginalizing of the other.' "

The hoax of those who reject Christian civilization as the product of "dead white European males," is that they overlook the fact that the two greatest shapers of Christian culture were two converts—St. Paul, an Asian Jew, and St. Augustine, an African, born in what is today Algeria.

Why do the champions of primitivism and disorder so tremble at the achievement of Renaissance perspective?

First and foremost, it is because it brings man closer to the God. Just as God creates "all that is seen and unseen" out of the void and emptiness, so the artist-scientist can create a believable receding space, where created figures interact and dialogue in what was once only an empty, blank plane. Through perspective man perceives created space in approximation of the "vision of God." *Perspectiva,* from the Latin *perspicere* means "to see through."

Secondly, it is universal. While the discovery and application of Renaissance perspective is not part of the art of China, Islam, or other cultures, pictures created with it can be read and understood by men and women of every race and creed. The great discoveries of western civilization, to be sure, are inconceivable without the rich cultural inputs from other cultures, yet the fact remains, that it was on the European Christian artistic palette that the different paints mixed.

Thirdly, the perspective "revolution" in painting, sculpture, and architecture begun in the time of Giotto (1300) and completed in 15th-century Florence, based on the rediscovery of Euclidean geometry, Archimedean optics, etc., demonstrated that there was no contradiction between Classical learning and Christian humanism.

Johannes Kepler later expressed the underlying theological significance of man's truth-seeking through geometry in

the following way (as quoted by Edgerton):

"The Creator, the true first cause of geometry . . . as Plato says, always geometrizes. . . . [His] laws lie within the power of understanding of the human mind; God wanted us to perceive them when He created us in His image in order that we may take part in His own thoughts."

Renaissance painters were the first to challenge the fixed assumptions of the celestial spheres. Artist-scientists from Giotto's frescoes in the Basilica in Assisi through Raphael's incomparable, spherically curved perspective in the theological *Disputà* fresco in the Vatican demonstrated that all space, heavenly and earthly, is perceived as obeying the same physical properties and geometric rules. Furthermore, the founders of modern science later born in the late 16th century—William Gilbert, Tycho Brahe, Johannes Kepler, among others—were among the first Europeans to be exposed to the illustrated scientific text.

By the mid-15th century Renaissance artists considered the mastery of geometry and optics as essential to their training. The two most important scientific instruments which are our inheritance from the principles of Renaissance perspective were the microscope and the telescope.

Thus, it is in the study and application of perspective, where the aesthetic aspects of geometry and optics are emphasized, that the discoverer and viewer achieve a complete union overcoming the false dichotomies between art and science, and faith and reason.

Franciscan optics

There is ancient literary evidence that "backdrops" and sets in perspective were first employed by the stage designer for Aeschylus (525-456 B.C.). Euclid's *Optica* had presented the first geometric constructions of the visual ray and cone of vision, yet optical "perspective" is quite a different matter from "pictorial perspective." Certainly, the writings on geometry and optics from Euclid (ca. 300 B.C.), Archimedes (282-212 B.C.), through Ptolemy in the second century A.D., demonstrate man's attempts to conceptualize and explore the way in which three-dimensional space is projected onto a two-dimensional surface. Ptolemy's *Geographica,* for instance, presented a projection of the spherical form of the Earth onto a two-dimensional surface. This is the earliest known linear perspective construction of the globe. Yet the surviving art and illuminations from the Middle Ages display primitive difficulties in depicting a convincing geometrization of pictorial space.

So the situation remained through the 13th century when the followers of St. Francis of Assisi at the time of Dante (himself likely a member of the lay or Third Order Franciscans), discovered the power of art for making mysterious and complex Christian religious conceptions more readily accessible. Around 1300 Dante called perspective the "handmaiden of geometry."

The Franciscan story begins with Roger Bacon (1214-94), an English Franciscan friar, who adapted the optics of Euclid and Ptolemy to the Christian idea of how God spreads His divine grace through the universe. Bacon believed that the Christian effort to retake the Holy Land from the Saracens had collapsed in 1254 because of insufficient mastery by the Christians of optics and geometry. In 1267 Bacon sent his *Opus majus* to Pope Clement IV, writing:

"Oh, how the ineffable beauty of the divine wisdom would shine and infinite benefit would overflow, if these matters relating to geometry, which are contained in Scripture, should be placed before our eyes in corporeal figurations! For thus the evil of the world would be destroyed by a deluge of grace."

The fusing of geometry and picture making first took root in the art adorning the new basilica being built to honor St. Francis at Assisi. The frescoes depicted the dramatic episodes of St. Francis's life as well as stories from the Old and New Testament. In 1288 Girolamo of Ascoli, the Minister General of the Franciscan Order, was elected pope (Nicholas IV).

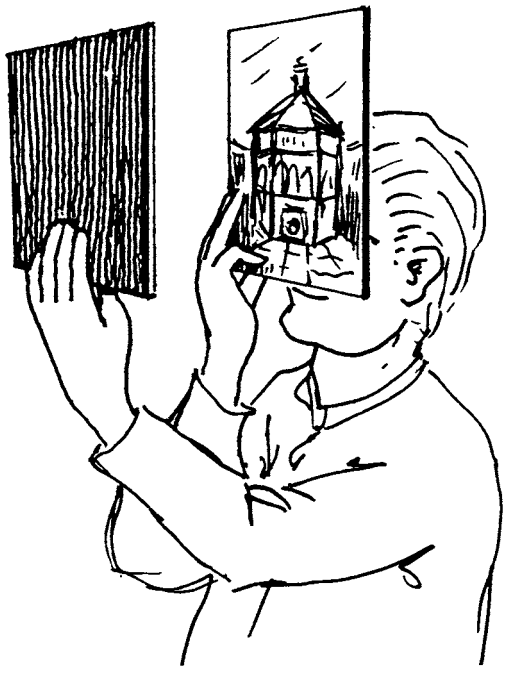
Then in 1306 the great artist of the Franciscans, Giotto (1266-1337), a student of another Franciscan-linked painter Cimabue (active ca. 1272-1302), painted 38 Biblical frescoes in the Scrovegni (Arena) Chapel in Padua. Giotto makes a revolution in the concept of space by showing people actually within landscape and architecture settings, not just in front of them as if they were painted backdrops.

Above the frescoes in the Upper Church in Assisi, the Francisan artists painted in imaginary framing borders and architectural modillions in convincing perspective. Within the frames the figurative scenes of St. Francis's life were depicted for the first time in perspective—crowd scenes, dialogues, and interaction among figures in complex architectural spaces.

At the Arena Chapel in Padua (a city which was, by the way, the greatest European center of the Franciscan order after Assisi) Giotto created one perspective masterpiece after another. In an Annunciation scene spanning both sides of the triumphal arch before the apse in true divergent perspective, the two depicted buildings in which the Virgin Mary and Gabriel kneel are overlapped below by a painted frame, creating the illusion that these structures are outside, beyond the wall of the Arena Chapel. It was only through being able to place the interacting figures on a "perspective" floorplan that Giotto was able to depict such tender interactions among a number of figures as in the Lamentation or the Epiphany.

Only a few years after the death of Giotto, in 1348, the Black Death erupted. Despite the fact that Giotto had trained a new generation of artists, under the conditions of a holocaust of disease, mass deaths, and cultural pessimism, there were no fundamental developments in the art and science of perspective.

When the subsequent generation recovered around the turn of the 15th century, as the following contemporary ac-



Brunelleschi viewing the mirror reflection of his first perspective picture, of the Florentine baptistery; from the sketch in Samuel Edgerton's book.

count documents, the impact of Cimabue and Giotto was viewed as the birth of what became known as the Florentine Renaissance; or as Filippio Villani wrote ca. 1400 in *De origine civitatis Florentiae et eiusdem famosis civibus* (*On the Origin of the City of Florence and on Its Famous Citizens*):

"After Cimabue, with the road now laid on fresh foundations, Giotto . . . restored painting to its pristine dignity and high reputation. For pictures formed by his brush follow nature's outlines so closely that they seem to the observer to live and breathe."

Also in 1400, the first copy of Ptolemy's *Geographica* arrived in Florence, with its projection of the sphere onto two dimensions.

Brunelleschi and Florentine perspective

There are various versions to the timing and history of the extraordinary breakthrough achieved by Filippo Brunelleschi in perspective.

One version is that in the year 1424, Paolo dal Pozzo Toscanelli (1397-1482), the great mathematician, cosmographer, and physician who later reportedly made the map used by Columbus on his 1492 voyage to America, returned from Padua to Florence. He is said to have written several books on perspective, now lost. Toscanelli had been a schoolmate of Nicolaus of Cusa at the University of Padua and his lifelong friend and collaborator. Cusa dedicated his work on the Mathematical Complements to Theology to him. Toscanelli, according to early biographers, became the mathematics teacher and adviser of Brunelleschi. In collaboration with Toscanelli, the great architect Brunelleschi (1377-1446), best known for his magnificent, octagonally ribbed dome over Florence Cathedral, demonstrated the geometric-optical principles of perspective by painting a true facsimile of the Florentine Baptistry, in true scale and perspective as seen from the door of the cathedral across the piazza. The viewer stood in the door of the cathedral, held a mirror at arm's length, and looked through a peephole in the back of the painted Baptistry panel into the mirror. In the mirror he saw the Baptistry exactly as if he were looking at it directly. The top of the panel was silvered so that the reflections of actual moving clouds moved above the imaginary baptistry. Other scholars argue that Brunelleschi executed his Baptistry panel as early as 1413 based upon a document of that year which specifically mentions Brunelleschi's interest in *prespettivo* (sic).

In either version, the year, 1425, is given as the founding year of Renaissance perspective in Art. Using the rules and principles of pictorial perspective worked out and demonstrated by Brunelleschi, two of his students—the artist Masaccio and the sculptor Donatello—implemented his approach. In that year Masaccio painted the Trinity fresco in the Church of Santa Maria Novella using a magnificent single-point perspective. The Holy Trinity of Father, Son, and Holy Spirit (depicted as a dove) are placed in a realistic architectural space. Below the Trinity is a skeleton which has the inscription, "Where you are now, I once was; where I am now, you will soon be." The centric point of the perspective, below the feet of Christ, is at the exact eye level of the average Florentine citizen of the time, thereby working to pull the viewer into the painting.

Obviously, the subject of man's relation to the Trinity was not irrelevant to the artist-scientist since these were the very years in Florence that a faction was growing, shortly to succeed in the Council of Florence, in reunifying the Eastern and Western Churches around St. Augustine's emphasis on the notion that became embodied in the *Filioque* section of the Nicene creed. "Filioque," Latin for "and from the Son," refers to the conception that the Holy Spirit proceeds both from the Father *and from the Son*. As understood in Christianity, this idea was associated with the fact that man was imitating Christ through his contributions to his fellow man, particularly through his artistic creations and scientific discoveries.

During the roughly one century which followed the 1425 "founding year" of Renaissance perspective, the masterpieces which culminated in the achievements of Leonardo and Raphael unfolded. In this century, various treatises and manuals on perspective were written.

In 1434 in his famous work dedicated to Brunelleschi, *Della Pittura,* Leon Battista Alberti summarized the rules and principles of perspective as then known. He described the panel or canvas plane as a "window" through which the

artist sees into the entire space he creates by following certain geometric rules: "First of all, on the surface I am going to paint, I draw a rectangle of whatever size I want, which I regard as an open window through which the subject to be painted is seen."

The great painter Piero della Francesca (1410/20-92) published works "On the Perspective of Painting" and in 1485 a book on the five regular solids, an illustrated commentary on the *Five Regular Solids* which Plato had demonstrated fit in a sphere. Piero constructed elaborate perspective drawings of these complex faceted figures and their semi-regular variants.

In 1509 Fra Luca Pacioli (1445-1517), a Franciscan brother in Milan, published *The Divine Proportion* with woodcut illustrations based on original drawings by Leonardo da Vinci illustrating the way in which the regular and semi-regular solids behave in geometric space.

However, the most advanced writings on perspective were not published at all, but only privately circulated. These were the famous *Notebooks* of Leonardo da Vinci (1452-1519). In his notebooks *On Perspective for Painters* Leonardo developed the idea that there are three different interelated types of perspective:

1) Linear perspective, or the perspective of diminution, which was the system developed by Brunelleschi, Alberti, and others, to create a geometry of receding space on the plane; by exact geometric laws the figure grew smaller as it was located further back in the space.

2) Perspective of color, or the fact that hues closer to the foreground of the painting were brighter and fuller than the hues in the distance;

3) Perspective of form, of the fact that as figures receded they were more geometrical in shape with less detail.

Not only did Leonardo devise this threefold nature of perspective. He showed that the continuous space which receded into the picture was divided at regular intervals just as the continuous "glissando" tones in an octave interval, are divided into the notes of a musical scale. Thus, Leonardo explored the common laws of harmonics that govern the visual and musical "scale."

Leonardo also discovered the perspective of "curvature" to correct certain anomalies in linear perspective. For instance, the outer and inner columns in a row are necessarily distorted if they are projected onto a fixed centric line on the plane. If, however, the perspective lines are projected onto a circle and then onto the plane the correct scale is created.

Based upon his learning the "secrets" of perspective from the Italians, in the 16th century the German artist Albrecht Dürer published his famous *Painter's Manual* and *Books on Human Proportion*.

The artist-engineer

If Christian civilization is to be revived, it must rediscover the central conception of the interrelationship among art, science, technology, and economic development. During the Renaissance men such as Brunelleschi and Leonardo da Vinci were the most accomplished of a new class of "artist-engineers" who used their skill in geometry and the arts to lead technology projects for civilian and military purposes, from moving rivers, to weaponry and fortifications; from great architectural achievements to the invention of labor-saving machines.

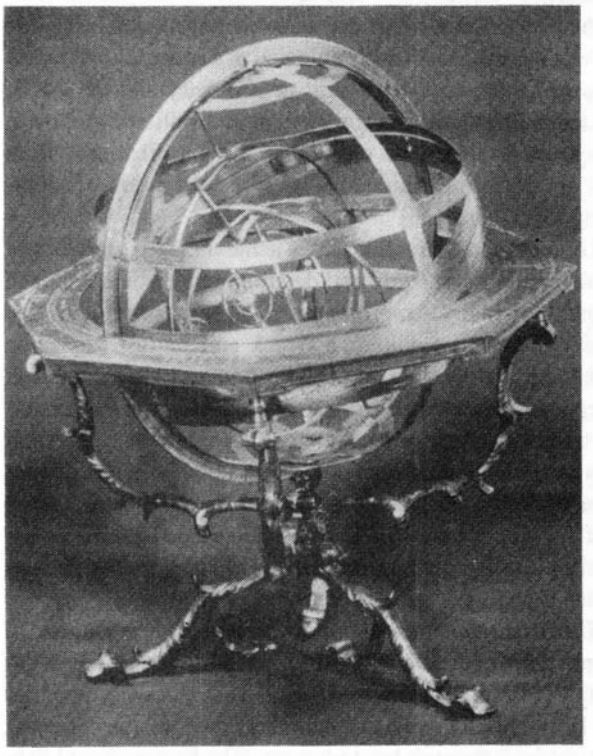
Leonardo and Brunelleschi's achievements grew out of several centuries of study and development, which included the study of many Arab manuscripts. As early as the 12th century, heretofore unknown Greek and Latin treatises on mechanics, architecture, aqueducts, and military technologies began to circulate in European courts. After the 13th century a tradition developed among court engineers to test their ideas by drawing diagrams of military and civilian machines on paper. Through the use of perspective, the Renaissance artist-engineers were able to transform crude squashed view sketches into the modern precise "exploded" views of engineering drawing.

The two critical men in this development were Mariano di Jacopo, called Taccola (1381-1483) and Francisco di Giorgio Martini (1439-1501), both of Siena. Taccola, whose mentor was Brunelleschi, was to become known as the "Sienese Archimedes" through his two texts "On Engines" and "On Machines" which were accompanied by 200 of his own drawings. He devised ways of showing the three-dimensional interior mechanics of complex pumps and machines with perspective foreshortening and chiaroscuro. *Chiaroscuro* is an Italian term that means "light/dark." Francesco di Giorgio wrote and illustrated the inner workings of fortifications, hydraulics, military weaponry, gearing, and jacking for hauling, lifting, and milling, and many pumping devices. Leonardo da Vinci's famous engineering drawings on these subjects represented, of course, a qualitative advance in these areas, because he was brilliantly able to elucidate the way in which power is transferred through the various mechanisms of his labor-saving machines and inventions.

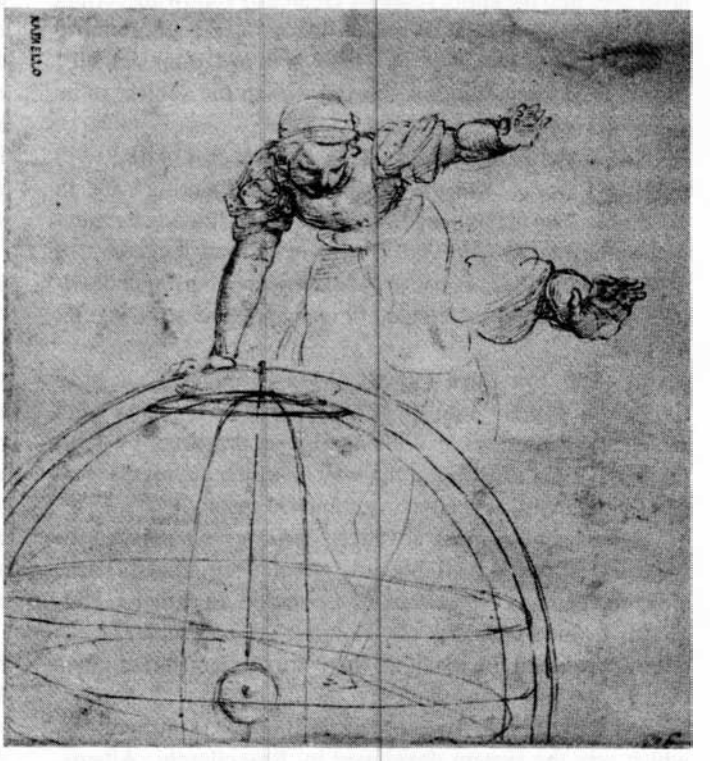
Negative spherical curvature of heavenly space

Even more crucial to the survival of Christian civilization than practical engineering technology, was the way in which Renaissance artist-scientists were able to represent the geometrization of the supernatural and heavenly space. Artist-scientists such as the Dominicans Fra Filippo Lippi and Fra Angelico were able to portray the most divine moments such as the Annunciation with such tenderness and universality that they became accessible to the crudest viewer. In his *Notebooks* Leonardo asks his reader to judge which is more powerful—the words of Christ written as text on the wall of a chapel or an image of Christ's life artfully depicted on the wall of the next chapel.

No artist-scientist better solved this challenge than Raphael Sanzio of Urbino, who in 1509 at the age of 26 came



An armillary sphere, used in the Renaissance for charting the heavens and for navigation.



Raphael Sanzio: Astronomy, *detail of a sketch for the ceiling of the Stanza della Segnatura.*

to Rome and was given the assignment of Pope Julius II (Giuliano della Rovere) to fresco the walls of the new papal quarters. The first of the rooms is the famous Stanza della Segnatura, the "Signature Room," a private library where the pope wished to keep his own collection of books in low cupboards, and subsequently used for the signing of important documents.

During the very months that Raphael was painting the Stanza frescoes, Luca Pacioli's *On Divine Proportion* was published.

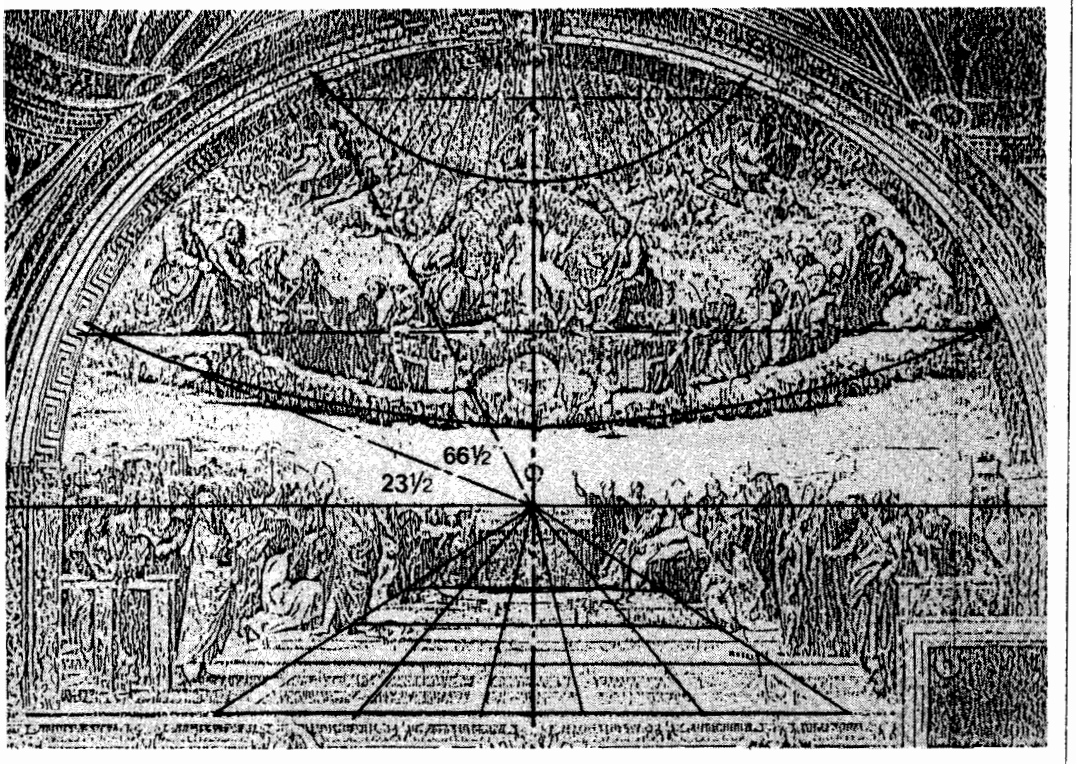
The frescoed walls of the Signature Room glorify the themes of Truth, Good, and Beauty. Facing one another are the *School of Athens* and the *Disputà* or *Discussion on the Blessed Sacrament,* representing natural Truth and revealed Christian Truth. Each of these two masterpieces creates a perspective such that the viewer is looking from the centerpoint of a sphere to the inner surface of a spherical quadrant. On the other walls the concept of Beauty, inspired by poetry, is depicted in *Mount Parnassus* facing the Good in the *Theological and Cardinal Virtues* and in *Law,* both ecclesiastical and civil. The ceiling decorations echo the same concepts.

In his book Samuel Edgerton devotes an entire thrilling chapter to the perspective geometry of Raphael's initial fresco on Theology, the *Disputà,* and related works, which demonstrates that the artist created a geometry as if it were the inside of an armillary sphere. From the time of Ptolemy, the armillary sphere placed the zodiac constellations and was used for understanding the geometry of the cosmos. Edgerton proposes that the artist decided to lay out the *Disputà* along the curves where the metal rings forming the hollow sphere would be.

There are a record number of preparatory drawings, 45 in all, for this fresco. Raphael creates a perspective of negative curvature on the inside surface of a spherical quadrant. The viewer stands with his feet at the center of the sphere as he looks up and outward onto receding curved inner surface. From his earliest sketches, Raphael had the solution of arraying his figures in three symmetrical parallel horizontal tiers of curving clouds with open sky space between.

Along the points where the framing meridians of the armillary sphere intersected the long curves of the Arctic Circle and the Tropic of Cancer, Raphael placed, respectively, the heads of six angels flying on either side of God the Father (the "horizon" of which passes above his halo) and the upper side of the cloud-bank dais on which the prophets, apostles, and martyrs were to sit below.

In the painting he shows the Father, Son, and Holy Spirit descending in a series of repeated circles. At the base of this heavenly radius there is an altar on which Jesus Christ presents himself as on earth through human history in the transubstantiated form of the Eucharist. The circular Host is displayed in a monstrance. Raphael places the centric van-



Compositional diagram of Raphael's Disputà.

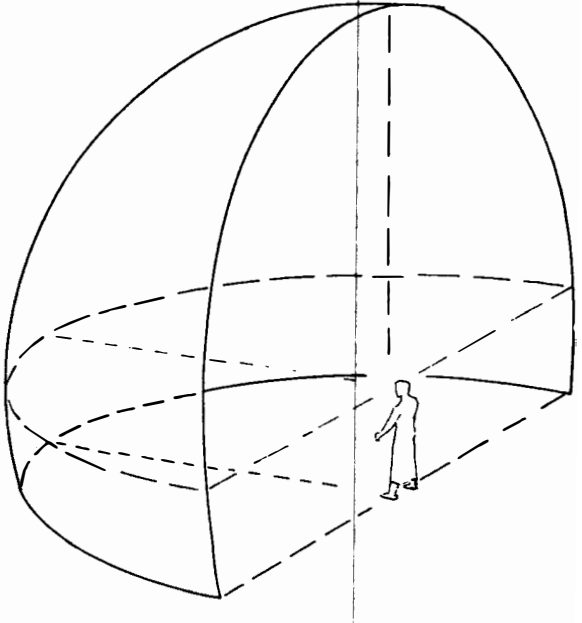
ishing point at the precise point where the main equator horizon crosses the stem of the monstrance. The centric vanishing point on the main horizon is of course the point which governs the entire perspective of the depicted architecture. According to one of the basic principles of Florentine Renaissance perspective, Raphael calculated this vanishing point to be at the same height as the intended viewer. Alberti, in fact, had written in his 1434 Treatise:

"The suitable position for this centric [vanishing] point is no higher from the base line than the height of the man to be represented in the painting, for in this way both the viewers and the objects in the painting will seem to be on the same plane."

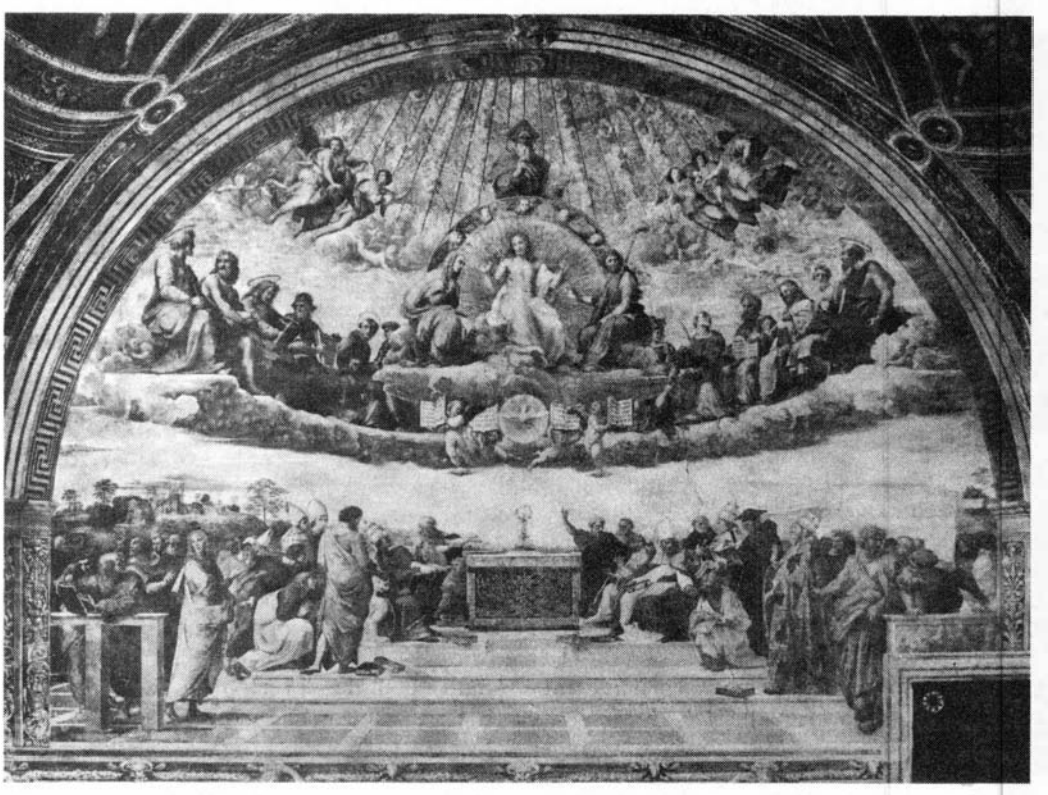
Edgerton comments: "Despite the fact that the base line of the fresco is considerably above the floor of the Stanza della Segnatura, we are able to conceive ourselves standing in the fictive foreground of the picture, on the extended gridded pavement just halfway between two males in togas gesturing toward the altar at right and left. Once 'within' the painting, we see immediately the eyes of these figures, like ours, are exactly level with the vanishing point. Moreover, Raphael intended this point, the radial center of the entire picture, to signify that God *is* the center of the universe; he descends from heaven to the circular earth, appearing to humankind in the form of the circular Host."

The geometrization of astronomical space

Space does not allow us to do justice to the closing two chapters of Edgerton's book. One presents the application of Renaissance perspective to astronomy around the focus of Galileo Galilei's work and contains some very impressive wash drawings of the moon done by Galileo in 1609. The



Spherical quadrant.

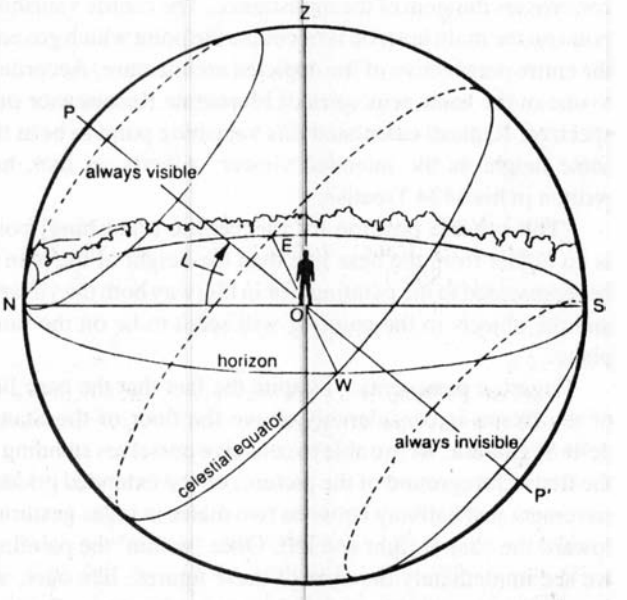


Raphael Sanzio: Disputà *(Theology), the fresco facing the* School of Athens *(Natural Science) in the Stanza della Segnatura, 1509.*

last chapter is a fascinating account of the way in which Father Matteo Ricci centered his attempts to evangelize the Chinese around demonstrating the power of Renaissance perspective both in painting and because of its utility in astronomy. The study of astronomy and the heavens was recognized by Ricci and his colleagues as the intellectual passion of the Chinese people. Ricci and his Jesuit colleagues, basing themselves on the successes in New Spain, presented glorious perspective etchings of subjects such as the Nativity and Annunciation not only as teaching devices to those unable to read. More fundamentally, the beauty and power of perspective paintings was "proof" that the Creator lived and can be imitated on earth in art and science.

Today, as the world is wracked by incredible crises which threaten the very fabric of mankind, Renaissance perspective is the most under-utilized strategic asset of Christian civilization. It is not accidental that there is a correspondence in this century between incredible suffering for mankind through world war, starvation, and disease, and the fact that "modern art" is based upon a war on perspective. Whatever else one may say or think about the various zoological species of modern art, its essence is to destroy all moorings on the canvas. Without perspective there is no ordering relationship between the viewer and the created space. The very idea of the artist-scientist imitating the Creator is forgotten and man is left helpless and hopeless in a sea of endless anxieties and crises.

The study and revival of the lost art-science of Renaissance perspective—this tested method proven to uplift and comfort, inspire vision and cause truth-seeking and creative solutions—is the key to the victory of the civilization of all cultures over barbarism.



Perspective diagram of star orbits around the earth.