

## Leonardo da Vinci (1452–1519) A Modern Scientist

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In our previous 2 publications, the reader learned about, and I was almost certainly astonished by, the revolutionary studies on the cardiovascular system conducted by Leonardo, and their clinical implications.

In his accomplishment, Leonardo may look distant, un-touchable, almost unreal. Probably, one could get even more impressed by the problems Leonardo had to overcome, when his ideals and horizons had to face the narrow road of everyday life. I would like to call attention to the difficulties he encountered as an innovator: His life offers a lesson to all who find themselves in difficulties related to new ideas, either in medicine or everyday life.

Leonardo was the illegitimate son of Ser Piero, a rich notary in Florence. He was raised almost as a clandestine in a small village near Florence. A priest and his uncle took care of the education of Leonardo. In regular schools, which Leonardo could not attend, students were not allowed to use the left hand for writing and all students were obliged to use the right hand. Conversely, Leonardo was allowed to freely use his left hand, writing from right to left. Leonardo did not have the opportunity to study Latin or Greek, so he could not read all the major textbooks of the time, which were written in Latin, including the Anatomy by Galen. Leonardo often described himself as "... omo senza lettera ... (a man without education)." In such a way, he was not influenced and contaminated by contemporary knowledge, full of superstition and errors of the past. Leonardo received an alternative form of education and took advantage of it.<sup>1-3</sup>

Leonardo had continuous economic problems. His 10 step-brothers and his 2 step-sisters, legitimate children of Ser Piero, excluded him from the rich inheritance they received. In the difficult political scenario of contemporary Italy, with many small states, not rarely in contrast and often at war with each other, Leonardo had to move from city to city. Local princes changed continuously and Leonardo was offered several opportunities, in which he always expressed his ambition to move towards the horizons of the future.

Leonardo was a painter, sculptor, architect, scientist, mathematician, poet, inventor, astronomer, geologist, historian, and cartographer. In all his activities, he showed fertile imagination, well above his times.<sup>1,2,4-6</sup> His mind and personality seem

to be superhuman, in times when superstition and logics tried to move together in an anarchic march.

Leonardo was a stubborn and compulsive researcher. Despite many obstacles and economic difficulties, he continued his experiments and ideas. In Rome (1513–1516), he was accused of being a sorcerer, and he escaped prison thanks to his friendship with his cousin of the Pope. People destroyed his laboratory when they knew that he was performing human dissections: his only words were, "They have destroyed my laboratory." When he performed experiments using solar energy with a system of mirrors to make a steam water pressure engine that could move a car, his collaborators refused to work and ran away, defining all his work as *magia nera* (black magic).

Vasari<sup>3</sup> described Leonardo as a "tall and elegant man... able to fascinate people with his talks ... his favourite past time was to go in markets and to buy birds in cages. Soon, he made them free, looking them flying away ..." Much of this description about Leonardo came from an interview Vasari had with Fabrizio Melzi, the disciple of Leonardo. Vasari, who never met Leonardo, added personal considerations, which probably derive from the common contemporary ideas about the studies by Leonardo "... he was a great painter and musician ... and probably he could be greater if he did not get interested in other things ... like the bizarre experiments made in Rome ... and he did not finish many of the work ..." Most of the influential people who commissioned his artistic work did not understand and accept the ideas of Leonardo, or they had economic problems in the uncertainty of the Italian political condition, so that Leonardo was not able to complete the work. For instance, Leonardo was commissioned by Ludovico Sforza, Prince of Milan, to make an equestrian statue, as big as possible, honoring the Prince's father. After a long study period, and exhausting work, Leonardo was able to make the final wax model. The wax model was 7 meters tall and 20 meters long. The ultimate step consisted of the fusion of 100 tons of bronze. In this period, the city of Milan was attacked by a foreign army, and the prince decided to use the 100 tons of bronze to make cannon balls. The enemy army entered Milan, and the soldiers destroyed the model of the statue by using it as a target to test their crossbows. Leonardo left Milan, moving from city to city.

Matteo Bondello, a novelist, saw him working at the fresco "The Last Supper" and he wrote "... early in the morning, at the sunrise, Leonardo started to work on the Cenacolo (Last Supper) and he painted until the sunset, without eating or drinking, just painting .... Other times, he remained to watch the fresco for four-five hours, judging and examining the figures in silence ..." (Figure 1).

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Leonardo used to write in his notebooks "... now it is time to stop working ... otherwise the soup will get cold ...". His vision of the world was essentially logical, using an empirical method of study, unusual for his times and for many centuries after. He wrote, "... no human investigation can be said true science, if it cannot be demonstrated by mathematics ..." and "... nature is driven by the intelligence of its laws ...". Leonardo had the strength and capability to move from ideas to the real-world, often between criticisms and suspicions. At the same time, he had the courage to look at nature and to translate in the laboratory specific experimental conditions<sup>5,6</sup> (Figure 2).

Leonardo gave a special importance to feeling and sensations. The personages of his paintings appear in an un-definable psychological movement. Freud, the father of psychoanalysis, once wrote: "Each of the paintings by Leonardo is a treatise of psychology ..." (Figure 3).

Leonardo felt always young in his enthusiasm. At the age of 66 (an advanced age for those times), Leonardo accepted the offer by the King of France to go and work in Amboise, where he arrived with his 2 disciples after a 2-month long journey.<sup>1,2</sup>

The progress of science requires the possibility to correlate art and science and to have the courage to follow our intuitions. A scientist should be an artist, at least in her/his soul.

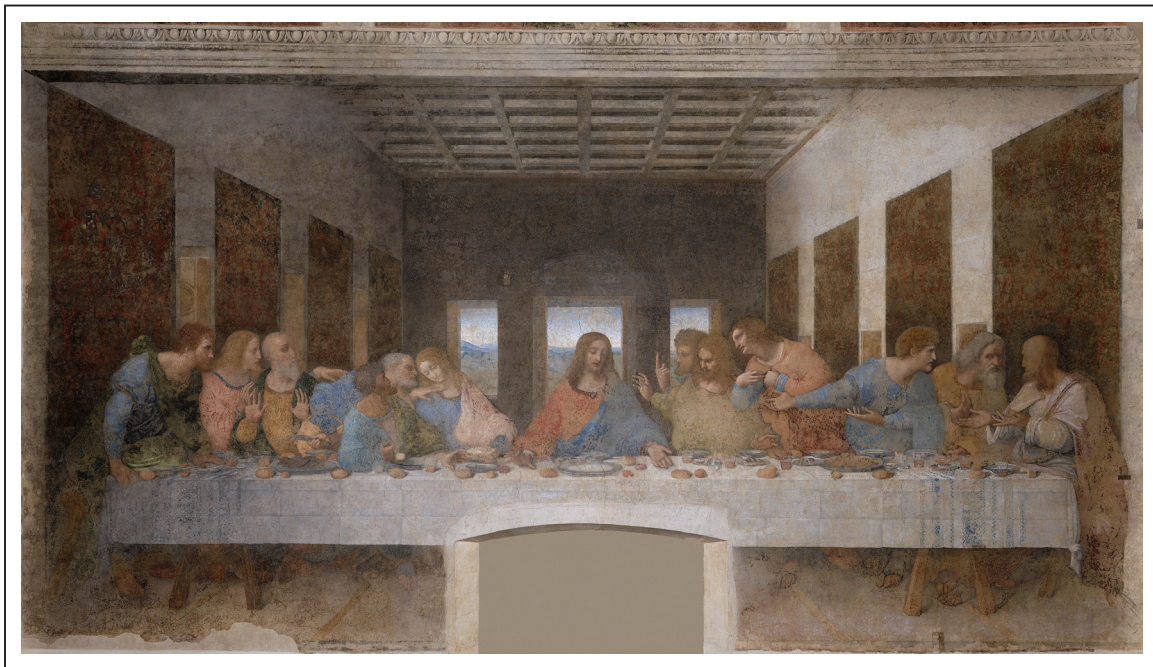
## Disclosures

None.

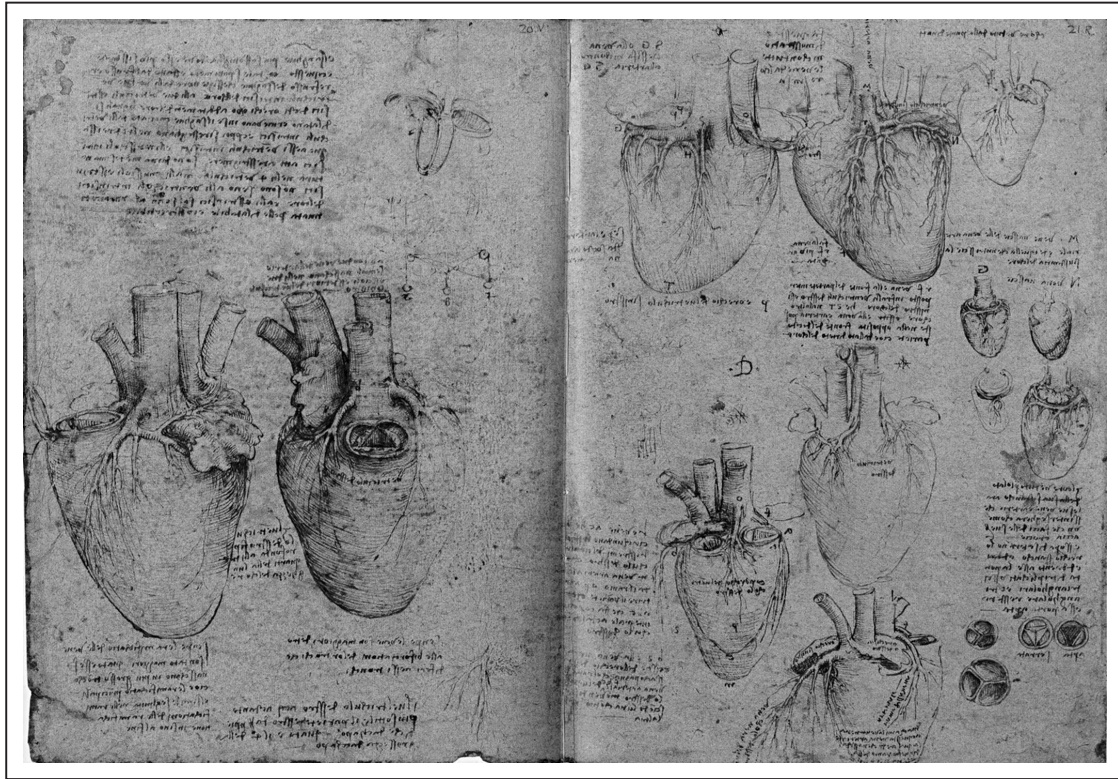
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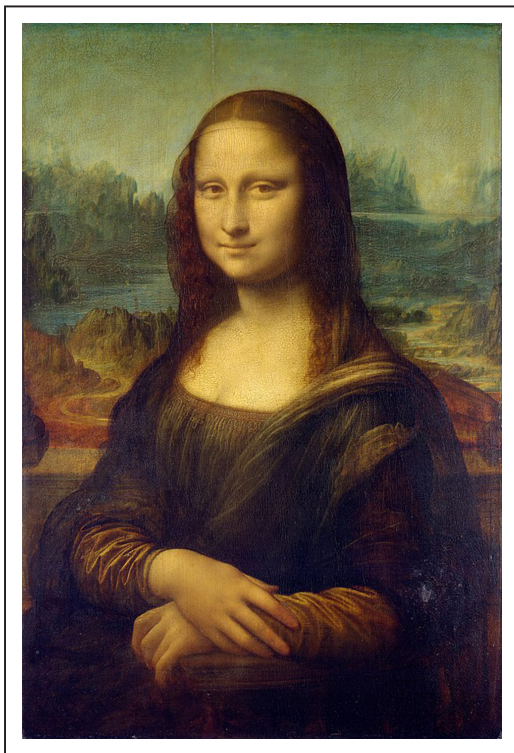
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**Figure 1.** "The Last Supper" (Leonardo- 1490-Fresco- Convent of Santa Maria Delle Grazie-Milan-Italy). The personages of the fresco communicate a psychological turmoil when Jesus says, "One of you will betray me." Judas is in the middle of the disciples, and not separated as in all traditional paintings of the Last Supper. Many art experts have analyzed the painting; everybody has given personal interpretations of some details of the fresco.



**Figure 2.** Leonardo described the central function of the heart, overcoming the old theories. The coronary arteries were described in detail, reaching the conclusion that the heart feeds itself. He noted that the “blood from the heart receives freshness and air in the lungs.” (Drawing and Annotations by Leonardo- 1510 circa- Collection Windsor Castle-UK- Permission by Her Majesty Queen Elisabeth II 2018.)



**Figure 3.** “La Gioconda” (Leonardo- 1503–1505 circa- Oil on Wood- Louvre Museum- Paris). This is probably the most famous painting in the world. Leonardo was asked by Mr del Giocondo to make a portrait of his wife Lisa Gherardini, honoring the birth of their second child. Leonardo took almost 3 years to paint the portrait and he did not give the work to the commissioners, keeping the painting with him for the rest of his life. An impossible, idealistic love?