Leonardo Da Vinci: The Art of Anatomy in The Renaissance

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Abstract. The contention of a hundred schools of thought during a cultural movement which characterised the Italian and European life from the 14th to the 17th century. During this period, artists represented by Da Vinci also conducted wonderful research in various scientific fields, among which anatomy was the most typical. The subject of this article is the achievements of Renaissance artists in the field of anatomy, exploring the beauty of combining art and science. As one of the "Three Masters of the Renaissance", Leonardo Da Vinci has made great achievements in anatomy, and has disclosed these secrets about the human body to the public with works of great artistic value. This article sorts out the events related to anatomy by making a comparative analysis of his representative works of art and other anatomy-related works of other artists in the same period, so as to fully understand the interdependent relationship between art and anatomy in the Renaissance.

Keywords: Renaissance, Leonardo, anatomy.

1. Introduction

After the 11th century, with the recovery and development of the economy, the rise of cities and the improvement of living standards, people began to pursue self-spiritual satisfaction and fun instead of worrying about real life. Revolt emerged in 14th-century Italy, where urban economies flourished. At that time, Italian citizens and secular intellectuals hated Catholic theocracy and its hypocritical asceticism on the one hand. On the other hand, since there was no mature cultural system that can replace Catholic culture, they expressed their own cultural claims in the form of revival of ancient Greek and Roman culture and this revolution has been called Renaissance.In the 16th century, the Renaissance revolution reached its peak. Artists represented by Leonardo began to show their talents in various scientific fields, and appealed to the society in a very expressive and influential way, thus bringing Europe into the age of science and art. Among them, anatomy was a field that has been widely studied and achieved great achievements. Leonardo da Vinvi, Michelangelo di Lodovico Buonarroti Simoni, Albrecht Dürer and other famous artists were all obsessed with it. So how did they seamlessly blend art and anatomy? What is the relationship between the two? This article mainly studies and analyzes Leonardo's anatomy-related life and focuses on his anatomical manuscripts and oil paintings. It compares them with other artists, conducts analysis and discussion. Finally, it realizes the inseparable connection between anatomy and art in order to help people learn from science. Through detailed analysis, readers can understand works of art from a scientific point of view and discover the beauty of art from a scientific point of view.

2. Life and Works

2.1. Leonardo’s Life

There are not many detailed records of Leonardo da Vinci's early life. It is only known that he was born in Tuscany, northwest Italy, a small town called Vinci, from which his name also comes from. Leonardo's father was a town lawyer, and his mother was a peasant girl. Leonardo was very smart and likes to learn new knowledge, but he has not received an advanced education. Nevertheless, Leonardo was still interested in mathematics, music and painting and was very good at them. Later Leonardo taught himself Latin, but he was still not used to reading the scientific masterpieces at that time, so he would have more practice and thinking in science, instead of being swayed and influenced

by published theories. It is precisely because of Leonardo's spirit of keen to explore new knowledge that pushed him to the top of the Renaissance.

When Leonardo was around fifteen years old, his father sent him to the studio of Andrea del Verrocchio as an apprentice. There, Leonardo mastered a very important skill, that is, painting, which played a vital role in his subsequent scientific research and provided funds for his scientific experiments.

Leonardo performed very well in the studio, and Del Verrocchio especially admired his unique understanding of human muscles and structures [1]. So, when Leonardo was about 20 years old, he was allowed to create independently. At that time, the Renaissance was in full swing. This was a great revolution in European history. From the late 13th century to the middle of the 16th century, it promoted the religious reform in Western European countries, attacked the authority of the Roman Church, broke through the shackles of theology, liberated people's minds, and the development of natural science has created a democratic academic atmosphere and provided a materialistic method of understanding [2].As one of the later famous three masters of the Renaissance, Leonardo has been described as the man who awoke too early in the darkness, while all the others were still asleep [3]. Leonardo emphasized the role of nature on art, as he said that it was necessary for painters to study the general nature and consider more what he saw, using the beauty which make up the kind of each thing. In this way, the painter's heart will reflect like a mirror, then everything was second nature to him. Leonardo was especially obsessed with the structure of the human body, he believed that the human body is the most beautiful research object in nature, and realized that anatomy is indispensable for art. It is also clearer that science cannot do without the auxiliary role of art. He once warned future generations that art never belongs to anatomy, in order to express more accurate human beauty and emotions, anatomy is essential. So, to pursue a higher level of beauty in painting, Leonardo began to dissect. But later, Leonardo's love of anatomy far exceeded his original purpose, and he was completely intoxicated by the wonderful structure of the human body [4].

Since the age of 30, Leonardo devoted himself to the study of anatomy. Although people were very dissatisfied with the church at that time, the church still had a lot of power. However, dissection of the human body was not prohibited, as is commonly claimed; in fact, it was explicitly permitted in a papal bull of 1482. However, as a painter, Leonardo could not easily obtain a corpse and dissect it, so most of his understanding of the human body was limited to the anatomy and inference of animals. During his first long sojourn in Milan (1482-99) when his notebooks already contain studies of the brain and cranial nerves, and his experiments on the spinal cord of the frog. In this period, too, he summarized his knowledge into a Treatise on Painting and the Human Figure, the one fragment of his work which was destined eventually to break through the shadows into publication. It is worth mentioning that Leonardo did not acquire a human skull until 1489. Leonardo cut off the front of the face, exposing the underlying structure, which was no easy feat at the time. He then recorded his findings in a notebook, annotated in his customary mirror writing. Among them, there are eight exercises on the skull, including side views, cross-sectional views, and oblique views from above. Different angles are chosen for the sketches—some depict the blood vessels of the face, some illustrate the relationship between the eye sockets and the jawbone, and some look down on the cavity of the skull, showing the nerves and blood vessels in the skull. In order to fully explain the whole process of dissection, he also deliberately drew a sketch of the scalpel [5].

However, the information given to Leonardo by skull research is still too small, and Leonardo's research has encountered a bottleneck. Leonardo returned to the subject years later when he was commissioned to paint a colossal battle scene, The Battle of Anghiari, at the Palazzo della Signoria in Florence. In preparation for this project, he made many drawings of male musculature, interestingly all the male models are very similar in Leonardo's manuscript. Then in 1557, the famous art historian and painter Vasari painted a new fresco for the Palazzo Vecchio's town council hall, thus covering the original "Battle of Anghiari". Vasari once described Leonardo da Vinci like this: "tall and elegant man... able to fascinate people with his talks... his favorite past time was to go in markets and to buy birds in cages. Soon, he made them free, looking them flying away…" In fact, Vasari never saw

Leonardo himself, most of his knowledge about Leonardo came from interviews with Leonardo's apprentice Fabrizio Melzi and added his own imagination. Leonardo described by Vasari is obviously a person who loves nature and freedom very much. However, Leonardo's life was not smooth sailing, nor was he able to achieve freedom. Because he was an illegitimate child, Leonardo was not assigned to his rich father's inheritance. Faced with the large amount of funds required for scientific research, Leonardo could only use painting or other artistic creations as a way to make money. support his great research. Therefore, Leonardo is always facing economic problems.

Leonardo seems to have collaborated with Marcantonio della Torre, professor of anatomy at the University of Pavia, in 1510-11. Marcantonio solved one of the major problems of dissecting sources for Leonardo, who may have dissected as many as 20 corpses that winter. He concentrated on bones and muscles, analyzing their structure from a purely mechanical point of view, and the results were astonishing. Perhaps with the encouragement of a professional anatomist, Leonardo drew every bone and most of the major muscle groups except the skull. "In the winter of 1510, I believe I will have done all my dissections," he wrote on one painting [6].

However, things did not go as smoothly as Leonardo thought. In 1511, Milan fell into war, Professor Marcantonio died unfortunately, and Leonardo moved into a villa in the suburbs with his assistant. Due to the lack of materials, Leonardo had to shift his focus to animal anatomy. Most impressive is the bull's heart, which is structurally indistinguishable from a human heart. Leonardo described the ventricles and atria with great accuracy and analyzed the structure and function of the valves in detail. In an excellent experiment, he made a glass model of the aortic valve and studied the eddies as the aortic root widened by pumping in water mixed with grass seeds. These vortices, he reasoned, were essential for the valves to close -- a discovery that wasn't confirmed until the 20th century [6].

2.2. Leonardo's Anatomical Manuscripts

During Leonardo's life, he dissected nearly 30 corpses in total to understand the structure of human muscles, blood vessels, and internal organs and had studied how many human teeth there are, how many types they are divided into, and what the roots of incisors, canines, and molars look like. Among the more than 6,000 manuscripts left by Leonardo to later generations, about 200 are about anatomy.

The two anatomical diagrams of the neck, shoulder and right arm show in detail Leonardo's in-depth study of human structure. The manuscript on the left side from different angles focuses on the shoulders and neck, especially the left and right shoulders are separated for detailed interpretation and notes. The muscle lines of the human neck also change with the movement of the head. The manuscript on the right is clearly focused on the study of the right arm. It is still from different angles to study in detail the structure between the neck and shoulders, that is, the trapezius muscle, and the muscle lines of the forearm and forearm. At the top of the manuscript is a detailed description of the posterior cervical spine.

The accuracy of Leonardo's human body sketches is comparable to the images drawn by any current scientific painter. His sketch level is at least 300 years ahead of his time. Perhaps until recently, the images obtained by 3D digital imaging technology can be regarded as accurate [7]. The profoundness and elegance displayed in the manuscripts of Leonardo are comparable to works of art, and Leonardo can also be said to be the founder of artistic anatomy. To draw fine lines, Leonardo used the quill pen that most painters would use, and his inks were presumed to be made from oak galls, gum arabic, and iron sulfate, while viewing variations It is constructed using carbon-rich black chalk and iron-rich red chalk. Leonardo used this technique on many of his anatomical drawings to draw very, very sharp shadows on curved surfaces. He will only use a quill to draw scribbled lines to draw light and shadow, which is also very rigorous and precise.

2.3. Leonardo's Use of Anatomy in the Fine Arts

Faced with the gradually refined research results, Leonardo was always willing to apply them in his usual artistic creation. "Saint Jerome" is one of them.

There is also an interesting story behind "St. Jerome", although it sounds absurd, but judging from the situation of the work, it seems to be true: in 1820, Cardinal Joseph Fisch was in a Roman family. The painting was found in a thrift store, when the store used the painting directly as a table board, and at that time the middle part of the painting, that is, the head, was missing; and this missing part was taken by a shoemaker Use it as a wedge for an ottoman. It can be clearly seen that there is a square cutting mark on the painting. According to the knife mark, it can be judged that it is a kind of leather knife commonly used by shoemakers. This cut part is precisely the part of the whole painting that can best show Leonardo da Vinci's in-depth study of dissection, that is, the application of paintings on the head, neck and trapezius. In many places of the painting, the white exposed by the plaster base can be seen, while some other places where the shadow is built are painted by the author with his fingers and palms. This is Leonardo's classic technique of Sfumato. It not only represents the visual effect like smoke, but also describes a phenomenon of diffusion, that is, the transition between colors. However, this method will make the picture softer and rounder, full of power and mystery [8].

3. Comparison with Other Artists

Michelangelo, who was born in the same period, also devoted himself to the field of anatomy and drew a large number of anatomical manuscripts. Although his media is almost the same as Leonardo, there are still differences between his and Leonardo's manuscripts. Leonardo prefers light in painting, and the tiny muscle protrusions of the human body can be compared with the surroundings as long as they do not involve changes in light and shadow. Organization and coordination. Leonardo paid attention to how he viewed the overall relationship between muscles and muscles, and bones and bones. He first analyzed whether the light and shadow effects of these muscles were consistent. So, in Leonardo's oil paintings, most people are always very round and full. However, Michelangelo became obsessed with the shape of muscles, and even exaggerated them. But it doesn't mean that Michelangelo's manuscripts are not accurate. In contrast, studies of Michelangelo's art show that his likenesses are remarkably anatomically accurate. Those exaggerated muscles and movements are often the painting methods used by Michelangelo to achieve perspective, which better shows the vitality based on his detailed observation [9].

At the same time, under the influence of Da Vinci, the artist Dürer from Germany also conducted in-depth research on anatomy. Unlike Da Vinci, Dürer paid more attention to precise measurement and calculation, and spent more energy on the internal structure of the human body [10].

4. Conclusion

Leonardo believed that human anatomy is the key to understanding the dynamics of the human body, thereby unlocking the mysteries of life. What makes him extraordinary is that he will not be bound by other people's thoughts, but at the same time he will not be self-centered but treat each of his own research with an inclusive attitude. He often connects physiological, pathological, and anatomical factors to analyze problems, and often uses comparative anatomy, animals versus humans, old people versus children, and so on. Art and science have never been two opposite topics. They cannot be separated, or once they are separated, it is difficult to make progress in this regard. In fact, nothing in the world can be in a state of complete opposition, and there must be places where they can support each other or have a positive impact. But art and science are not exactly the same thing. Not only Leonardo, but artists regard art as a kind of skill, which plays a role in promoting basic scientific research-human anatomy, optical research, etc. On the contrary, the success of artistic exploration and its methods promote scientific research. advances in research. Therefore, during this period, painters enthusiastically studied perspective, dissected corpses, and observed the muscle and bone structure of the human body. The reason why human civilization can continue to grow, and advance is precisely because of human beings' endless thirst for wisdom and beauty. The former is transformed into science, and the latter is transformed into art. The two complement each other and

form the first driving force to promote human society. There is science in art, and science always contains the observability of art. If the scientific research people engage in can be sublimated to the realm of art, scientific research can also reach a higher realm.

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