Leonardo da Vinci

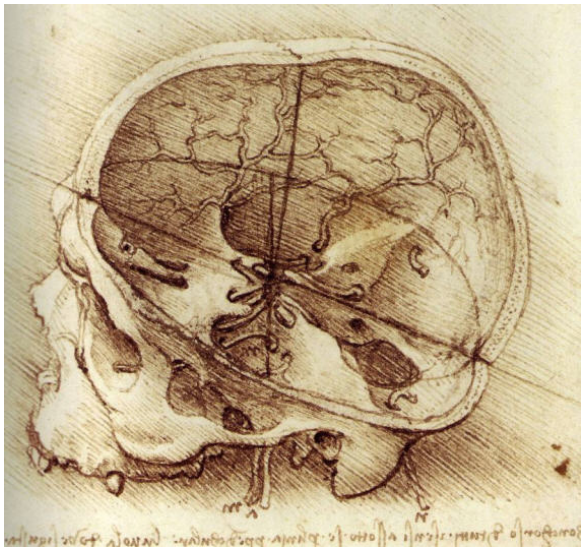
Leonardo da Vinci *(1452-1519) is remembered by posterity as the quintessential "Renaissance Man"—painter, architect, sculptor, engineer, inventor, writer, musician…there was seemingly no endeavor in which he showed himself to be anything short of exceptional. His paintings are today among the most well-known and iconic works of Western art. His fame as a painter was tremendous in his own day, and also primarily how history remembered him until the late nineteenth century when his notebooks, containing thousands of engineering drawings, were rediscovered in the dusty archives of Europe. Thus, his reputation as a multi-talented genius, which he held in his own day, was lost in the centuries that followed his death and recovered in fairly recent times.*

Leonardo was born in the village of Vinci, about 20 miles from Florence on the road to Pisa. He was the illegitimate child of a Florentine notary, Ser Piero, and a woman of lower social standing named Caterina. Piero eventually took the young Leonardo into his household and legitimized him. Beginning life in humble circumstances, Leonardo did not enjoy the formal education that many of his famous contemporaries had, and struggled later in life to master Latin and mathematics. His family moved to Florence when Leonardo was around sixteen years of age, arriving just as the Italian Renaissance was emerging into its full maturity.

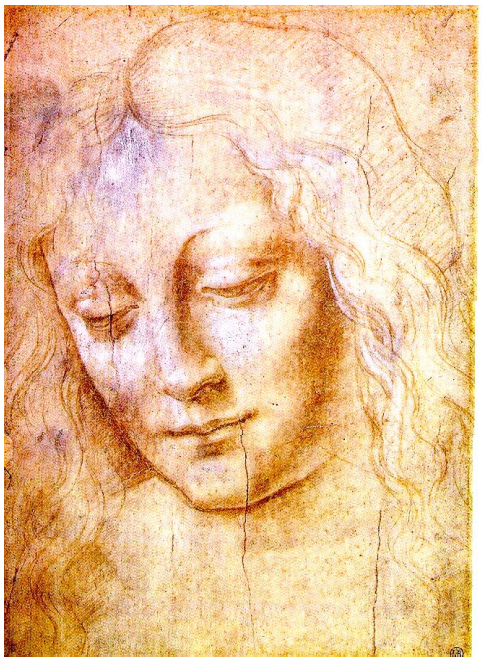
It would have been typical for Leonardo to follow his father (and grandfather) into the family business and become a notary. It is to his father's credit that he recognized the artistic talents of his son and had him apprenticed to Andrea del Verrocchio, one of the most celebrated artists in Florence and a favorite of the ruling Medici family. Here the young Leonardo learned the skills that the previous two generations of painters had developed, and his connection to the Medici allowed him access to their much-admired collection of classical sculpture where he could be inspired by the art of Antiquity. By his late twenties he was a licensed master, able to take commissions and train students of his own.

Leonardo's life was a restless one, due both to his own nature and to the vicissitudes of Italian politics in the fifteenth century. Moving from Florence to Milan, with brief stays in Venice and Rome, sometimes fleeing foreign invasions and sometimes his own creditors, Leonardo finally ended his days in Amboise, France, under the comfortable patronage of King Francois I.

Leonardo da Vinci embraced, more fully perhaps than anyone else of his period, the Renaissance desire to reexamine every aspect of the world around him and to understand it in a rational, scientific manner. He was not content to merely copy the works of his master, or even the beautiful collection of antiquities in the Medici gardens—to make his painted figures as true-to-life as possible, he dissected human cadavers (over 30 of them) over the course of his life, and made the most careful and accurate drawings of human anatomy that had ever been made. Today, these look as though they could be illustrations in an anatomical textbook.



Finding the manner of rendering figures in light and shade of his day ("chiaroscuro") clumsy, he refined the technique, eliminating all harsh outlines and producing the most gentle gradations from light to shadow in a technique that art historians call "sfumato" (Italian for "smoky"). Indeed, once Leonardo had raised the bar on the techniques of realism, other painters had to either match him, or resign themselves to obscurity.



And Leonardo did far more than paint. As evidenced by his many surviving notebooks filled with thousands of technological drawings, Leonardo really preferred engineering. These drawings are not, as most think, evidence of a unique genius inventing the modern world ahead of his time, but a reflection of his involvement with the many ambitious engineers of his day from whom he eagerly absorbed the principles of mechanics, hydraulics, civil and military engineering. This was a tradition that stretched back to the medieval builders of mills, trebuchets and cathedrals, and to other restless engineers like Villard de Honnecourt. Leonardo was certainly a brilliant engineer, but he was one of many in the Italy of his day.

Like many of his contemporary artists, Leonardo dedicated himself to making a science of art, and wrote a treatise on the subject that displays both his own knowledge of the techniques of Renaissance painting, and the mental habits of Renaissance humanists, scientists and emerging modernity.

Leonardo da Vinci's "Treatise on Painting"

"Let no one who is not a mathematician read my works."

Knowledge, Learning & Experience

I know that many will say that this is a useless work, and these people will be those of whom Demetrius said that he took no more account of the wind from their mouths, which caused their words, than of the wind which issued from their lower regions. These men possess a desire only for material wealth and are entirely devoid of the desire for wisdom, which is the sustenance and truly dependable wealth of the mind.

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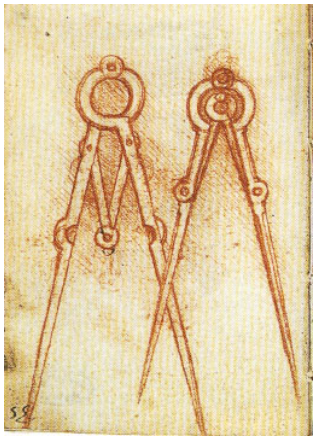
Anyone who argues on the basis of authority does not exploit his insight but his memory. Good writing is born of a good natural understanding, and since the cause is to be praised rather than the effect, you should praise natural understanding without bookish learning rather than bookish learning without understanding. Many will believe that they can reasonably reproach me, alleging that my proofs go against the authority of those men held in greatest reverence by those of inexpert judgment, not considering that my works are born of simple and pure experience, which is the true mistress. This gives the rules by which you are able to distinguish the true from the false, and enable men to strive towards what is possible with more discrimination, and not to wrap themselves in ignorance. …



These rules will enable you to possess a free and good judgment, since good judgment is born of good understanding, and good understanding derives from reason expounded through good rules, and good rules are the daughters of good experience—the common mother of all the sciences and arts. Experience does not err, but rather your judgments err when they hope to exact effects that are not within her power. Men wrongly complain of experience, which with great abuse they accuse of falsity, but let experience be, and turn such complaints against your own ignorance which causes you to be carried away by vain and foolish notions. They say that knowledge born of experience is mechanical but that knowledge born and ending in the mind is scientific, and that knowledge born in science and ending in manual operations is semi-mechanical, but to me it appears that those sciences are vain and full of error that have not been born of experience, mother of every certainly, and which do not likewise end in experience; that is to say, those that have neither at their beginning, middle or end passed through any of the five senses.

True sciences are those which have penetrated through the senses as a result of experience and thus silencing the tongues of disputants, not feeding investigators on dreams but always proceeding successively from primary truths and established principles, in proper order towards the conclusion. This may be witnessed in the principles of mathematics. Here no one hazards guesses as to whether two threes make more or less than six, or whether the angles of a triangle are less than two right angles. Here all guess work remains destroyed in eternal silence, and these sciences are enjoyed by their devotees in peace, which is not possible with the delusory sciences of a wholly cerebral kind.

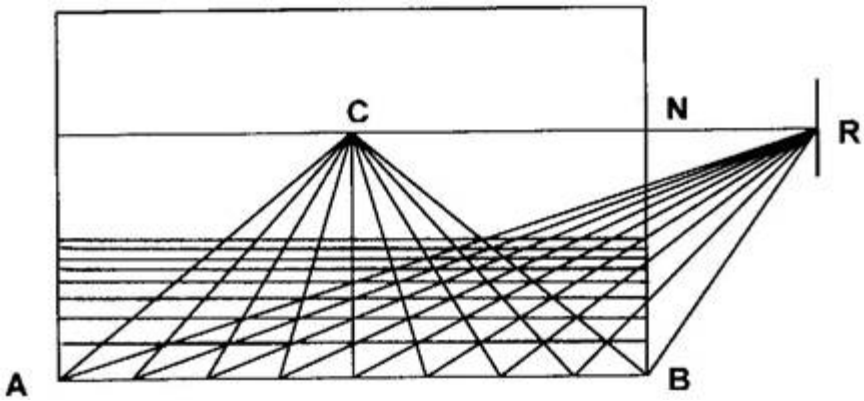
THE PAINTER'S PRACTICE

How painting falls into decline and deteriorates through the ages when painters have no other authority than existing works

The painter will produce pictures of little excellence if he takes other painters as his authority, but if he learns from natural things he will bear good fruit. We saw this in the painters who came after the Romans. They always imitated each other and their art went ever into decline from one age to the next. After these came Giotto the Florentine who was not content to copy the works of his master Cimabue. Born in the lonely mountains inhabited only by wild goats and other beasts, and being inclined by nature to such art he began to copy upon the stones the movements of the goats whose keeper he was. And thus he began to copy all the animals to be found in the countryside in such a way that after much study he surpassed not only the masters of his age but all those of many centuries before. After this, art fell back into decline, because everyone copied the pictures that had already been done, and thus from century to century the decline continued until Tomaso the Florentine, nicknamed Masaccio, showed to perfection in his wok how those who take as their authority any other than nature, mistress of the masters, labor in vain. … O, the arch stupidity of those that reprove men who study from nature, leaving aside the authorities who were themselves followers of nature.

How the mirror is the master of painters.

When you wish to see whether your whole picture accords with what you have portrayed from nature, take a mirror and reflect the actual object in it. Compare what is reflected with your painting and carefully consider whether both likenesses of the subject correspond, particularly in regard to the mirror. You should take the mirror as your master, that is a flat mirror, because on its surface things in many ways bear a resemblance to a painting. That is to say, you see a picture which is painted on a flat surface showing things as if in relief: the mirror on a flat surface does the same. The picture has but one surface and the mirror the same. And if you recognize that the mirror by means of outlines and shades and lights makes things appear to stand out, you, who have among your colors stronger light and shade than those in the mirror, will certainly, if you know how to put them together well, make your picture, also, look like something from nature seen in a large mirror.



Perspective diagram of a tiled floor

THE SCIENCE OF ART

He who despises painting loves neither philosophy nor nature

If you scorn painting, which is the sole imitator of all the manifest works of nature, you will certainly be scorning a subtle invention, which with philosophical and subtle speculation considers all manner of forms: sea, land, trees, animals, grasses, flowers, all of which are enveloped in light and shade. Truly this is science, the legitimate daughter of nature, because painting is born of that nature; but to be more correct, we should say the granddaughter of nature, because all visible things have been brought forth by nature and it is among these that painting is born… therefore we may justly speak of it as the granddaughter of nature and as the kin of God.

Why painting is not numbered amongst the sciences

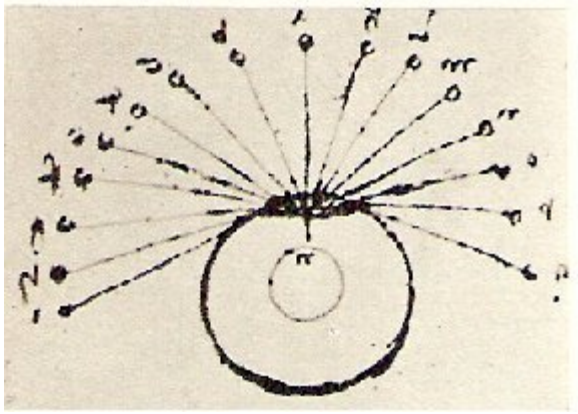
Because writers had no access to definitions of the science of painting, they were not able to describe its rank and constituent elements. Since painting does not achieve its ends through words, it is placed below the … sciences through ignorance, but it does not on this account lose its divinity. And in truth it is not difficult to understand why it has not been accorded nobility, because it possesses nobility in itself without the help of the tongues of others – no less than do the excellent owrks of nature. If the painters have not described and codified their art as science, it is not the fault of painting, and it is none the less noble for that. Few painters make a profession of writing since their life is too short for its cultivation. Would we similarly deny the existence of the particular qualities of herbs, stones or plants because men were not acquainted with them? Certainly not. We should say that these herbs retained their intrinsic nobility, without the help of human language or writings.

What is the first intentional aim of the painter?

The first intention of the painter is to make a flat surface display a body as if modeled and separated from this plane, and he who most surpasses others in this skill deserves most praise. This accomplishment, with which the science of painting is crowned, arises from light and shade, or *chiaroscuro* [kee-**år**-uh-**skyur**-o]. Therefore, whoever fights shy of shadow fights shy of the glory of art as recognized by noble intellects, but acquires glory according to the ignorant masses, who require nothing of painting other than beauty of color, totally forgetting the beauty and wonder of a flat surface showing relief.

INTRODUCTION TO PERSPECTIVE

The Nature of Light and Vision



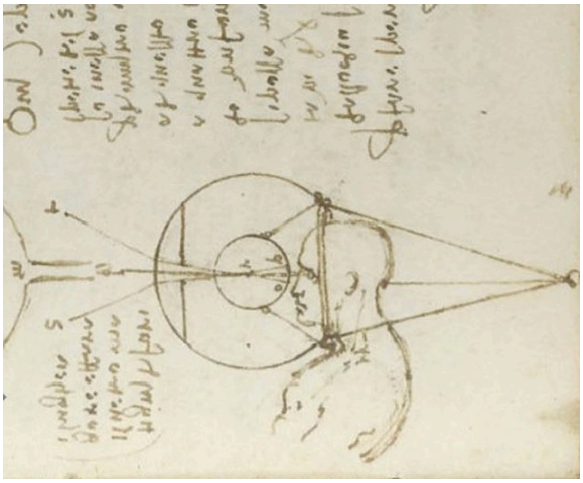
Leonardo: study of how light enters the eye

Now, take note reader, something of which we cannot believe our ancient predecessors, who have wished to define the nature of the soul and life – things beyond proof – whereas those things which at any time can be clearly known and proved by experience have for so many centuries been unknown or falsely conceived. The eye, the function of which is thus clearly shown by experience, has, until my own time, been defined by innumerable writers in one way; I find by experience that it is different!

In the eye, the shapes, the colors, all the images of the parts of the universe are reduced to a point, and this point is such a marvelous thing! O wonderful, O marvelous necessity, you constrain with your laws all the effects to participate in their causes in the most economical! These are miracles… In so small a space the image may be recreated and recomposed through its expansion. In this way, clear and immediate effects can arise from confused origins, like the images which have passed through the aforesaid natural point.

The eye sees in no other way than by a pyramid. The body of the air is full of an infinite number of radiant pyramids caused by the objects located in it. These pyramids intersect and interweave without interfering with each other during their independent passage through the air in which they are infused. They are of equal power, and all can be equal to each and each equal to all. The semblance of a body is carried by them as a whole into all parts of the air, and each smallest part received into itself the image that has been caused.

Immediately the air is illuminated. It is filled with an infinite number of images which are caused by various bodies and colors located within it. They eye becomes the target and the magnet of these images. It is impossible that the eye should send the power of vision outside itself through visual rays, because, on opening that front part of the eye which would have to be the source of their departure, the power of vision could not reach out to the object without a lapse of time. This being so, it could not climb in a month to the height of the sun, when the eye wished to see it. …



INTRODUCTION TO PERSPECTIVE

The Three Parts of Perspective

The painter who copies by practice and judgment of the eye, without rules, is like a mirror which imitates within itself the things placed before it without any understanding of them.

Perspective, with respect to painting, is divided into three principle parts, of which the first is the diminution in the size of bodies at various distances; the second part is that which deals with the diminution in color of these bodies; the third is the diminution in distinctness of shapes and boundaries which the bodies exhibit at various distances. Of these three perspectives, the first has its foundation in the eye, while the other two are derived from the air interposed between the eye and the objects seen by the eye. …

Geometry & Linear Perspective

Perspective is a rational demonstration by which experience confirms that all things send their semblance to the eye by pyramidal lines. Bodies of equal size will make greater or lesser angles with their pyramids according to the distances between one and the other. By pyramidal lines I mean those which depart from the surface edges of bodies and traveling over a distance are drawn together towards a single point.

All the instances of perspective are expounded through the five terms of the mathematicians, namely point, line, angle, surface and body. The point is unique of its kind: the point has neither height nor breadth nor length nor depth, and, hence, it is to be concluded that it is indivisible and occupies no space. Line is of three

Drawings to illustrate perspective studies by Albrecht Dürer, a German artist of the sixteenth century who traveled to Italy to learn the techniques of the Italian Renaissance. His treatise on painting introduced the "Italian style" of art to the northern regions of Europe.

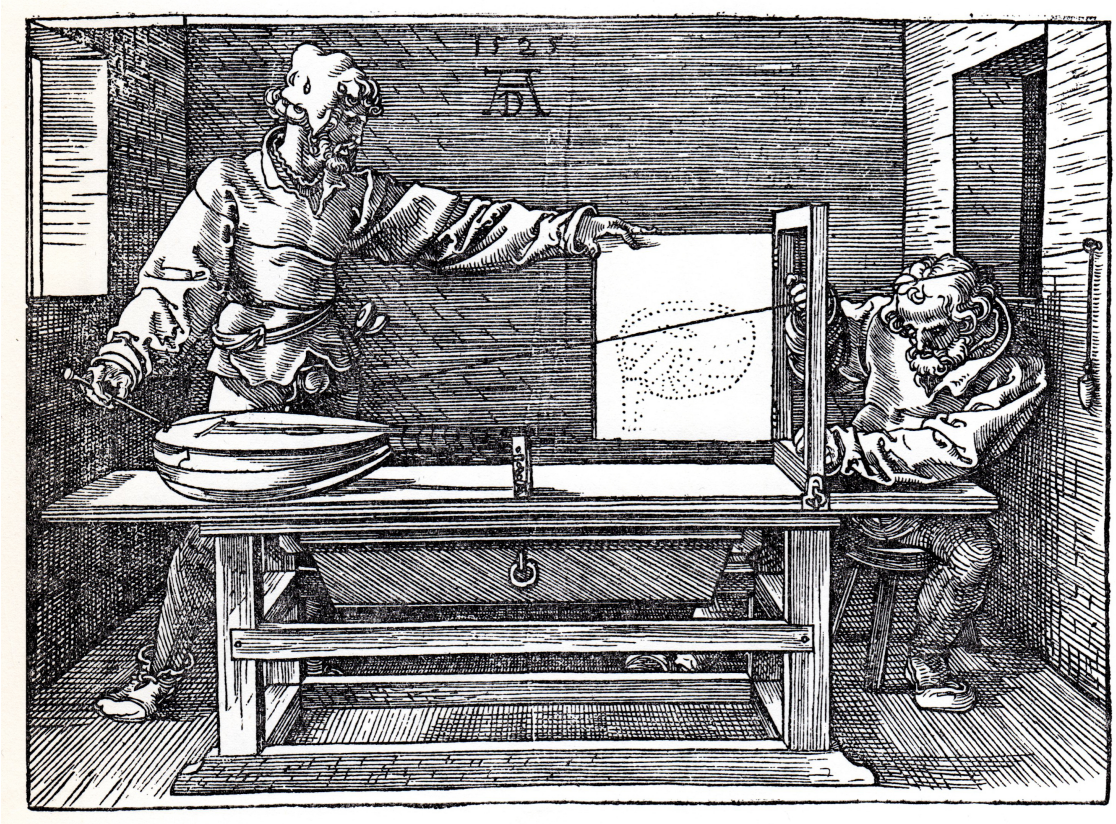
INTRODUCTION TO PERSPECTIVE

types, namely straight, curved and sinuous, and has neither breadth nor height nor depth, and hence, is indivisible except in its length; it ends are two points. Angle is the termination of two lines at a point. The surface is the boundary…and the boundary of a body is not part of that body…and the boundary of one body is the start of another. … But the lateral boundaries of these bodies is the boundary line of the surface, which as a line is indivisible. Therefore, painter, do not surround your bodies with drawn lines, above all when representing objects smaller than they are in nature. For these objects will not exhibit their lateral boundaries, nor will their component parts be visible from a distance.

oooooooooo

If the eye is in the middle between the tracks of two horses which are running towards their goal along parallel tracks, it will seem to you that they are running to meet each other. This happens because the images of the horses which impress themselves on the eye are moving towards the center of its surface, that is, the pupil of the eye.

With respect to the point in the eye, this will be more easily understood as follows: if you look at someone's eye, you will see your image reflected; now if you imagine two lines starting from your ears and running to the ears of the semblance of yourself that you see in the other person's eye, you will understand that these lines are arranged in such a way that a little behind your reflected image they would subsequently come together in a point.



THE HUMAN BODY

On the Measurements of the Human Body

Vitruvius, the architect, has it in his work on architecture that the measurements of man are arranged by nature in the following manner: four fingers make one palm and four palms make one foot; six palms make a cubit; four cubits make a man, and four cubits make one pace; and twenty-four palms make a man; and these measures re those of his buildings.

If you open your legs so that you lower your head by one-fourteenth of your height, and open and raise your arms so that with your longest fingers you touch the level of the top of your head, you should know that the central point between the extremities of the outstretched limbs will be the navel, and the space which is described by the legs makes an equilateral triangle. … The span to which the man opens his arms is equivalent to his height.

[*see image next page*]

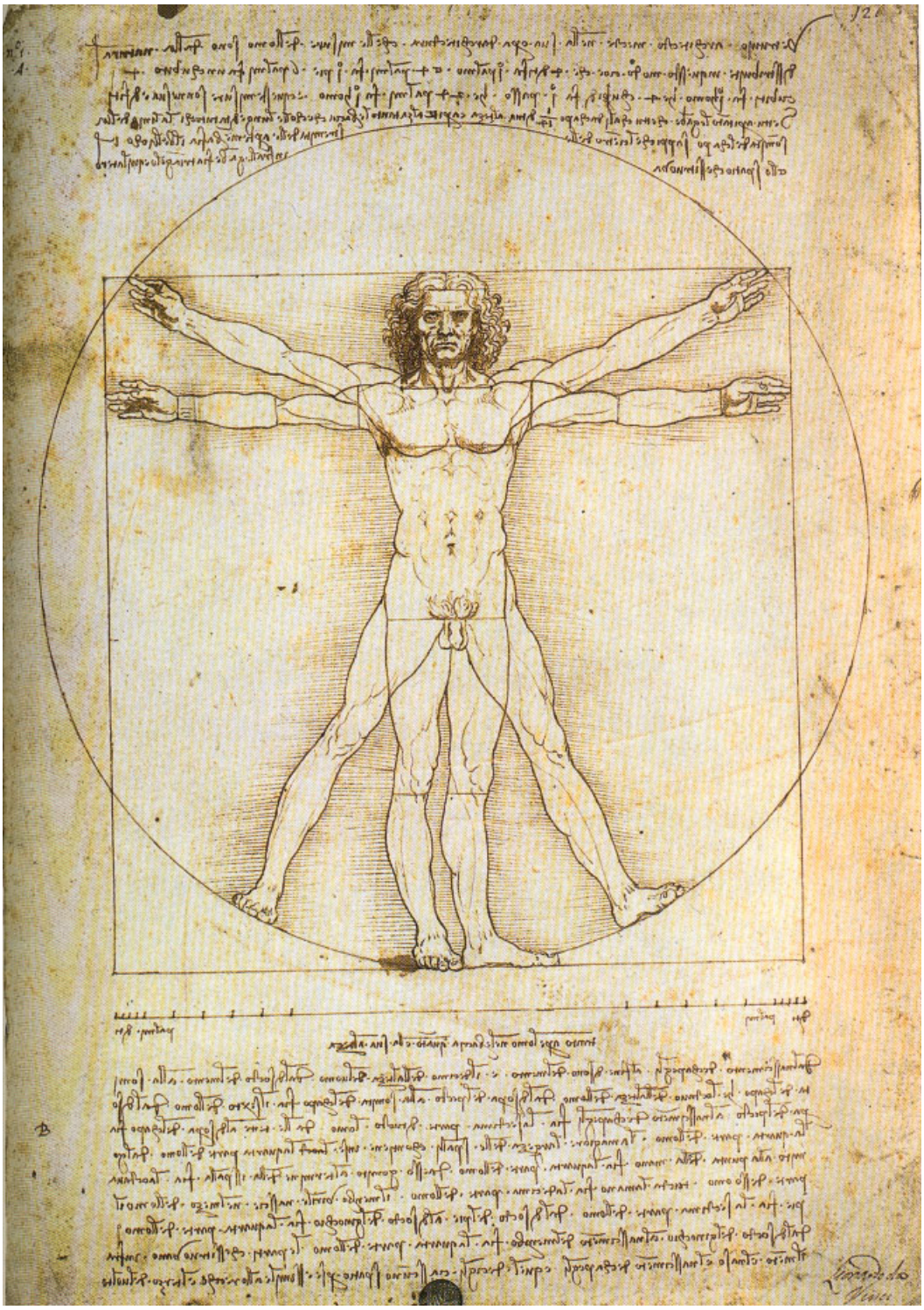
How the painter has to paint two things: man and his mind

The good painter has to paint two principle things, that is to say, man and the intention of his mind. The first is easy and the second is difficult, because the latter has to be represented through gestures and movements of the limbs—which can be learned from the deaf, who exhibit gestures better than any other kind of man. Do not laugh at me because I propose an instructor without speech, who is to teach you an art of which he is unaware, because he will teach you better through what he actually does than others can through their words. And do not despise such advice, because the deaf are the masters of movements and understand what one says from a distance when one accommodates the motions of the hands to the words.

The movement which is depicted must be appropriate to the mental state of the figure. It must be made with great immediacy, exhibiting in the figure great emotion and fervor, otherwise this figure will be deemed twice dead, inasmuch as it is dead because it is a depiction, and dead yet again in not exhibiting motion either of the mind or of the body. … Vary the air of faces according to the states of man—in labor, at rest, enraged, weeping laughing, shouting, fearful, and suchlike. And, in addition, the limbs of the person together with his whole posture should correspond to the altered features.

The Representation of Women

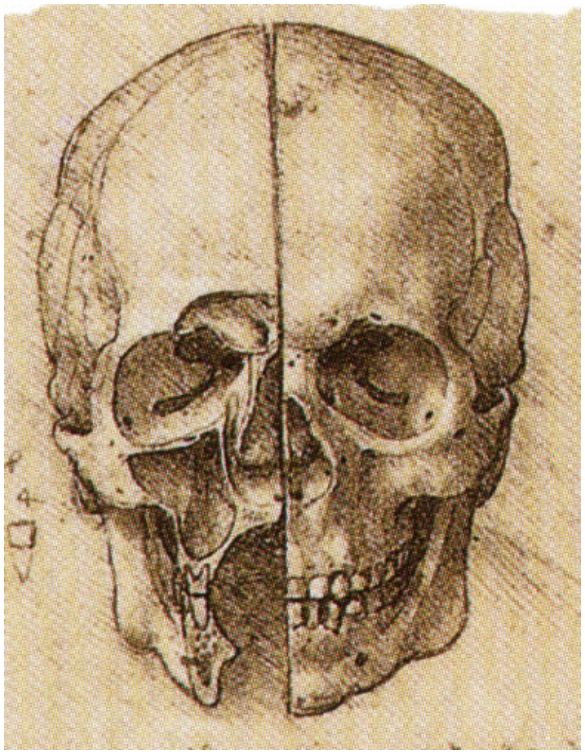
Women should be represented with demure actions, their legs tightly closed together, their arms held together, their heads lowered and inclined to one side. In women and girls there must be no actions where the legs are raised or too far apart, because that indicates boldness and a general lack of shame, while legs closed indicate the fear of disgrace.

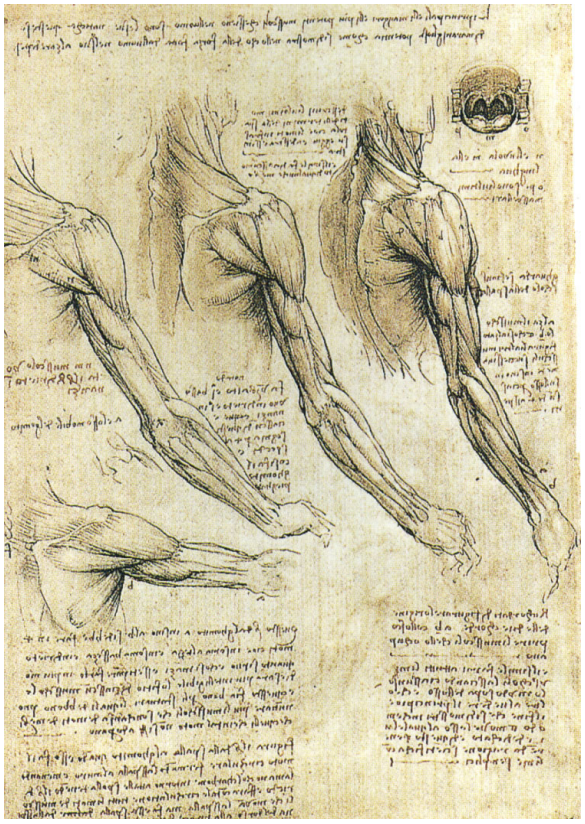


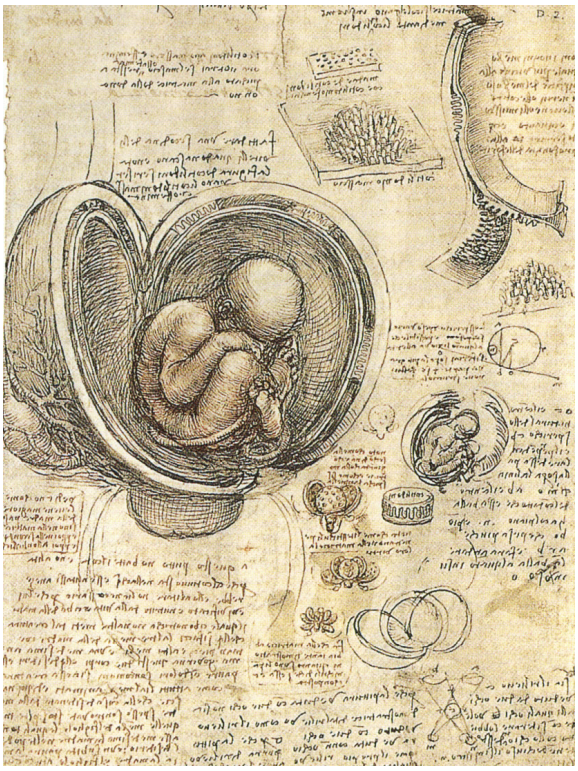
The Study of Human Proportions according to Vitruvius

The "Vitruvian Man" is one of Leonardo's most iconic drawings. Like most of his contemporaries, he studied the ancient Roman architect, Vitruvius [fl. 25 B.C.], for clues to the restoration of the ancient achievements in the arts.

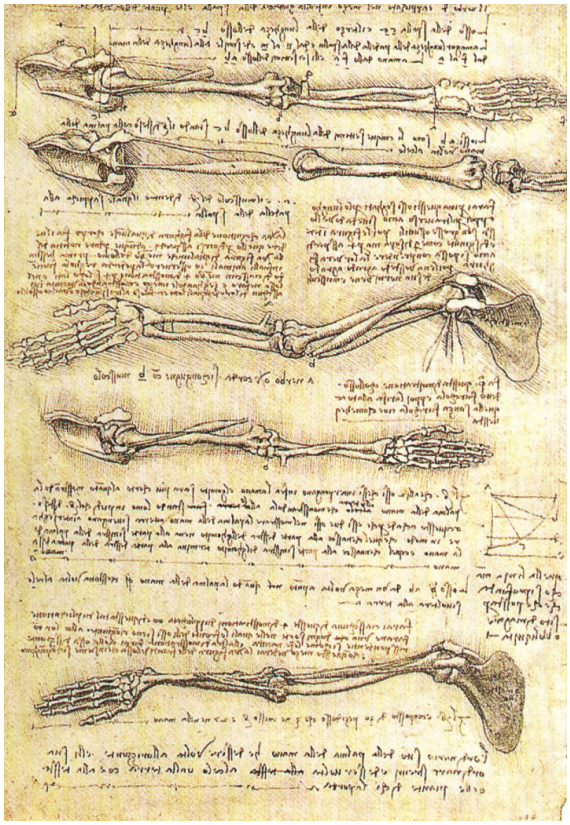
Leonardo da Vinci: Anatomical Studies

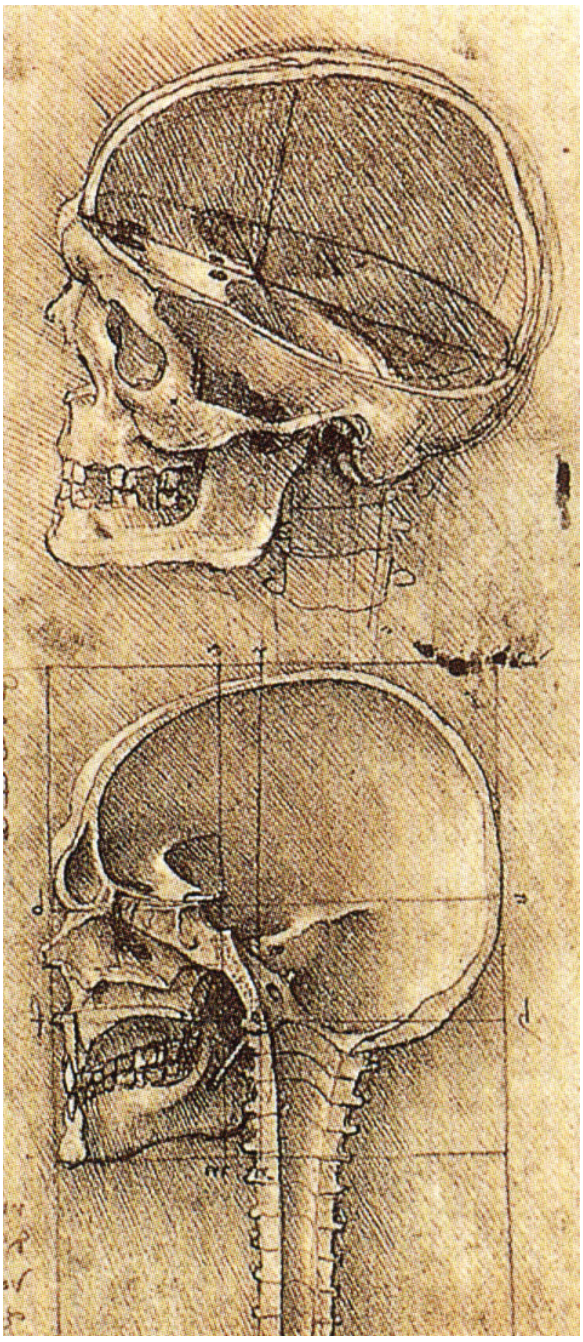


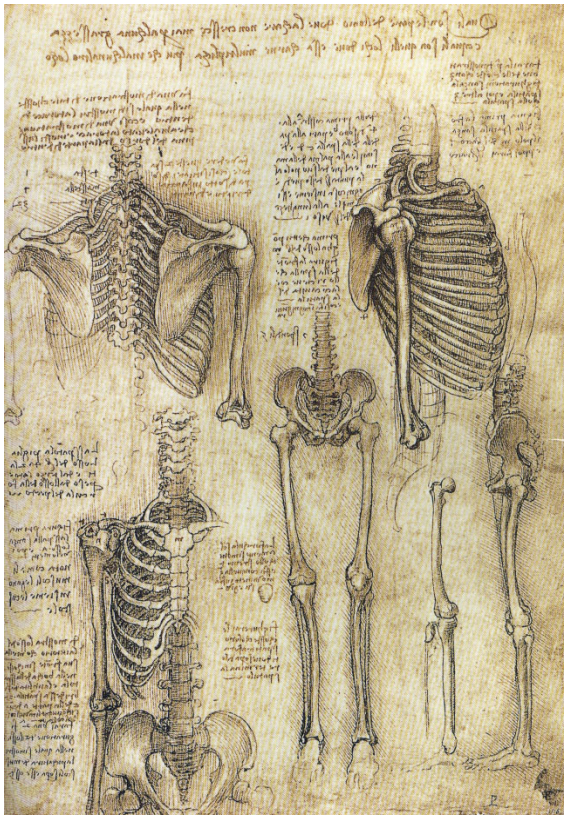




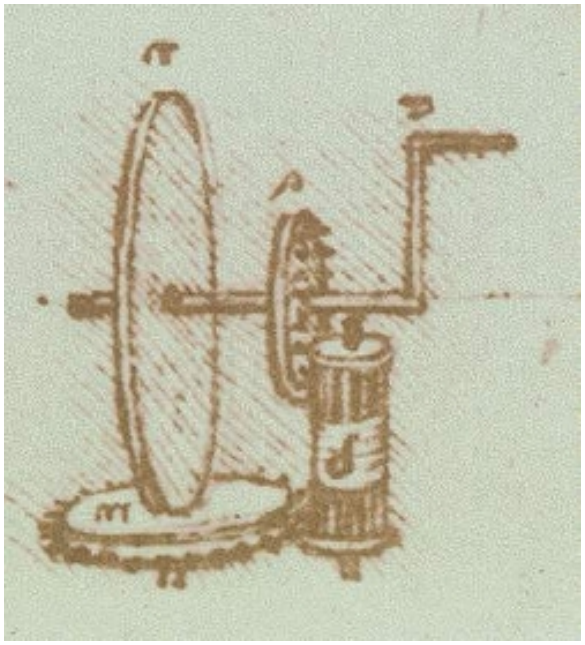
Leonardo da Vinci: Anatomical Studies



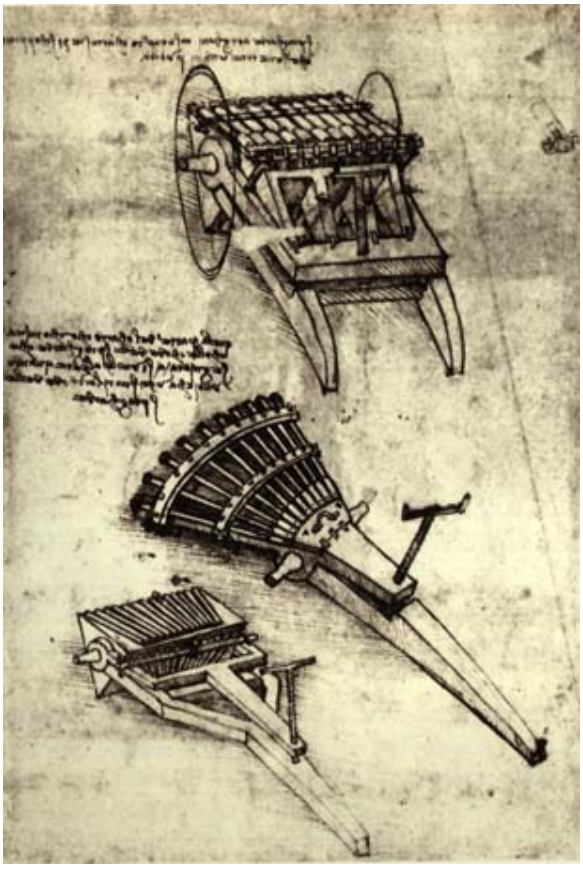




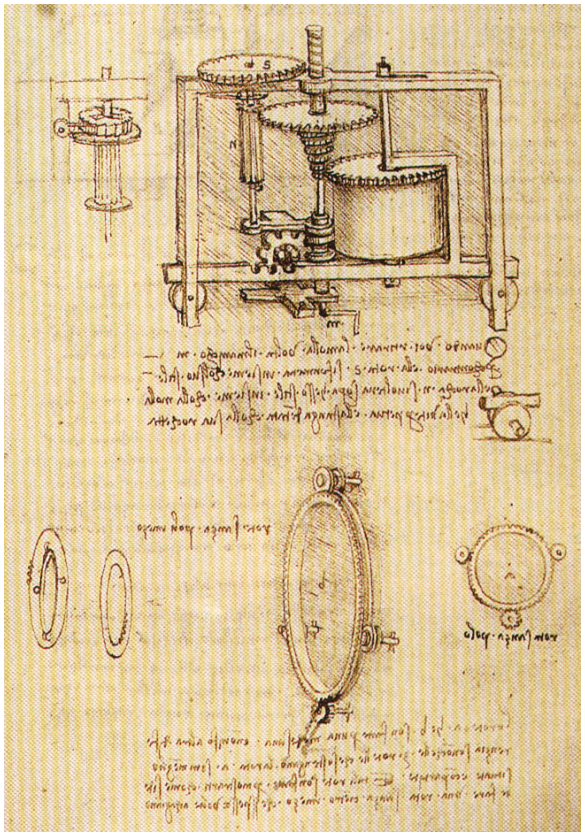
Leonardo da Vinci: Mechanical Drawings



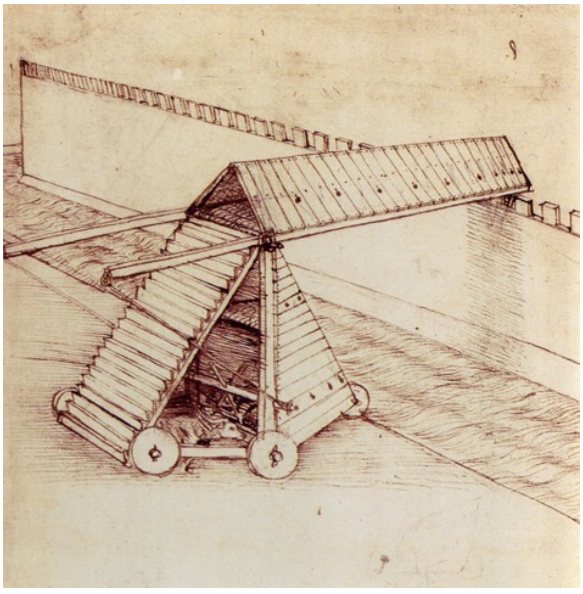
Lens Grinder



Multiple Barrel Firearms

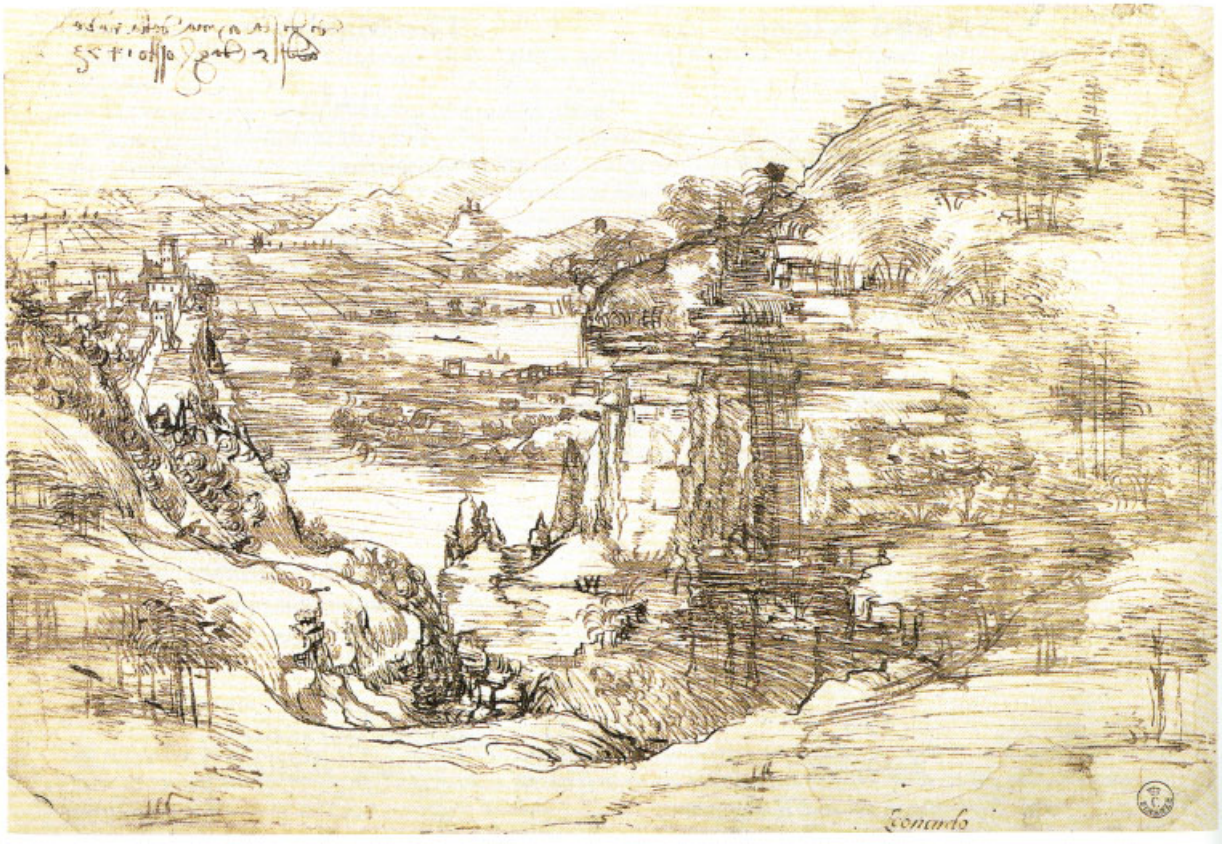


Clock Mechanisms



Mobile Siege Tower

Leonardo da Vinci: Depictions of the Natural World



Leonardo's earliest known drawing is this landscape of the village of Vinci

Leonardo da Vinci: Caricatures, Monsters & Whimsy

Leonardo da Vinci: Studies for Flying Machines