

## Albrecht Dürer

Of all the Renaissance artists, the most accomplished mathematician was the celebrated painter, printmaker, and engraver **Albrecht Dürer** (May 21, 1471 – April 6, 1528) had magnificent technical abilities, synthesizing both Italian and Northern European traditions in a unique and much-imitated style. He was responsible for developing techniques and raising standards in his woodcut and copper engravings and still is hailed as one of the greatest printmakers of all time. He also painted



detailed watercolor studies of plants and animals. He was equally at home in his oil paintings with secular and sacred subjects. He exercised a major influence on the development of European art. Many of his letters, annotations, and theories of anatomy and perspective have survived. It is natural to compare with Leonardo da Vinci, born 19 years earlier. It has been claimed that was more an engineer while Leonardo was more a scientist. Like da Vinci, placed the sitter's hands at the front of a painting to intensify the illusion that the viewer is included in the piece of art.

was born and died in the Imperial Free City of Nuremberg, halfway between the two leading artistic centers of the time, the Netherlands and Italy. He was the third son and one of eighteen children born to a goldsmith who had emigrated from Hungary. Dürer attended Latin school at St. Lorentz and then began an apprenticeship with his father in 1485. Dürer must have turned to painting while quite young, as the earliest known of his works is a self-portrait done when he was 13. In 1486 Dürer was apprenticed to painter and printmaker Michael Wolgemut and soon was producing woodcuts and copper engravings of his own. Beginning in 1490 Dürer made trips to Italy and the Low Countries to learn the artistic secrets of the painters there. In Italy Dürer was greatly influenced by Giovanni Bellini and his brother-in-law Andrea Mantegna. The years between 1494 and 1505 were ones of great

productivity and artistic growth for Dürer. It was during this period that he set up his own studio in Nuremberg. Although influenced by the works of the major artists of Europe, he was truly an innovator. He is the first artist known to have painted self-portraits and landscapes of specific scenes. His more than 350 woodcuts and engravings made him famous across Europe. He was equally successful with oil paintings, at least 60 of which have survived. His patrons were not only found among the nobility but also came from the newly wealthy merchant class.

Among his greatest works were his self-portraits, *The Seven Sorrows of the Virgin* (c. 1496-97), *The Adoration of the Magi* (1504), and *Adoration of the Trinity* (1511). Among his most memorable engravings and prints are *The Four Horsemen of the Apocalypse* (1498), *The Knight with Death and the Devil* (1513), *Melancholia I* (1514), and *Saint Jerome in His Study* (1514). His engraving *Melancholia*, originally named *Melencolia* by Dürer, (Figure 5.7) is his most famous and enigmatic engraving. Its symbolism reflects both mathematics and to alchemy. As a result this allegorical work is one of the most analyzed and interpreted pieces of art in all history. It contains a truncated polyhedron. In his “A New Hypothesis on Dürer’s Enigmatic Polyhedron in His Copper Engraving *Melancholia I*,” *Historica Mathematica*, 1999, P. Schreiber suggests that it is from a rhombohedron with 72-degree face angles, truncated so it can be inscribed in a sphere. The engraving also shows a solid sphere, a pan balance, an hourglass, the first magic square (Figure 5.8) to be seen in Europe and a brooding thinker holding compasses.

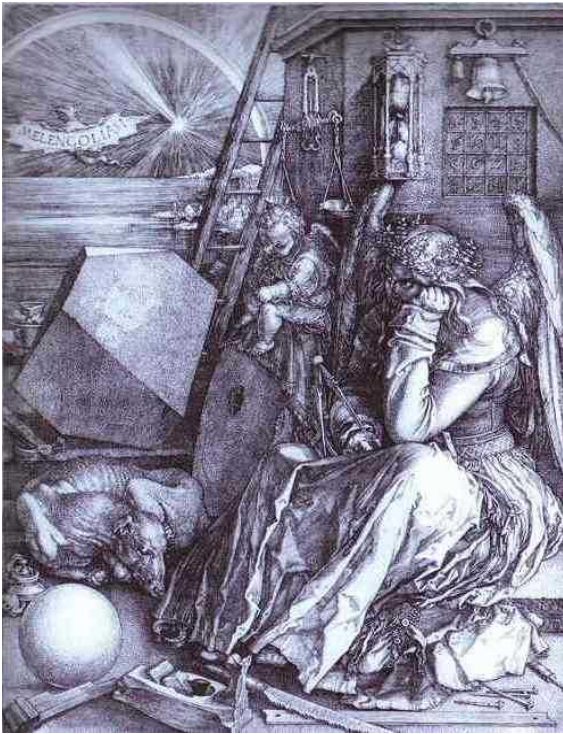


Figure 5.7

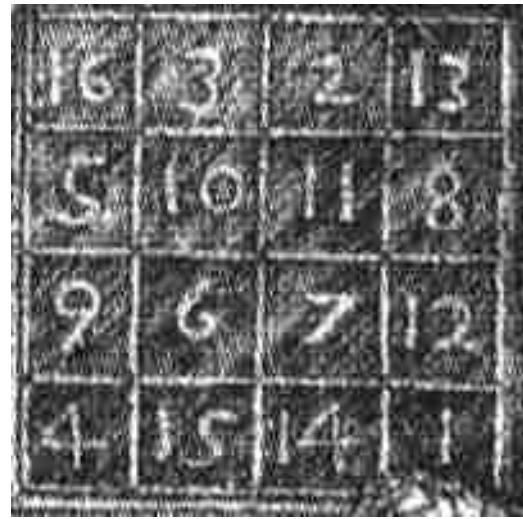


Figure 5.8

The Roman numeral “I” in the title of the engraving suggests that Dürer planned it to be the first of a set, perhaps illustrating the Four Temperaments: melancholic, phlegmatic, choleric, and sanguine. These were linked in medieval times with the Four Elements of the alchemists, the Four Humors of the body, and the four outstanding colors indicating the stages of alchemy (black, white, citrine, red). In addition, the magic square is of order four. seems to have employed the last line of the magic square 4 – 15 – 14 – 1 as a means to communicate the date of the painting 1514 and his monogram, as the numbers 4 and 1 are the gematric values of **D** and **A**. [In Hebrew and many other ancient alphabets, every letter also had a gematric, that is, numerical value.] The magic square, the compasses, the polyhedron and sphere reflect the Pythagorean insistence on the importance of number and form in the Universe. Each object in the engraving has meaning in terms of alchemistic symbolism. Some art historians have suggested that the figure in the engraving represents Michelangelo, the most melancholic artist of the Renaissance. To support this claim, the simple Latin Gematria numerical

values of the letters in *Melencolia* is 89, the same number obtained by assigning gematric values to *Michelangel*, a variation on the spelling of Michelangelo.

In 1495 Dürer began a self-study of mathematics and architecture from ancient classics. His second trip to Italy (1520-21) was not so much to avail himself of the artistic secrets of the Italian painters as to become better acquainted with their mathematical knowledge of proportions and perspective, which he realized he would have to master to accomplish his goals in art. Upon his return to Nuremberg, his health, which had not been good for several years, worsened. However, he did not reduce his work schedule, but instead added to it by working on a treatise on proportion to be shared with the German artists.

Although he completed the work in 1523, Dürer realized that to understand it required far more mathematical knowledge than most artists of the day possessed. He was determined to write a more elementary text. He published his treatise *Unterweisung der Messung mit dem Zirkel und Richtscheit* (*Instruction in Measuring with Compass and Straightedge*) in four books in 1525. This primarily geometric work was the first mathematics book, with the exception of commercial arithmetic texts, published in German. The first part described the construction of geometric curves. In the second Dürer gave exact and approximate methods of constructing regular polygons with 5, 7, 9, 11, and 13 sides. He also gave approximate methods to square a circle and to trisect an angle using ruler and compass constructions. Book three was a study of solid bodies such as pyramids and cylinders. It also included studies of sundials and other astronomical instruments. The final book dealt with the five Platonic solids as well as the semi-regular Archimedean solids. It also featured Dürer's theory of shadows and an introduction to the theory of perspective.

In learning mathematics to enhance his craft as an artist, Dürer also advanced mathematics itself. He

was among the first to study space curves. He started with helical space curves and considered the projection of them onto a plane. The projections are various types of spirals that he showed how to construct. He introduced the epicycloids, which is the locus of a point on a circle that rolls on the outside of a fixed circle. He also studied the orthogonal projection of curves and of human figures on two and three mutually perpendicular planes. These studies were the origins of descriptive geometry, which would be more thoroughly developed in the late eighteenth century by Gaspard Monge.

**Quotation of the Day:** “Geometry is the right foundation of all painting.”– Albrecht Dürer