



# An Overview of Gombrich's Research on the Ideological Coherence of Leonardo da Vinci's Manners of Motion in Water and Air Manuscript

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## Abstract

In Leonardo da Vinci's manuscripts, the way of motion in water and air appears most frequently. This caught Gombrich's attention. Art and science complement each other in advancing human civilization. After the Renaissance, the field of natural science throughout Europe seemed to be on the rise, and many masters who screened our physics textbooks emerged. The field of fluid mechanics is no exception. However, in order to explain and calculate the flow scientifically, the great gods selectively ignored the chaotic flow full of eddies described by da Vinci in the pictures before, but chose to study the ideal fluid. The term "generalist" has become a cliché, and Gombrich believes that it was his consistency of thought that made his life so rich. I hope that while people in the museum can't help admiring Leonardo's works as miracles, they should also remember that the creative spirit and critical spirit of art in the Renaissance period are still alive today.

## Subject Areas

Art

## Keywords

Art Story, Art Thought, Art Research, Art Conjecture

## 1. Introduction

The earliest description of turbulence probably dates back to the European Renaissance. Leonardo da Vinci was a remarkable figure, and his description of turbulent flow was certainly a milestone in his work in that dynamic era. (**Figure 1**)



Leonardo da Vinci  
(1452 ~ 1519)

**Figure 1.** Da Vincis 1452-1519.

Leonardo da Vinci's thoughts are profound, and his knowledge is extensive. In addition to masterpieces such as "Mona Lisa" and "The Last Supper" [1], da Vinci was a great, intelligent and talented painter. He not only mastered artistic skills superbly, such as painting, sculpture, and architecture, but also excelled in various fields such as mathematics, biology, physics, astronomy, etc. He created many famous works of art, and at the same time, he made important and outstanding contributions to the natural world.

The depiction of fluid in da Vinci's paintings is amazing as if traveling through time and space, it is unbelievable. His mastery of turbulence is astonishing as if he was carrying a CFD computer that could simulate real-world turbulent conditions.

When we look at Leonard's manuscript, we still have a feeling, as if the research in every field it dabbles in has been studied in a whole life, as if the other fields he dabbled in never existed in his life. Gombrich's study of Leonardo's paper "Motion Modes in Water and Air" attempts to discuss this issue by taking Leonardo's research on water and air as an entry point. This article attempts to summarize Gombrich's research.

## **2. Leonardo da Vinci's Manuscript Thoughts on Movements in Water and Air**

When discussing the development of turbulent flow, da Vinci's works (**Figure 2**) become the most prominent representatives. It shows da Vinci's deep understanding of complex rivers and the changes of river bed eddies. With its exquisite images, the shape of river bed eddies is clearly visible, which is breathtaking. The water flows from the channel into a pool, the water splashes roll and curl, and there are tiny bubbles scattered on the water surface, which well shows the appearance of the vortex rolling up layer by layer. But this alone is not enough to make this painting enter the annals of turbulence research. What is even more special is that Leonardo da Vinci wrote a paragraph under this painting to record its essence in a wonderful language:



**Figure 2.** A painting by da Vinci talking about turbulence.

(English version of the text about turbulence) Observe the motion of the surface of the water, which resembles that of hair, which has two motions, of which one is caused by the weight of the hair, the other by the direction of the curls; thus the water has eddying motions, one part of which is due to the principal current, the other to the random and reverse motions.

Observing the movement of the water surface is like studying the shape of hair: the shape of hair is composed of two shapes, one caused by the weight of the hair, and the other caused by the curl of the hair; In vortex motion, the motion of water is partly determined by the mainstream, and the other part is determined by random reverse motion [2].

This passage not only describes the complex movement of water flow, but also decomposes the movement of water flow into two parts: mainstream flow and random flow. This point of view is similar to Reynolds decomposition, so it is considered to be a point of view with deep physical insight. More particularly, da Vinci also called the chaotic movement of water *la turbolenza* in his notes, a word that corresponds exactly to the English word turbulence, more than 300 years before Sir Kelvin used this word to refer to turbulence. The word turbulence in English at that time had already appeared, and their appearance greatly enriched people's thinking, and also proved the uniqueness of da Vinci's thinking. Da Vinci's uniqueness and profound insight made him an outstanding leader leading the development of turbulence science.

### 3. Some Features of Leonardo's Manuscripts Discovered by Gombrichle

First of all, Leonardo systematically listed, divided, and subdivided the observed natural phenomena, and established a set of words and concepts to evoke a fleeting phenomenon and fix it in his mind [3]. We even have a wonderful feeling that the style of the sketch and the content of the text seem to be integrated,

which not only reminds us of Aristotle. Aristotle believes that the world is composed of various things whose forms and materials are in harmony. Compared with his teacher Plato, Aristotle pays more attention to the connection between things. For a certain material, Aristotle emphasizes the context of the material (context) and emphasizes logical reasoning

Secondly, the diagrammatic sketches in Leonardo's notes are simplified visual representations of theoretical propositions, rather than snapshots obtained by a pair of extraordinary eyes, which are "deductive" in character. We usually think that Leonardo's research mainly relies on observation, but he has repeatedly emphasized the importance of logical reasoning in his notes in manuscripts. He does not believe in metaphysical debates, theological debates, astrology, etc. We can also find this feature of emphasizing logical reasoning in his research. For example, he once came to such a conclusion in his research on perspective: Looking from above, the closer the foothills are to the horizon, the darker they will be. This theory reveals that it is based on the reasoning of a strong artisan tradition rather than on Leonardo's observations, as Gienini put forward in his famous "Artist's Handbook" the rule of "light near dark recede" [4]. If we have the experience of looking down from above while flying in an airplane, we will find that the scenery is not as Leonardo reasoned. Leonardo's theory could not completely get rid of the influence of tradition, which also broke the myth and prejudice of his "all-rounder". As for his research on water, through scientific experiments in modern times, he found that some of the motion states of water in sketches are consistent. (Figure 3)

These manuscripts exhibit a remarkable interplay between knowledge and perception, showcasing the extent to which Leonardo's ideas were shaped not solely by observation, but by contemplation, underscoring the significance of reasoning.

#### 4. Discovering Aristotelianism in Manuscripts

These manuscripts make us wonder why Leonardo was so interested in water and air. We can find the answer in the school of Aristotle. According to Aristotle's tradition, the world under the moon is composed of four elements: earth, water, air, and fire. Each of them has its "inherent position" in the universe, and they tend to their own homes. We can see Leonardo's description of what he called "natural motion" in his manuscripts. Of course, Aristotelian mechanics has many obvious absurdities, but it is hard to dismiss because of its simplicity, which allows it to reduce most of the fundamentally different natural phenomena into a single law. One of these laws is "elasticity" [5].

According to Aristotle, everything wants to remain in its own nature. Therefore, Leonardo pays great attention to the spring or winding rope as the driving force, and the method of storing and transforming energy-wound the spring and the energy is stored, and the spring is relaxed, and the energy is released. And the end of the movement is also like the "natural movement", the elements are still in their "inherent position". At the same time, he followed a Greek



**Figure 3.** Wake flow described by da Vinci.

scientific legacy that “Nature hates a vacuum”. Hence any displacement in the liquid which appears to create this vacuum is instantaneous counter moves towards this void. For example, his theory of the tides of lunar attraction also relies on the idea of reverse motion caused by river water flowing into the ocean [6].

After completing his research on the consistency of Leonardo’s thoughts, Gombricz made a bold speculation, suggesting that the concept of the dynamic and counter-dynamic forces that generate diverse forms of water, formed by Leonardo, is also reflected in his compositions [7]. We can boldly guess that “The Last Supper” is such a creation, just as Leonardo once said in a note about the spread of momentum: “The distance that ideas travel in the universe is longer...” Christ Jesus in the center of the painting, his thoughts spread out like ripples on a stone running towards the surface of a lake. This is a very exciting conjecture [8].

## 5. Gombrich Conjectures on the Basis of the above Research

Gombrich also speculates that one of the reasons Leonardo was interested in painting natural elements was to avoid direct competition with the human body, which Michelangelo specialized in. Leonardo stayed in Rome one after another from 1513 to 1516. It is very likely that he saw the Sistine ceiling painting. Perhaps while he was amazed by Michelangelo’s paintings of human bodies, he was also surprised to find that Michelangelo’s paintings lacked the shaping of natural elements such as air and water, so Leonardo had the intention to avoid competing with Michelangelo for the human body and turned to the tendency to study nature [7]. In fact, we can see similar inferences in Vasari’s “Biography of Celebrities”, but this inference is not about Leonardo, but about Raphael. Vasari speaks of Michelangelo’s influence on Raphael, arguing that Raphael had the same motives that the author speculates Leonardo had, that is, to focus attention on those areas that his opponents ignored [9].

## 6. Limitations of the Study

First, art has grown to the heights. In terms of understanding art, various pre-

supposed viewpoints and thinking paths have been formed, and Gombrich is one of them. Gombrich's research on the ideological consistency of Leonardo da Vinci's manuscripts of movement in water and air allows him to look at masterpieces of art with fresh eyes and understand the intention and process of their creation. Gombrich delves into the artwork of Leonardo da Vinci, looking at these masterpieces from a fresh perspective to better understand their intent and process.

Second, there is an irreplaceable nature between word description and image reproduction, which also affects art appreciation. Neither the traditional aesthetic definition, nor the abstract concept of art, nor even the technical lines, light and shade, and blocks are enough to fully describe the essence of a work. Therefore, when discussing a specific work, whether it is real, Aesthetic definitions such as goodness and beauty, stylistic concepts such as abstraction and figuration, or technical jargon such as lines, light and shade, and block surfaces, they cannot describe the mystery of the work at all.

Third, art has its own vivid and subtle visual effects. The charm of art lies in its unique visual effect, which is an artistic adventure more challenging and valuable than words.

## 7. Prospects for Future Research

Speaking of Leonardo, we often say that he combined art and science, but if he heard such praise, he probably couldn't accept it. Because of the lack of awareness of the basic truths of science and art by most people, his chosen profession is often overlooked. He believes that art and science are closely linked, the art in "art" refers to skills, and painting can be classified as Liberal Arts [Liberal Arts], which is a knowledge-based discipline. One of his famous notes says: "The poet's pen runs out before he has adequately described what the painter can at once show you with his science; the poet's mouth feels the Dry, his body was tired and hungry."

The term "generalist" has become a cliché, and Gombrich believes that it was his consistency of thought that made his life so rich. I hope that while people in the museum can't help admiring Leonardo's works as miracles, they should also remember that the creative spirit and critical spirit of art in the Renaissance period are still alive today.

## Conflicts of Interest

The authors declare no conflicts of interest.

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