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# HISTORICAL LINKS BETWEEN CARTOGRAPHY AND ART

RONALD REES

**I**N a footnote to her study of the Renaissance polymath, Leon Battista Alberti, Joan Gadol rebuked a historian of science and cartography for denying the existence of a reciprocal relationship between Renaissance painting and cartography.<sup>1</sup> Although the position of the historian was extreme, his denial pointed to an aspect of the history of cartography neglected by both historians and geographers. While most authors readily acknowledge a connection between early maps and paintings, few do more than comment on the evident similarities between them. To go further would mean foraging in the history of art, or, to borrow a phrase from John Speed, the eighteenth-century cartographer, dipping one's sickle in other men's corn. The contention here is that an extensive trespass would broaden an interesting facet of the history of cartography and would serve as a reminder that important branches of geography and art are rooted in common ground.

Until science claimed cartography, mapmaking and landscape painting were kindred activities, often performed by the same hand. As miniatures of landscape or the earth, maps and paintings were artifacts in the particular Levi-Straussian sense as well as in the popular sense: making a map invariably was an occasion for the display of artistry.<sup>2</sup> Cartography and landscape painting were also connected by the fact that their practitioners held common conceptions of the earth and shared the problems of selecting phenomena and of representing them coherently on a plane surface. They are similar arts in that they both present phenomena in context rather than in isolation—mountains, rivers, roads and towns are inconceivable outside a physical setting. So alike were the approaches and the products of painters and cartographers that until the Renaissance there was no terminology to distinguish clearly between maps and paintings. Cartography and landscape painting were also linked by cosmic as well as terrestrial considerations; maps and paintings reflected prevailing notions of space and the cosmos. What follows is a tentative amplification of each of these points of contact.

## ARTISTRY IN MAPS

The most obvious link connecting cartography to art is "the very evident soul" that cartographers invest in their maps.<sup>3</sup> Maps have served esthetic as well as utilitarian ends, having been used as floor mosaics, frescoes, and wall hangings since earliest times. In the seventeenth century they became a collector's item and competed for

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<sup>1</sup> Joan Gadol, *Leon Battista Alberti: Universal Man of the Early Renaissance* (Chicago: University of Chicago Press, 1969), p. 198.

<sup>2</sup> According to Levi-Strauss, miniatures are artifacts, not just passive homologues of the object that they represent. By seeming to simplify objects through a reduction of scale, miniatures gratify the intelligence and provide a sense of pleasure that can be called aesthetic. Claude Levi-Strauss, *The Savage Mind* (Chicago: University of Chicago Press, 1962), p. 63. Levi-Strauss's observation was anticipated by geographer W. W. Jervis, *The World in Maps* (London: Geo. Philip, 1938), p. 177.

<sup>3</sup> A. L. Humphreys, *Old Decorative Maps and Charts* (London: Halton and Truscott Smith, 1962), p. 2.

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FIG. 1—"Imola" by Leonardo da Vinci (Royal Library, Windsor Castle, Windsor; copyright H. M. Queen Elizabeth II).

wallspace with landscape paintings, a circumstance confirming the opinion of Georg Braun that people have a “naturall love of Pictures and Mappes, Prospective and Chorographical delights.”<sup>4</sup>

Mapmaking as a form of decorative art belongs to the informal, prescientific phase of cartography. When cartographers had neither the geographical knowledge nor the cartographic skill to make accurate maps, fancy and artistry had free rein. The mapmaker’s dilemma and the customary solution to it were the target of Jonathan Swift’s satire in a much quoted quatrain:

So geographers, in Afric maps,  
With savage pictures fill their gaps,  
And o’er unhabitable downs  
Place elephants, for want of towns.<sup>5</sup>

The most fanciful maps belong to the Middle Ages, the least scientific period of European cartography; the most aesthetically pleasing were the gift of the Renaissance. For cartography the Renaissance fusion of art and technology was particularly felicitous. Painting and mapmaking were so closely related that the first professional cartographers were pictorial artists who had engaged in the work of copying, decorating, and even compiling maps. Many, like Gerardus Mercator, were clever in mind and hand—“ingenio dexter, dexter et ipsu manu” was how his contemporaries described him. Mercator was an expert engraver and a calligrapher whose maps were renowned particularly for their fine italic lettering. Other notable examples of craftsmen or artists who became cartographers were Abraham Ortelius and Hans Konrad Gyger. Ortelius began his career as a collector and a colorer of maps in Antwerp, while Gyger started as a glass painter. Like many cartographers, Gyger and Ortelius maintained lifelong interests in the arts.

Established painters were also interested in cartography. Pieter Bruegel was a friend and an associate of Ortelius.<sup>6</sup> On his visit to Italy Bruegel sought out Scipio Fabius, the Bolognan geographer. At least one art historian speculated on the relationships between Bruegel’s cartographic interests and the map-like character of some of his paintings.<sup>7</sup> Albrecht Dürer and Leonardo da Vinci were also enthusiastic and accomplished cartographers, each making valuable contributions to the theory and the practice of mapmaking. Besides drawing and decorating maps and globes, Dürer wrote treatises on land measurement and bestowed on sixteenth-century cartography the technique of limning the countryside in bold lines and cross hatchings. DaVinci characteristically anticipated the conceptions and the designs of modern cartography.

Although science and technology eventually were to produce the relatively impersonal modern map, during the Renaissance they actively contributed to the artistry in cartography. Like the cartographers themselves, the woodcutters, engravers, and printers were former pictorial artists. Although they were handicapped by tools

<sup>4</sup> Quoted in R. A. Skelton, *Decorative Printed Maps of the 15th to 18th Centuries* (London: Staples Press, 1952), p. 20. George Braun was the publisher of the renowned city atlas, *Civitates Orbis Terrarum* (6 vols.; Cologne: 1572–1618).

<sup>5</sup> Although cartographers were often driven to imaginative and decorative extremes, Wilma George counseled against sweeping condemnation. Neither the choice of animals nor their placement was as arbitrary as was previously thought. Wilma George, *Animals and Maps* (Berkeley: University of California Press, 1969).

<sup>6</sup> A. E. Popham, Pieter Bruegel and Abraham Ortelius, *Burlington Magazine*, Vol. 59, 1931, p. 187.

<sup>7</sup> F. Grossman, *Bruegel, The Paintings* (London: Phaidon, 1955), p. 13.

less expressive and less versatile than the painter's brush, those craftsmen managed to turn craft into art. Copper engravers, who produced sharper, more delicate lines and more expressive tonal variations than woodcutters, eventually dominated cartographic design.<sup>8</sup> Cartography became the handmaiden of engraving to the extent that cartographers, when they compiled manuscript maps, anticipated the needs of engravers in the same way that architects anticipate the needs of builders and engineers. Thus conventional signs, which are relatively easy to reproduce, gradually replaced pictorial likenesses. So closely associated were painting, cartography, and reproduction that they were sometimes carried out by one person, or, if by several, then usually in one place. The capitals of Renaissance art were also prominent centers of publishing and mapmaking: Venice and Antwerp were notable examples.

A far greater restriction on artistry and invention in cartography came with the introduction of the instruments and the techniques of modern survey. These began to replace the artist's or the draftsman's eye in the fifteenth century. For some time after the establishment of systematic, scientific surveys in the seventeenth century, the techniques of landscape sketching, so useful to natural scientists, engineers, and soldiers, kept alive the direct relationship between cartography and art. Paul Sandby, a distinguished eighteenth-century watercolorist, worked in the map and survey office of the Tower of London, and from 1768 to 1779 he was drawing master at the Royal Military Academy, Woolwich, the training school for British military surveyors and draftsmen. Early in the nineteenth century Thomas Hornor, a versatile surveyor and landscape painter who described himself as a "Pictorial Delineator of Estates," tried to reunite pictorialism and surveying. To advertise his services, and to silence skeptical colleagues, he wrote in 1813:

The art of land surveying has remained stationary for a long period. The arts of surveying and landscape painting, which seem to have been united in former days, are now distinct. That a plan may be drawn with the same precision and afterwards so finished as to form a faithful and interesting picture of the various features of the property, comprehending the prospects which it commands, as if beheld in a camera obscura or from a lofty eminence, has been proved by the enlarged specimens which I recently submitted to public inspection. In these the whole subject country is represented in the colours of nature, and all its parts are drawn in a correct and faithful manner.<sup>9</sup>

Despite Hornor's claim to the contrary, his latter-day attempts to combine plans and prospects were more decorative than practical, and in the long run they failed to satisfy. His ingenuity, as one observer remarked wryly, won admirers but no followers.<sup>10</sup>

Hornor's pictorial delineations demonstrated the incompatibility of pictorialism and accuracy, but his failure did not signal the end of relationships between art and cartography. Cartographers still follow ancient pictorial techniques when, for example, they show relief by the use of highlights and shadows and depict slopes by line hatchings. But more valuable than the effects of particular techniques is the animation that artistic sensibility can give to maps. The effective use of line, color, and symbol can transform maps that might otherwise be dull, mechanical records into dynamic complexes charged with meaning.<sup>11</sup> In cartography, as in art, abstraction

<sup>8</sup> David Woodward, *Five Centuries of Map Printing* (Chicago: University of Chicago Press, 1975), p. 19.

<sup>9</sup> Ralph Hyde, Thomas Hornor: Pictorial Land Surveyor, *Imago Mundi*, Vol. 29, 1977, p. 26.

<sup>10</sup> Hyde, footnote 9 above, p. 31.

<sup>11</sup> Rudolph Arnheim, *The Perception of Maps*, *American Cartographer*, Vol. 3, 1976, pp. 5–10; Arthur H. Robinson, *The Look of Maps* (Madison: University of Wisconsin Press, 1952); and John K. Wright, *Map-*

has laid greater emphasis on relationships; the less an artifact interests our eye as imitation, Kenneth Clark noted, the more it must delight as pattern.<sup>12</sup>

In addition to the artistry of maps in general, there were specific similarities of style between the recognized schools of painting and cartography. The schools coincided both in space and in time; countries and regions that produced schools of landscape painting at the same time produced schools of cartography. Cartographers may work within a narrower convention than painters, but in lettering, coloring, and decoration, regional and national characteristics are apparent. "Design and nationality" as R. V. Tooley put it, "are like weave and woof." He observed that the maps of the first recognized school of cartography, the Italian, were as restrained as classical Italian Renaissance paintings. Italian mapmakers were the acknowledged patricians of the map world, producing maps that were "fastidious, severe, cultured and polished, almost modern in their disregard of inessential detail."<sup>13</sup>

Much less fastidious were the maps of Dutch cartographers who had superseded the Italians by the late sixteenth century and who continued to form the leading school of cartography into the seventeenth century. Dutch maps were lavishly colored, and, like Dutch paintings, they were crowded with details of dress, labor, and customs of the localities that were depicted. The northern taste for the ordinary had irritated Michelangelo who admonished Dutch and Flemish painters for depicting "patches, masonries, plants in the fields" to the detriment of the Italian ideals of "reason . . . symmetry, or proportion."<sup>14</sup> In some of the exuberant Dutch maps, accuracy was an inevitable casualty, a lapse that prompted a contemporary of Willem Blaeu to deride his atlas as a picture book for dilettantes. But the restraints imposed by increased geographical knowledge, accurate surveys, and demands for precise information were bound to enhance classical values. Reason, symmetry, and proportion returned to cartography in French maps of the seventeenth and eighteenth centuries. Like the landscapes of "the stern, cartesian, Poussin,"<sup>15</sup> French maps were "logical in treatment, brilliant in design, and clear in presentation."<sup>16</sup> Maps, geographer W. W. Jervis remarked, reflect the spirit of an age as faithfully as does its art.<sup>17</sup>

Similarities in style between maps and contemporary paintings were even more evident in the treatment of decorative borders and cartouches. As fact replaced fancy and as conventional signs replaced pictorial images, the purely decorative element in maps migrated to the borders where designers were free of the restraints controlling the cartographers who worked on the maps proper. Design of the borders, which usu-

makers Are Human: Comments on the Subjective in Maps, *Geographical Review*, Vol. 32, 1942, pp. 541-542.

<sup>12</sup> Kenneth Clark, *Landscape into Art* (Harmondsworth: Penguin Books, 1966 [originally published in 1949]), p. 19. Cartographer Max Eckert, for whom cartography was creation, not imitation, made a similar point when he argued that with abstraction or generalization, "art" became a factor in mapmaking. Max Eckert, On the Nature of Maps and Map Logic, *Bulletin of the American Geographical Society*, Vol. 40, 1908, pp. 344-351. Eckert's observation is quoted in Richard Edes Harrison, *Art and Common Sense in Cartography, Surveying and Mapping*, Vol. 19, 1959, p. 29.

<sup>13</sup> R. V. Tooley, *Maps and Map-Makers* (London: B. T. Batsford, 1949), p. 2.

<sup>14</sup> Quoted in Robert J. Clements, *Michelangelo's Theory of Art* (New York: New York University Press, 1961), p. 208.

<sup>15</sup> Clark, footnote 12 above, p. 78.

<sup>16</sup> Tooley, footnote 13 above, p. 2.

<sup>17</sup> Jervis, footnote 2 above, p. 68.

ally bore no functional relationship to the maps themselves, was a specialized branch of art. Painters commissioned to do them invariably worked into their designs the motifs of the period. Seventeenth-century maps were framed with fluted columns, strapwork, and sensuous images of the Baroque and Rococo: cherubs, fruit pendants, buxom and mythical females, muscular and heroic males, and wild horses. Readers of eighteenth- and nineteenth-century maps, on the other hand, had to be content with the more wholesome rural images of Romanticism: shepherds, milkmaids, spreading trees, and sheaves of wheat.<sup>18</sup>

#### RECIPROCAL RELATIONS BETWEEN CARTOGRAPHY AND ART

Although artistry was an important, often dominant, characteristic of early maps, it was only one aspect of the relationship between cartography and art. Both maps and landscape paintings must represent the earth or conceptions of it. Until objective scientific schemes ousted pictorialism in cartography, the approaches of mapmaker and painter and the forms of maps and paintings were often so similar that no clear distinction could be made between practitioners or their products. The evidence from the maps and paintings is endorsed by terminology that emphasized the conscious, visual aspect of cartography. In the Middle Ages a map was an "orbis imago" or "pictura." Holy Roman Emperor Maximilian I, an early enthusiast and patron of cartography, declared that as a youth he like other princes began "to paint the landscapes of the earth."<sup>19</sup> Georg Braun invited contributors to his city atlas to send the "portrait" of their native places. The notion of maps as pictures survived well into the age of scientific cartography. A reluctant eighteenth-century French cartographer, one Colonel Bonne, urged other cartographers not to forget that "a topographical map is a kind of painting. The subject itself," he added sardonically, "is dry enough."<sup>20</sup>

As "pictures," early maps may be valuable sources of geographical information and, usually more reliably, of prevailing notions of space and environment. Like landscape paintings, the maps mark stages in conceptions of the environment. Early European conceptions, we now realize, were quite unlike present-day ones. To modern eyes, most medieval maps are mere aggregations of unintegrated features and places. Towns might be arranged in lists, scales varied to give prominence to particular localities, and shapes distorted to fit the map on the available sheet or parchment. Notoriously inaccurate were the mappae mundi. Two disgruntled interpreters of the thirteenth-century Hereford map dismissed the typical mappa mundi as an "illustrated romance" and a "chaos of error and confusion."<sup>21</sup> Accuracy was preserved only where it was indispensable: on certain military and land-registry maps, and, above all, on the portolan charts used by navigators. Yet even on these maps of areas actually traversed and observed there was no uniform scheme of geographical space. Well into the fifteenth century, estate maps were not drawn to scale, even though numerical dimensions were stated precisely. On the portolan charts all-important direc-

<sup>18</sup> E. Lynam, *Period Ornament, Writing and Symbolism on Maps 1250–1800*, *Geographical Magazine*, Vol. 18, 1946, pp. 365–368.

<sup>19</sup> Quoted in Leo Bagrow, *History of Cartography* (London: C. A. Watts, 1964), p. 157.

<sup>20</sup> Bagrow, footnote 19 above, p. 220.

<sup>21</sup> W. L. Bevan and H. W. Phillott, *Mediaeval Geography* (London: Stanford, 1874), p. 22.

tions were accurate, but distances were unreliable. Further, because they lacked a system of rectangular coordinates, the charts provided no means to amalgamate knowledge of the mapped areas.

The idiosyncracies of medieval cartography characterized medieval art.<sup>22</sup> Paintings might indicate clearly the sequence in which objects were meant to be seen, as well as their orientation relative to the picture plane, but might offer no clues as to size and spacing. As on the portolan charts, angles and directions were reliable, but distances were not. Relative sizes usually depended less on actual size than on the emphasis that the artist chose to give to the depicted objects: thus important figures and features, like important places on maps, were magnified. There was also a tendency to let objects “float” to the foreground of the paintings and to show them from different viewpoints. Space, in other words, was “naive” or discontinuous and so rarely penetrated that there were few vistas. Medieval nature, as C. S. Lewis remarked, is all foreground.<sup>23</sup>

Such “landscapes” were landscapes of symbol rather than fact.<sup>24</sup> Like the maps, they indicate two characteristics of medieval life and perception: first, a view of reality that did not equate the real with the material and, second, the importance of symbolism in medieval communication. Medieval reality was multidimensional; planes of truth that we see as distinct and clashing, in the Middle Ages were seen as concurrent parts of a harmonious whole.<sup>25</sup> With literalism at a discount symbolism was paramount, and the interpretation of symbols seems to have been so deft that poets could dispense with narrative connectives and painters with continuous, articulated spaces. It follows that medieval art was not addressed to the sight alone; its spaces were meant to be experienced, not just seen.<sup>26</sup> Paintings of towns, for example, show not so much what the towns looked like as what it felt like to be in them. We get an impression of the towns not as they might have looked to a detached observer from a fixed vantage point, but as they might have impressed a pedestrian walking on the streets and seeing the buildings from many different sides. The two modes of perception are akin to “visual world” and “visual field,” as defined by perceptual psychologist J. J. Gibson.<sup>27</sup> Our visual world is the solid, three-dimensional world that we see and experience as we look about; our visual field is the more limited world that we see when our eyes are fixed on a particular point or feature.

Although medieval painters and cartographers were indifferent to empirical accuracy, they were concerned with affective experience of the world, thus the prominence given to particular persons, objects, and places. In maps affective experience was determined by conventional space relations. World maps were often “oriented” so that east, which held the earthly paradise, was at the top and Jerusalem in the center. Occasionally Christian symbolism was even more explicit. On the Ebstorf map, the world was depicted as the crucified body of Christ, with Christ’s head,

<sup>22</sup> For a comparison of a painting and a map, see Samuel Y. Edgerton, *The Renaissance Rediscovery of Linear Perspective* (New York: Basic Books, 1975), pp. 96–97.

<sup>23</sup> C. S. Lewis, *The Discarded Image* (Cambridge: Cambridge University Press, 1964), p. 101.

<sup>24</sup> Clark, footnote 12 above, p. 17.

<sup>25</sup> Carolly Erickson, *The Medieval Vision: Essays in History and Perception* (New York: Oxford University Press, 1976), pp. 5–9.

<sup>26</sup> Marshall McLuhan and Harley Parker, *Through the Vanishing Point* (New York: Harper and Row, 1968), p. 87.

<sup>27</sup> J. J. Gibson, *The Perception of the Visual World* (Boston: Houghton Mifflin Co., 1950), pp. 26–43.

hands, and feet projecting beyond the circular frame of the map. Like the Hereford map, the Ebstorf map was compiled by monks and probably used as an altarpiece.

Because of the authority of the medieval church, there was little hope for naturalism in art or for science in cartography “til the monks were turned adrift,” as eighteenth-century topographer Richard Gough put it.<sup>28</sup> Scientific mapmaking and realistic or naturalistic painting were a product of Renaissance empiricism. Medieval indifference to objective reality gave way in the Renaissance to a desire for precise knowledge. Certainty, in a revival of the Greek notion, came to be associated with measurement and through measurement with proportion.<sup>29</sup> Because proportion is both a logical mathematical concept and a basic concept of aesthetics, the idea of measurement thus became the link between natural science and art. In the words of Luca Pacioli, the Renaissance mathematician, proportion is not only the mother of knowledge but also the “mother and queen” of art.<sup>30</sup>

The search for correct proportion in art led to the discovery of the “laws” of linear perspective by Filippo Brunelleschi and their development into a working scheme for painters by Alberti. Alberti’s scheme offered a mathematical solution to the problem of diminution of size with distance. Painters who adopted the scheme were able to create an illusion of depth in which each object was related to the viewing point of the beholder and was in scale with every other object in the painting. In other words, space in a perspective painting was uniform and measurable.<sup>31</sup>

A scheme for the systematic organization of space was new to art, but not to science. The problem of determining correct relative positions in space had been confronted by ancient Greek geographers. The most comprehensive solution was Ptolemy’s.<sup>32</sup> In “Geography” Ptolemy divided the world into a network of meridians and parallels and presented several methods to project them on a plane surface. His third method was from a fixed-eye position: the reader was asked to look at a central point—where the parallel through Syene intersected the polar axis—that was both the center of the viewer’s visual field and the center of the ecumene. The eyes were so positioned that the visual plane was parallel to the planes of the lines of latitude: that is, the viewer was asked to look at the globe as he would a conventional picture—at eye level from a fixed point of observation. Ptolemy explained how the grid, projected on a flat surface, enhanced the viewer’s perception of the world. The properties of the projection were strikingly similar to those of a painting constructed by the laws of linear perspective.

We are able therefore to know the exact position of any particular place; and the position of the various countries, how they are integrated in regard to one another, how situated in regards to the whole inhabited world.

Although his constructions were not intended for the use of artists, Ptolemy under-

<sup>28</sup> Richard Gough, *British Topography*, 1780. Quoted in *My Head is a Map* (edited by Helen Wallis and Sarah Tyacke; London: Francis Edwards and Carter Press, 1973), p. 5.

<sup>29</sup> Ernst Cassirer, *The Individual and the Cosmos in Renaissance Philosophy* (New York: Harper Torchbooks, 1964 [originally published in 1927]), pp. 46–51.

<sup>30</sup> Quoted in Cassirer, footnote 29 above, p. 51.

<sup>31</sup> A. Richard Turner, *The Vision of Landscape in Renaissance Italy* (New Jersey: Princeton University Press, 1966), p. 6.

<sup>32</sup> For analyses of Ptolemy’s influence on Renaissance painting, see Gadol, footnote 1, above; and Edgerton, footnote 22 above.

stood that the principle of correct proportion could be applied to painting as well as to mapmaking:

The end of chorography is to deal separately with a part of the whole, as if one were to paint only the eye or the ear by itself. The task of geography is to survey the whole in its just proportion, as one would the entire head. For in an entire painting we must first put in the larger features and afterwards those detailed features which portraits and pictures may require, giving them proportion in relation to one another so that their correct distance apart can be seen by examining them, to note whether they form the whole or part of the picture.<sup>33</sup>

The significance of Ptolemy's observations did not escape Renaissance theoreticians when "Geography" was translated, in Florence circa 1406, into Latin from the original Greek. Ptolemy's system of grid coordinates provided cartographers with the principles of geometric harmony that Florentines sought in their art. Although there is no known connection between the discovery of the laws of linear perspective and Ptolemy's projections, it seems likely that Brunelleschi was familiar with them. Brunelleschi was both a Florentine and a friend of the mathematical geographer, Paolo Toscanelli, who was an enthusiast of "Geography."<sup>34</sup> Alberti's debt to Ptolemy is certain. The Ptolemaic network of meridians and parallels was the model for the scaled, checkerboard pavement of Alberti's "construzione legittima," that was used to determine relative positions. Painters using the method were advised to find by means of the "parallels" (the squares of the grid) the "latitude" and "longitude" of the surfaces that they wanted to depict. Alberti's "centric," or as it was later dubbed, vanishing point, like the central point of Ptolemy's third projection, was in the precise center of the drawing area. Ptolemaic grid-coordinate systems also inspired Alberti's well-known "velo" or veil, a net of colored strings hung in front of the object or the landscape to be painted. By means of a similar network laid on the drawing surface, the object or the landscape could be transposed in "its just proportions," to use the Ptolemaic phrase.

The task of making accurate images of the earth required both a grasp of mathematics and optics and a knowledge of the techniques of surveying and mapping. Alberti, no mere theorist, was familiar with the basic instruments of survey, and he understood the principles of triangulation. Guided by Ptolemy and the examples on portolan charts, Alberti devised a technique of surveying and mapping that he used to compile a descriptive geography of Rome.<sup>35</sup> Other Renaissance painters recognized the need for measurement. "There is no art," wrote Dürer, "by which Measurement is more, and more variously, needed than the Art of Painting, which not only requires Geometry and Arithmetic, the foundations of all Measurement, but, much more than any other art, depends upon Perspective, Catoptrica, Geodaesia, Chorographia."<sup>36</sup> He complained that young German painters "like young ungrafted trees . . . lack the art of measuring." To repair the omission he wrote in 1525 a treatise on the theoretical and practical problems of perspective in art, "The Instruction in the Mensuration with Compass and Triangle."

<sup>33</sup> Geography, Book 1, Chapter 19, and Book 3, Chapter 1; both passages are quoted in Edgerton, footnote 22 above, p. 111.

<sup>34</sup> Edgerton, footnote 22 above, pp. 120–124.

<sup>35</sup> *Descriptio urbis Romae*, circa 1450.

<sup>36</sup> Quoted in Otto Benesch, *The Art of the Renaissance in Northern Europe* (London: Phaidon, 1965), p. 8.

The problems of measurement, perspective, and proportion absorbed Leonardo da Vinci for whom mathematical certainty was an article of faith. Periodically his experiments in geometry interrupted the progress of his painting. "He is working hard at Geometry and has no patience with his brush," wrote his friend Fra Pietro in one letter, and in another, "his mathematical experiments have so distracted him from painting that the sight of a brush puts him out of temper."<sup>37</sup> During 1501 and 1502 he turned to cartography and military engineering and produced his beautiful, now famous, maps of central Italy for Cesare Borgia. But the involvement of painters in the practical work of cartography did not always end as happily. Ralph Aggas, a surveyor of estates in seventeenth-century England, complained of a plane table: "Mary, he was a plumber and had learned from a painter; in less than an acre and a half he fell short at his cloaze by two perches at least."<sup>38</sup>

In spite of these occasional lapses, participation of painters in surveying was a boon to cartography because it brought about a critical association of measurement and pictorialism. Except for the portolan charts, cartography had been an unscientific form of pictorialism until the Renaissance. Large-scale topographical maps were essentially sketches, occasionally supplemented by linear measurement, made from vantage points such as church towers and hilltops.<sup>39</sup> The advantage of high oblique, or "bird's-eye," views was that they showed features partly in elevation and partly in plan, an attribute that made them particularly attractive wherever there was a desire, as on coastal charts and city plans, to show profiles. Such views were popular on city maps until the eighteenth century. The disadvantages of oblique views are that not all places can be shown and that they are inaccurate; foreshortening of the orthogonals creates errors of scale that increase commensurately with area. To maintain a uniform horizontal scale the mapped area must be envisaged from a point vertically above it. In practice, this view from the air, which could not be achieved in reality during the Renaissance, had to be abstracted from observations made at ground level. The abstraction, crucial to the development of cartography, seems to have been a product of the creative imagination. It was first performed by an artist-cartographer, Leonardo da Vinci.<sup>40</sup>

Da Vinci's first cartographic attempt to convert ground observations into an imagined view from the air was a sketch map of Milan, on which the viewpoint is oblique rather than vertical.<sup>41</sup> Unlike contemporary city maps, which were perspective drawings based on views from actual vantage points, da Vinci's was imaginary.<sup>42</sup> His sketch therefore was not a view, but an abstraction based on the principles of mathematical perspective in an effort to preserve accuracy.<sup>43</sup> In later maps

<sup>37</sup> Quoted in Kenneth Clark, *Leonardo da Vinci* (London: Cambridge University Press, 1939), p. 115.

<sup>38</sup> Quoted in E. Lynam, *British Maps and Map Makers* (London: Collins, 1944), p. 26.

<sup>39</sup> The cartographer sometimes drew a small picture of himself on the map to show the nature and the location of the vantage point.

<sup>40</sup> Otto Benesch, *Leonardo da Vinci and the Beginning of Scientific Drawing* in Otto Benesch, *Collected Writings* (4 vols.; London: Phaidon, 1971), Vol. 2, pp. 344-345; and L. H. Heydenreich, *Leonardo da Vinci* (2 vols.; New York: Macmillan, 1954), Vol. 1, pp. 86-88.

<sup>41</sup> The imaginary viewpoint was anticipated in his panoramic landscape drawings. In them the artist was clearly not earthbound.

<sup>42</sup> By the end of the fifteenth century, painters of city views had begun to free themselves of the constraints imposed by an actual viewpoint. In order to encompass the whole city, painters sometimes projected themselves above the supposed vantage point and tilted the landscape forward. L. D. Ettlinger, *A Fifteenth-century View of Florence*, *Burlington Magazine*, Vol. 94, 1952, p. 164.

<sup>43</sup> This was a case of Leonardo applying an established practice of his art to cartography. He regarded perspective as the "guide rope" in painting, and he showed a predilection for geometrical proportioning and centering of his compositions. Heydenreich, footnote 40 above, Vol. 1, p. 86.

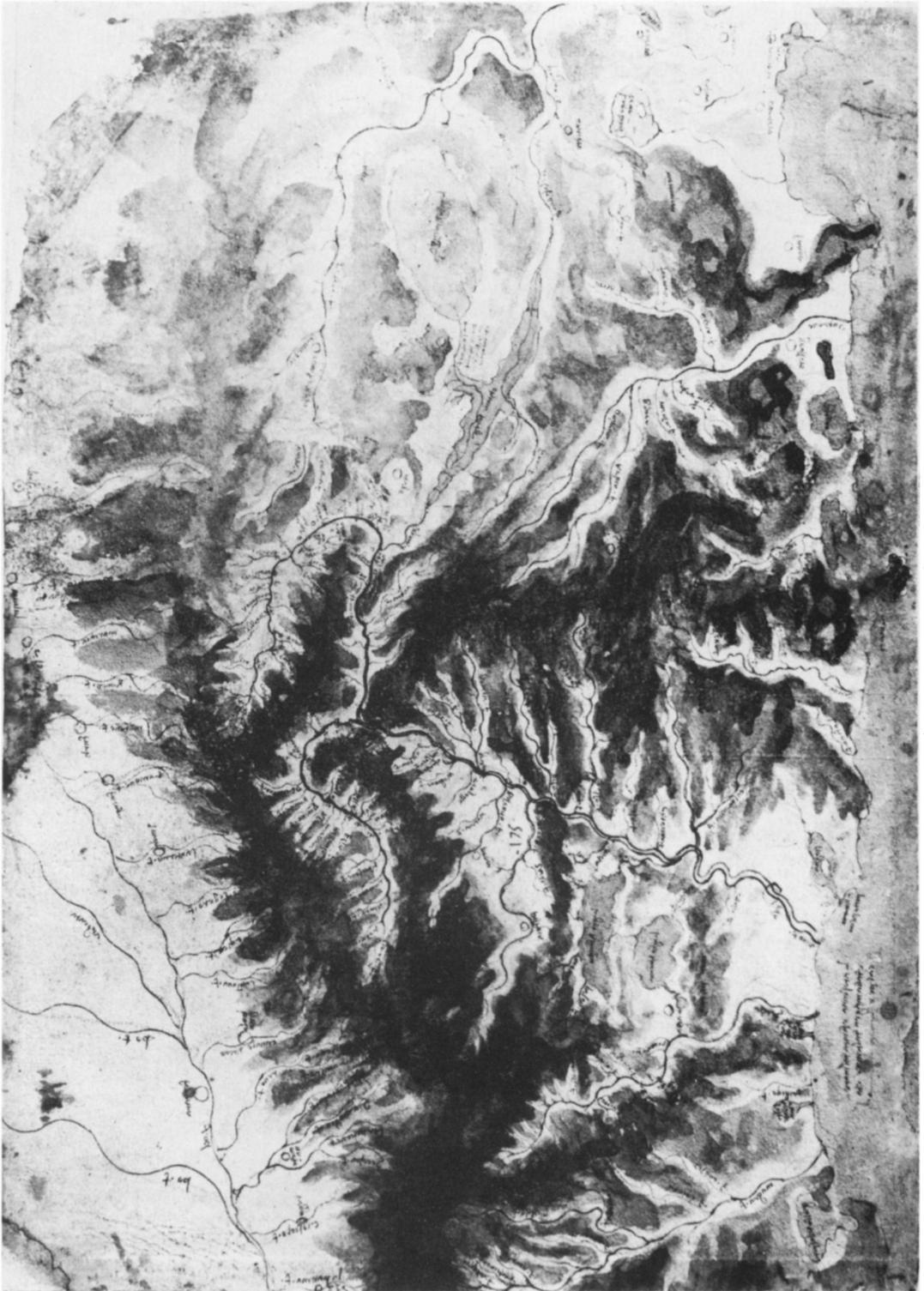


FIG. 2—"Map of Northern Tuscany Showing R. Arno" by Leonardo da Vinci (Royal Library, Windsor Castle, Windsor; copyright H. M. Queen Elizabeth II).

he rejected the oblique for the vertical viewpoint. His map of Imola, conceived from a vantage point directly above the city, is the first known map to reject completely “church-tower” perspective (Fig. 1). In combining method and imagination, the Imola map unified “the pictorial and the planimetric, image and measurement.”<sup>44</sup> Like the da Vinci relief map of the Arno Basin, the Imola map anticipated the work of modern cartographers in conception, design, and accuracy (Fig. 2). The only contemporary rival of the Imola map might have been a map of Rome made by Alberti to accompany his descriptive geography of the city. No copy has survived; indeed the map might not have been drawn. But Alberti’s description of how to make a scaled map suggests that his method of survey was copied by Leonardo, because the Imola map, like the one of Rome, was drawn within a circle, thought to be a section across Brunelleschi’s cone of sight and oriented by a wind rose. Plotting was done by compass bearing and measured distances from the center of the city. If the Roman map was drawn, it might have differed from the Imola map, after the conventions of the day, by showing only the city wall and important buildings, and these in elevation rather than in plan.<sup>45</sup>

By producing surveyed maps and by raising the viewpoint from oblique to vertical, the artist-cartographers of the Renaissance initiated practices that ironically would allow cartography to dispense with their services. A landscape seen from the air has only two dimensions and cannot be portrayed in the conventional manner. Appearances can be suggested only by signs or symbols that, on modern maps, usually approximate the shape of the object as seen from the air. As symbols became standardized, there was less and less need for the skills of the artist. By the eighteenth century, Colonel Bonne notwithstanding, maps were no longer pictures but symbolic abstractions, with losses in decorative effect balanced against gains in clarity and accuracy.

#### COSMOGRAPHY, ART, AND CARTOGRAPHY

A distinguishing characteristic of the Renaissance was the profound change in attitudes to the cosmos and to space. Thirst for space and its eventual mastery were a leitmotiv of Renaissance art and science.<sup>46</sup> A major instrument of change was the Ptolemaic revival. The intellectual movement inspired by Ptolemy’s methodical approach to space led to a reappraisal, which was to divest Ptolemy of his authority, not only of conceptions of the earth but also of the cosmos. In cosmography the confusing sequence of equants, deferents, and epicycles needed by Ptolemy to explain the irregular paths of the planets could not withstand the measured scrutiny that his work generally had inspired. Inevitably the ungainly universe of the “Almagest” yielded to the “more rational system of circles” of “*De Revolutionibus Orbium Caelestium*.” In the Copernican universe, which dispensed with Ptolemaic and medieval notions of a hierarchical order with a fixed, central position for the earth, the sun and planets merely hovered in space. Without fixed or privileged parts, the new universe

<sup>44</sup> Heydenreich, footnote 40 above, Vol. 1, p. 87.

<sup>45</sup> They are so shown in a nineteenth-century reconstruction of the plan. Gadol, footnote 1 above, p. 74.

<sup>46</sup> Max J. Friedländer, *Landscape, Portrait, Still Life* (New York: Schocken Books, 1963), p. 21.

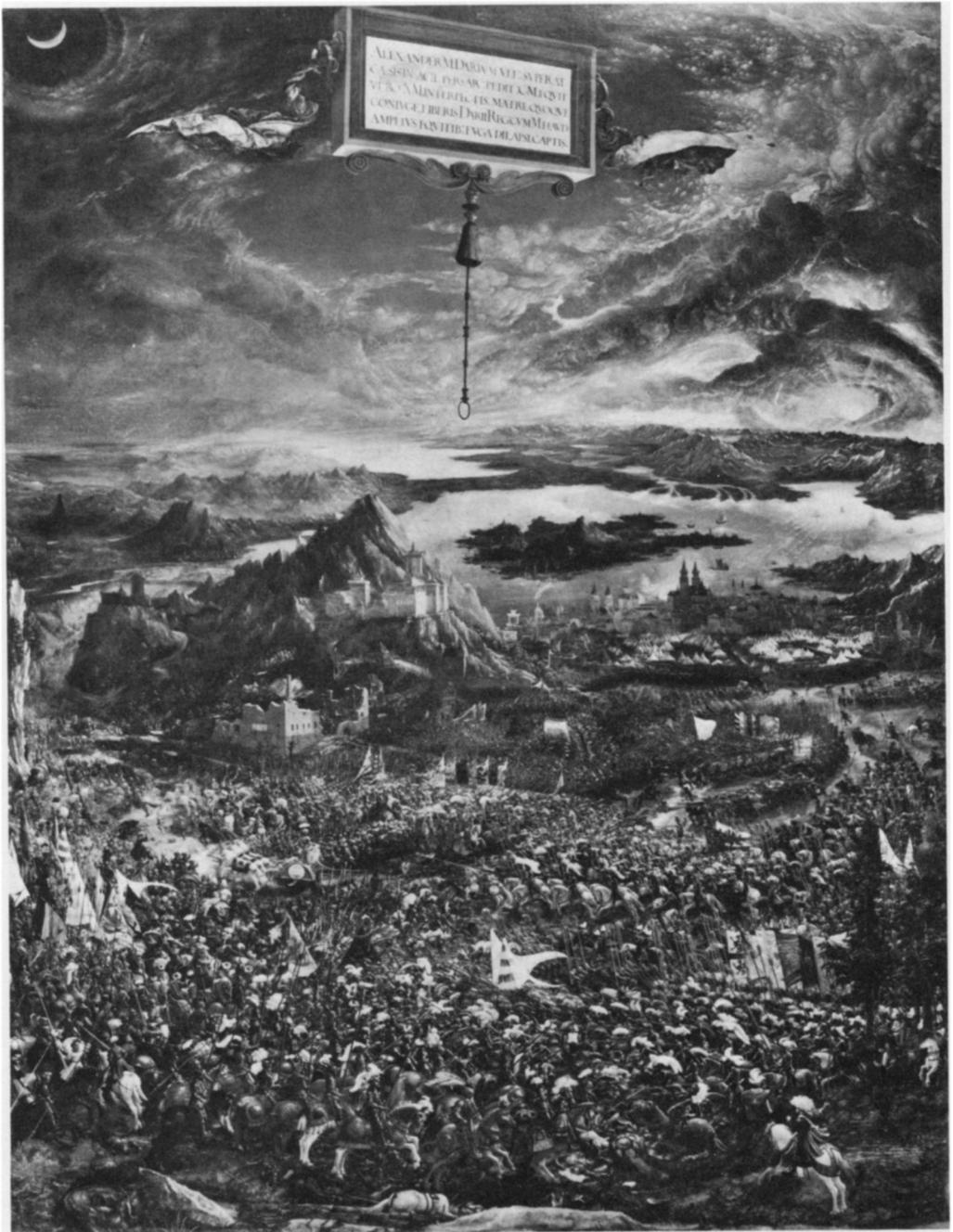


FIG. 3—"The Battle of Alexander" by Albrecht Altdorfer (Alte Pinakothek, Munich).

was one of relative rather than absolute positions in which space had equal value everywhere. As on a scientific map or in a perspective painting, space was neutralized.

The change in world view had inevitable repercussions in cartography and in art. The new conception of the cosmos encouraged a vision of the earth as a whole and views of its surface as if seen from a great height. In cartography the new perspective led to the first systematic attempts since Ptolemy to map the entire earth, knowledge of which was enlarged by the voyages of discovery. In 1569 Mercator published his world map, and in 1570 Ortelius his world atlas. Unlike earlier maps, these were based not on commentaries and itineraries but, where possible, on empirical information furnished by land surveys and astronomical observations. They were the first frames in the development of what Gadol called "the magnificent world picture of modern geography."<sup>47</sup> The new world was to supplant the old world of Ptolemy's "Geography" as decisively as the Copernican system had the universe of the "Almagest."

In painting the response to the Copernican discoveries was equally dramatic. The axial shift in world view from vertical to horizontal, occasioned by the dismantling of the hierarchic medieval cosmos, combined with a distant view of a rotating, revolving earth to induce a new sense of spaciousness. In painting the new sense of space was expressed in the series of fantastic panoramas that dominated sixteenth-century landscape painting (Figs. 3 and 4). Unlike previous panoramas, which were actual views from terraces, high windows, and hilltops, the sixteenth-century panoramas were imaginary, the viewpoint extraterrestrial. In dispensing with a foreground and in pushing back the horizon to its limits, those panoramas were the antithesis of the enclosed medieval landscapes.

Otto Benesch considered landscape painting as "a mirror of man's conception of the cosmos." He identified stages in the progression from actual, earthbound landscapes to imaginary panoramas. Landscapes of the early Renaissance are "terrestrial" landscapes, seen and experienced in the concave. The viewpoint, which corresponds to the medieval conception of the cosmos as a hollow sphere seen from the inside, is illustrated in Bosch's triptych, "The Garden of Earthly Delights and the Creation of the World." On the outside wings of the triptych, the earth is shown as a pale crystal ball hovering in the middle of a dark void (Fig. 5). The first signs of incipient change in world view appear in Altdorfer's "Nativity," painted circa 1520, twenty years before the Copernican revelations (Fig. 6). Altdorfer's sense of space was cosmic and spherical; he stressed the relative position of the earth, presented as a dependent object existing only in relation to a distant sun, itself suspended in an immeasurable universe. The change from terrestrial to cosmic landscape was completed in Altdorfer's "Victory of Alexander over King Darius of Persia," a work that Benesch regarded as "an adventure in painting no less daring than the voyages of the contemporary circumnavigators of the globe" (Fig. 3). The struggle is presented not as a limited clash between two armies but as a massive engagement, staged on a vast, convex landscape, involving all of mankind. The battle on earth is matched by an equally heroic struggle in the skies among surging ranks of clouds, sun and moon, and light and darkness.

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<sup>47</sup> Gadol, footnote 1 above, pp. 194–195.



FIG. 4.—“The Fall of Icarus” by Pieter Bruegel (Musées Royaux des Beau-Arts, Brussels).

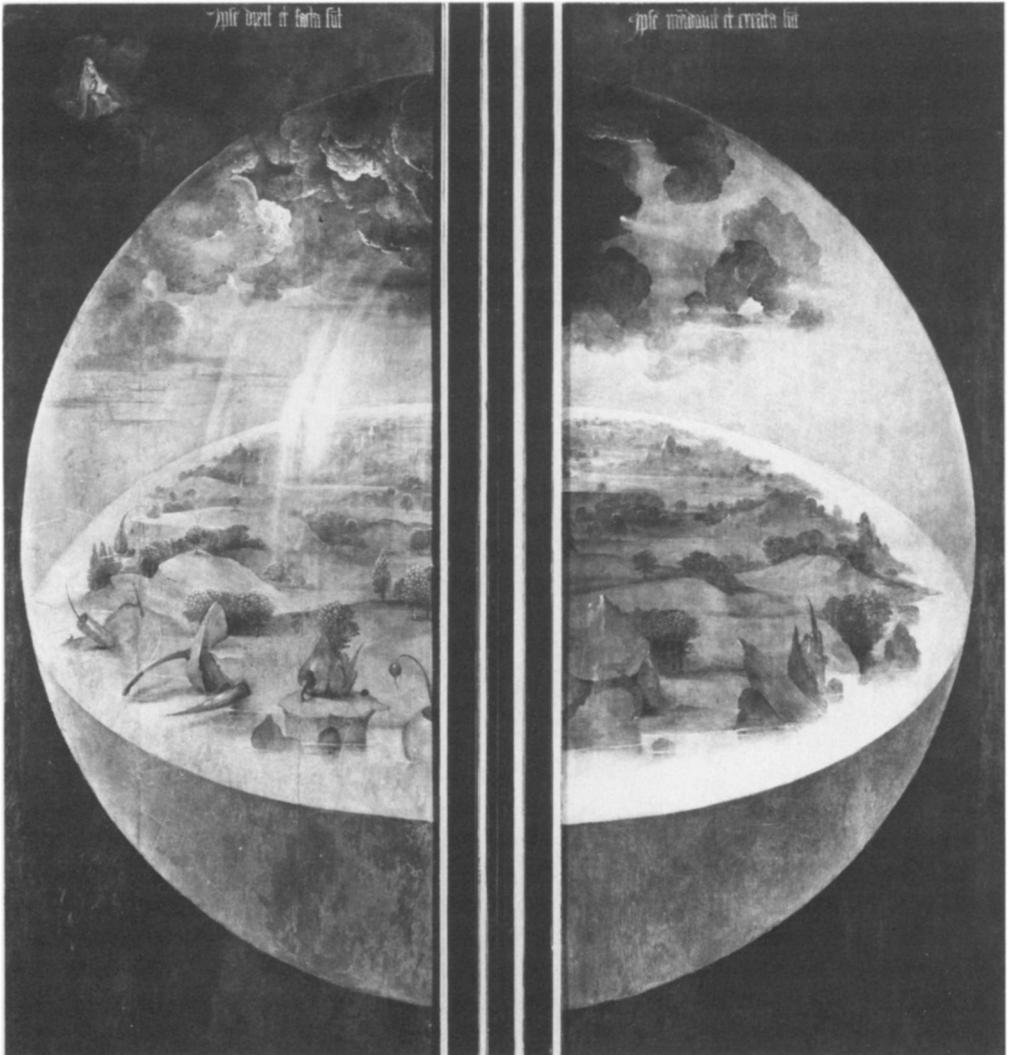


FIG. 5—"Garden of Earthly Delights" by Hieronymus Bosch (Museo del Prado, Madrid).



FIG. 6—"The Nativity of Christ" by Albrecht Altdorfer (Kunsthistorische Museum, Vienna).

Despite the pronounced curve of Altdorfer's horizons, Benesch concluded that the concave notion of space had not disappeared entirely from his work. Benesch noted that a viewer looks down on the earth at his feet, as on a huge *mappa mundi*, and averred that not until Bruegel was the convex view of space fully expressed.<sup>48</sup> In the panoramas of Bruegel the idea of the circle dominated and transmitted the feeling of the huge vault of the universe (Fig. 4). The cosmic viewpoint of Bruegel's work is reinforced by the anonymity of the diminutive figures with which he peopled his vast landscapes. These depart from the customary anthropocentric position and may well reflect the idea of the mechanism of the universe that was prominent in the scientific thought of the sixteenth century. A striking feature of Bruegel's panoramas is their organic wholeness. Max Friedländer pointed out that Bruegel was a pioneer in the boldness with which he overlooked details and visualized the relationship of the parts to each other.<sup>49</sup> His conception of the earth as an integrated whole seems to have been engendered by a world view that allowed him in imagination to perceive his subject from a great distance. Miniaturized, as Levi-Strauss would contend, the earth seemed more comprehensible. The idea was supported by de Tolnay.

In Bruegel's work for the first time the lofty post of observation acquires the meaning of a liberation from terrestrial limitation, of free breathing in purer air, of the ability to survey a wondrous order which remains forever concealed to those who live below.

From this cosmic viewpoint,

All the riches of the world are spread out. . . . The artist's gaze masters the whole, sees the homogeneity and the interdependence of all the forms. It catches the totality of the world, opens an insight into the structure of the cosmic system itself, as it would not be recognizable from below, and makes it possible for the beholder to relive the creative joy of the Architect of the World.<sup>50</sup>

An integrated view of the earth also informs da Vinci's landscapes and panoramas. For him an extraterrestrial viewpoint might have been a matter of course. He saw the earth as a "star," and throughout his life "he was haunted by the dream of a man who would lift himself above the earth."<sup>51</sup> Like Bruegel, he saw the world as a living organism. His view of the world as an organism was expressed also in his relief maps. These, like his anatomical drawings, to which they are often compared stressed functional or physiological relationships. The maps were drawn with such sensitivity that they appear to be living landscapes.<sup>52</sup>

## CONCLUSION

A paper conceived as a tentative introduction to a complex subject cannot come to a decisive end. By way of conclusion I can do no better than repeat the closing statement of a seventy-year-old paper that in part prompted this study. Eugen Oberhammer, writing on the relationship between Renaissance geography and art, emphasized that he wanted to exhibit geography and art "in a more intimate connection than the contrast between the exact investigator and the freely creating artist

<sup>48</sup> Otto Benesch, *German Painting from Dürer to Holbein* (Geneva: Albert Skira, 1966), pp. 177-179.

<sup>49</sup> Max J. Friedländer, *From Van Eyck to Bruegel* (London: Phaidon, 1956), p. 141.

<sup>50</sup> Charles de Tolnay, *The Drawings of Pieter Bruegel The Elder* (London: A. Zwemmer, 1952), pp. 12 and 15.

<sup>51</sup> Antonia Vallentin, *Leonardo da Vinci* (New York: Viking Press, 1938), p. 310.

<sup>52</sup> Robert Payne, *Leonardo* (Garden City, N.Y.: Doubleday and Company, 1978), p. 267.

would lead us to expect.<sup>53</sup> For cartography and landscape painting the connection was a creative partnership, each informing the other at key periods in the development of European attitudes to space and environment. Time has weakened the partnership without dissolving it. Maps are now symbolic abstractions, not pictures, but to be effective must still evoke appearances. A good map should “woo the susceptible mind.” Echoing Ruskin and the Sublime, C. E. Montague described his own reaction to a series of engraved, hachured maps produced in the monochromatic days of the British Ordnance Survey:

Some of their representations of mountains are almost temperamental; they awe you or exhilarate you with the sombre darkness of their mountain-sides, and the brilliant high lights of the summit ridges where you come into the sun; here, as you feel, is a measure of success, which can hardly be unconscious, in rendering the mountain glory and the mountain gloom.<sup>54</sup>

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<sup>53</sup> Eugen Oberhummer, Leonardo da Vinci and the Art of the Renaissance in its Relation to Geography, *Geographical Journal*, Vol. 33, 1909, p. 549.

<sup>54</sup> Quoted in Jervis, footnote 2 above, pp. 48 and 51.