

**THE HISTORY OF THE DEVELOPMENT OF
PERSPECTIVE SCIENCE**

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Abstract: *This article scientifically examines the history of the development of perspective science from ancient times to the present day. The theoretical foundations of perspective, its significance in art and architecture, as well as research conducted by foreign and Uzbek scholars are analyzed. The article demonstrates the state of perspective science in various historical periods and its interrelationship with geometry and optics.*

Keywords: *perspective, linear perspective, aerial perspective, projection, art history, renaissance, geometric optics, fine arts.*

Perspective is the art and science of depicting three-dimensional space on a two-dimensional surface. This discipline has been interpreted and developed differently at various stages of human civilization. Although the scientific foundations of perspective began to be established in ancient Greece, its complete theoretical system was developed by the artists and scholars of the Renaissance. Today, perspective holds an important place not only in fine arts, but also in engineering graphics, architecture, design, and digital technologies.

The study of perspective science is closely linked to human visual perception, the phenomena of light and shadow, and the laws of geometry. This article examines the historical formation and stages of development of perspective science in chronological order, and analyzes the contributions of prominent scholars in the field. The relevance of this topic lies in the fact that

the laws of perspective have not lost their fundamental importance even in today's digital age.

The earliest knowledge about perspective dates back to the 6th–5th centuries BCE. In ancient Greece, the philosopher and mathematician Euclid (approximately 300 BCE) was the first to mathematically substantiate the laws of visual rays and the way objects appear to the eye in his famous work “Optics.” Euclid introduced the concept of the cone of visual rays emanating from the eye and provided a geometric proof that the farther an object is, the smaller it appears (Euclid, 1945).

The Roman architect Vitruvius (c. 80-15 BCE) mentioned the use of perspective representation in stage scenery in his work “De Architectura.” Frescoes discovered in Pompeii demonstrate that ancient master painters were familiar with basic rules of perspective (Panofsky, 1991). However, perspective in this era was applied empirically - based on practical experience - and had not yet attained a fully developed theoretical system.

During the Middle Ages (5th-14th centuries), perspective science retreated in Western art as theological purposes took precedence. In Byzantine and European iconography, the size and placement of figures were determined by symbolic meaning: holy figures were depicted large, ordinary people small. In the Near East and Central Asia, however, science continued to advance. The great scholar Ibn al-Haytham (965-1040) correctly explained the structure of the eye and the mechanism of vision in his “Kitab al-Manazir” (“Book of Optics”), written in Egypt. His research later served as an important source for Renaissance scholars (Lindberg, 1976).

The true scientific system of perspective was created in Italy during the Renaissance - the 14th to 16th centuries. In this era, art and science came into harmony. The Florentine architect Filippo Brunelleschi (1377-1446) was the first to demonstrate a practical method of linear perspective around 1413-1420: he depicted the Florence Baptistery in such a way that when the image was

compared with the actual building using a mirror, they matched perfectly. This experiment became a turning point in the history of perspective (Vasari, 1568).

The theoretical foundation of perspective was created by the architect and writer Leon Battista Alberti (1404-1472) in his book “Della Pittura” (“On Painting”), written in 1435. Alberti introduced the concept of the “visual pyramid” and described a painting as the plane that cuts through this pyramid. He was the first to set forth the mathematical rules of perspective construction in the form of a practical manual for painters. Alberti's method entered the pages of history under the name “costruzione legittima” (legitimate construction) (Alberti, 1991).

The greatest genius of the Renaissance, Leonardo da Vinci (1452-1519), scientifically established a new type of perspective – “aerial perspective” (prospettiva aerea). He explained that the color of distant objects takes on a bluish hue and their outlines become hazy due to the effect of the atmosphere. In his “Treatise on Painting,” Leonardo distinguished three types of perspective: linear perspective (the diminishing of forms), color perspective, and perspective of definition (Leonardo da Vinci, 1956). His works “The Last Supper” and “Mona Lisa” are considered perfect practical expressions of these rules.

The German painter Albrecht Durer (1471-1528) brought perspective to Northern Europe. His work “Instruction in Measurement with Compass and Ruler,” published in 1525, describes in detail the mechanical methods of perspective construction. Durer also invented the “Durer veil” - a perspective grid device for drawing (Durer, 1525).

In the 17th century, the mathematical foundations of perspective were studied in greater depth. The French mathematician Girard Desargues (1591-1661) is recognized as one of the founders of projective geometry. His 1639 work “Rough Draft on the Events of Sections” laid out the fundamental concepts of projective geometry. Desargues formally expressed the concepts of

“point at infinity” and “horizon line” in the language of mathematics (Field & Gray, 1987).

In the 17th century, the discovery of the Cartesian coordinate system by Rene Descartes (1637) elevated geometric representation to a new level. This discovery made it possible to calculate perspective projections using algebraic methods. During the same period, the English mathematician Brook Taylor (1685–1731) wrote “Linear Perspective” (1715). Taylor fully generalized perspective theory and demonstrated its unification with measurement geometry (Taylor, 1715).

In the 18th century, the French scholar Gaspard Monge (1746–1818) established descriptive geometry as an independent scientific field. His 1798 work “Descriptive Geometry” systematized the methods of representing objects in two planes for the purposes of engineering and architecture. This science later became the foundation of engineering graphics and constructive geometry (Monge, 1811).

In the 19th century, descriptive geometry began to be taught as an independent academic subject at European universities. The invention of photography (1839) connected the laws of perspective with new technologies: the camera lens precisely obeys the rules of linear perspective. During the same period, the German philosopher and psychologist Wundt (1832–1920) studied perspective from the standpoint of visual psychology and scientifically analyzed problems of perceptual perspective.

In the 20th century, new scientific viewpoints were added to perspective science. Erwin Panofsky (1892-1968), in his fundamental 1927 study “Perspective as Symbolic Form”, interpreted perspective not merely as a technical method, but as a symbolic system expressing the worldview of a particular culture. He demonstrated that perspective representation in artworks differed across various historical periods and linked this to each era's relationship to space (Panofsky, 1991).

Rudolf Arnheim (1904-2007), in his work “Art and Visual Perception” (1954), studied the relationship between Gestalt psychology and perspective and scientifically grounded how the eye perceives perspective. With the advent of the digital age, perspective projections in graphics and computer graphics began to be expressed using matrix algebra. The pioneering work in this direction was carried out by Ivan Sutherland between 1963 and 1968, laying the foundation for modern 3D graphics systems (Sutherland, 1968).

Uzbek fine art scholars and educators have accomplished important work in the study and teaching of perspective science. The great Central Asian scholar Abu Rayhan Beruni (973-1048) examined matters of spatial representation in his works “Geodesy” and “Mineralogy”. The presence of ideas about optical phenomena and the laws of vision in his scientific legacy attests to the existence of scientific traditions regarding perspective science in Central Asia (Beruni, 1973).

During the years of independence, a number of scientific works devoted to perspective science were created by Uzbek scholars. R.H.Khasanov was the first to fully expound linear and aerial perspective in the Uzbek language in his textbook “Perspective and Reflection” (2003). This work served as a methodological foundation for Uzbek fine arts education. His research developed a national methodology for teaching the rules of perspective (Khasanov, 2003).

Research conducted by T.M.Mirzaev and his colleagues examined the issues of enriching perspective instruction with modern methods and pedagogical technologies. Dissertations on the methodology of teaching perspective science have been defended at higher educational institutions such as the National University of Uzbekistan and Chirchiq State Pedagogical University. These works examine the relationship between perspective techniques in folk applied arts and academic perspective (Mirzaev et al., 2018).

Furthermore, researchers have recognized the skillful use of perspective effects in the patterns and ornamentation applied to the magnificent structures in Samarkand, Bukhara, and Khiva - hallmarks of Uzbek architectural tradition. This demonstrates that the rules of perspective were also applied in the applied arts of Central Asia (Pugachenkova, 1994).

The history of the development of perspective science is directly linked to the history of the refinement of humanity's methods of perceiving and depicting the world. From the mathematics of ancient Greece, through Ibn al-Haytham's discoveries in the field of optics, the theoretical foundations of Brunelleschi and Alberti, Leonardo da Vinci's doctrine of aerial perspective, and the mathematical contributions of Desargues and Monge - all of these have played a decisive role in the formation of this discipline.

Today, the laws of perspective are widely applied not only in traditional fine arts, but also in computer graphics, virtual reality, cinematography, and architectural design. Uzbek scholars and educators, meanwhile, continue to contribute to the creation and development of national methodology in this field. In the future, the advancement of artificial intelligence and digital technologies is expected to open new opportunities and directions for perspective science.

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