Introduction

Metaphysics of Physics is the much needed and crucial voice of reason in the philosophy of science, rarely found anywhere else in the world today. We are equipped with the fundamental principles of a rational philosophy that gives us the edge, may make us misfits in the mainstream sciences but also attracts rational minds to our community.

With this show, we are fighting for a more rational world, mostly by looking through the lens of the philosophy of science. We raise awareness of issues within the philosophy of science and present alternative and rational approaches.

You can find all the episodes, transcripts, subscription options and more on the website at metaphysicsofphysics.com.

Hi everyone! This is episode thirteen of the Metaphysics of Physics podcast. I am Ashna, your host and guide through the hallowed halls of the philosophy of science. Thanks for tuning in!

Today we are going to go over some of the inventions and discoveries of possibly the greatest Renaissance Man, Leonardo da Vinci!

We cannot hope to cover all his inventions and discoveries. We will simply go over some of the ones we find the most interesting.

As this is simply an overview of some of his inventions and discoveries, we will almost certainly return to the topic of Leonardo da Vinci and cover his history, some of his influences and what influence he had on those that came after him. However, we will see a little bit of the influence he had on others in this episode.

Credit to the website Leonardo da Vinci Inventions which was used to check and reference much of the information in this podcast. You can check the site out here.

But, without further ado, let us see how many we can cover, in alphabetical order.

Anatomy

Leonardo was extremely interested in the human body and dissected many, many bodies. More than 30 according to his own claims.

Leonardo, being the great artist he was, drew many very detailed and remarkably accurate sketches of various parts of the human body. |

In 1510-1511 alone he compiled a series of 18 largely double-sided sheets containing over 240 drawings and 13,000 words of notes.

This is known as the Anatomical Manuscript A and is housed in the Royal Collection. He made many major discoveries as a result of all this work.

For instance, he produced the first accurate depiction of the human spine. As well as the first accurate description of cirrhosis of the liver.

The heart surgeon Francis Wells, working at Papworth Hospital in Cambridge, has examined many of Leonardo's sketches. He has commented that they were far better than anything he had seen in modern textbooks of anatomy.

In his words: "They were beautiful, accurate, absorbing - and there was a liveliness to them that you just don't find in any modern anatomical drawings."

He is not the only medical expert to express such opinions. Several other experts have expressed the view that his works are better than most or all other modern works they have seen.

In his time and well after, it was believed that the heart had a two-chambered structure. However, Leonardo discovered that it had four.

As well as this, he discovered that the atria or filling chambers contract together while the pumping chambers or ventricles relax and vice versa.

But, more impressive even than this, are his observations about the aortic valve which he made while experimenting with an ox's heart.

He was interested in the way the aortic valve opens and closes to ensure that blood flows in one direction.

So, he constructed a model by filling a bovine heart with wax. Once the wax hardened, he recreated the structure in glass and them pumped water mixed with grass seeds through it.

This allowed him to observe tiny vortices as the seeds swirled around in the widened root of the aorta. This allowed him to correctly posit that these vortices helped to close the aortic valve.

Since he never published his journals, this was not understood until the 20th century. In 1968, two engineers in Oxford demonstrated it. The only reference in the paper was to Leonardo.

His studies of anatomy may have proved useful in helping him develop some of his inventions.

For instance, by studying how muscles worked, he may have gained insight into how to approximate human motion using mechanical means.

33-Barrelled Organ

This is often referred to as a machine gun, however, it is not the same kind of “machine gun” we know today. It was composed of 33 small-caliber guns, likely hand muskets.

These 33 guns were divided into three rows of 11 guns each. They were connected to a revolving platform and attached to this platform were large wheels.

All 33 guns would be loaded and then all 11 guns from the first row would be fired. The platform was then rotated so that the next row of guns could be aimed. The first row of guns could then cool down and the third row could be loaded and ready to fire.

But why is it referred to as an organ? It is because the rows of guns resemble the pipes of an organ.

As far as we know, one of these has not been built in modern times, unlike some of his other inventions. However, we can imagine it would have made an effective and deadly weapon of war.

Colossus

This huge bronze horse was commissioned in 1482 by the Duke of Milan and was to be 24-feet tall.

The construction of this mammoth horse required making it out of a solid piece of bronze coming in at 80 tons.

Leonardo used his experience of building bronze cannons to help plan how to build the bronze horse. It required him to invent new mold-making techniques and an innovative oven to reach the high temperatures required to melt so much bronze.

Leonardo had finally solved all the problems required to create the huge horse when tragedy struck. In 1494, King Charles invaded France. In order to delay King Charles, the Duke offered King Charles a bribe of the bronze set aside for the creation of the horse.

Which was less than helpful, as the French simply used the bronze to make cannons.

In 1977, a retired airline pilot and artist, one Charles Dent decided to create the horse. He spent 17 years working on it before he died in 1994.

However, in 1999, the horse was completed and gifted to the people of Milan in Italy.

Friction

Leonardo was one of the first to study friction in any systematic fashion. While he studied all kinds of friction, he drew a distinction between sliding and rolling friction.

He stated the basic laws of friction 200 years before Newton defined what force is. He stated that:

1) The area of the points of contact has no effect on friction.

2) If the load of an object is doubled, its friction will also be doubled

However, since Leonardo never published his theories, he got no credit for his work until several centuries after Newton published his work

Geology

Leonardo was interested in many things, as most people know. So perhaps it will not surprise you to learn that geology was one of his interests.

At one point he lived in Milan, serving as the court artist to Ludovico Sforza. As this was close to the Alps, he often went walking in the mountains.

His notebooks detail how he explored a mountain cave and found massive fossil bones. His notebooks say he was famous for his interest in rocks and strange forms hidden within them. Which he then no doubt studied with the great care and astute mind with which he studied everything.

His research led him to the following conclusions:

Shells and fish bones must be the remains of animals that once swam in places that were once oceanic. So, therefore some parts of the Earth which were once covered by seas were no longer covered by seas. And therefore, the surface of the Earth must have changed over time.

Water is the most powerful natural force. Water has sculpted the largest features of Earth's landscape over long periods of time

All this indicates that slow and relentless natural processes have shaped our planet.

If this sounds quite familiar, it is because geologists would come to realize it centuries later.

His geological discoveries led him to conclude that the Earth must be much older than the few thousand years the Bible seemed to imply and to conclude that natural geological forces, not divine ones, were responsible for the drastic geological changes he observed inferred must have taken place.

Parachute

Credit for the invention of the first practical parachute typically goes to Sebastian Lenormand in 1783. However, Leonardo designed one much earlier.

He made a sketch of the invention, with this description: "If a man has a tent made of linen of which the apertures [openings] have all been stopped up, and it be twelve braccia (23 feet) across and twelve in depth, he will be able to throw himself down from any great height without suffering any injury"

Given it has a triangular, rather than rounded design, many questioned whether it would work. They questioned whether it would have enough air resistance to float. Or whether it's linen covering over a wooden frame might be too heavy.

As is typical with his inventions, it was never built or tested during his lifetime. Given how many of his inventions later proved to work well, wasn't this a shame?

However, in 2000, the daredevil Adrian Nichols constructed a parachute based on Leonardo's design and tested it. Despite widespread skepticism, it worked and provided a safe landing!

Robotic Knight

Leonardo was, as is widely known, extremely far ahead of his time when it came to feats of engineering. But, did you know that he designed a robotic knight?

This was not his first robotic design. There was his self-propelled cart, which we will cover shortly. The robotic knight is massively impressive all the same.

No complete drawing of this device is known to exist. However, we have fragments dealing with different aspects of the knight. Here is what we do know:

It consisted of a suit of plate-mail containing gears and wheels connected to a pulley and cable system. By using this mechanism, the knight was said to be capable of sitting down, standing up, moving its head and lifting its visor.

No doubt his intimate understanding of how the human body worked and how muscles worked, helped him figure out how to create a method of emulating a limited subset of human motions.

In 2002, robotics expert Mark Rosheim used several different da Vinci drawings to build a prototype of the robotic knight. It was able to walk and wave. He noted that it was designed to be easily constructed, without a single unnecessary component.

Rosenheim has used some of the same concepts used by da Vinci to design his planetary exploration robots for NASA. So, da Vinci has, in a way, helped us to explore space! Not too bad for a 15th-century

engineer...

Scuba Gear

It will surprise nobody that Leonardo was fascinated by virtually all aspects of the world around him, including the water. So, it should be no surprise that he might have tried to find a way to allow people to more easily navigate marine environments.

In 1500, when working in Venice, the “water-city”, Leonardo designed scuba gear to be used to allow sneak attacks on enemy ships from underwater. This was to be performed by allowing scuba-clad soldiers to cut holes in the bottom of enemy ships.

The leather suit was equipped with a mask like a bag that went over the head. Attached to the mask and around the nose area were two tubes that led to a cork diving bell which floated on the surface.

Air was provided by the opening of the tubes to the diver.

The mask was fitted with a valve-operated balloon that could be inflated or deflated thus allowing the diver to rise from the water more easily or more easily submerge himself.

Steel rings helped to reinforce the apparatus and to prevent the tubes from being crushed by water pressure.

Jacquie Cozens built a diving suit based on this design, using pig leather, bamboo tubes and a cork float. It worked quite well in shallow water.

Self-Propelled Cart

This invention is widely described as an “automobile”, however, more recent scholarly work has revealed that it was intended as a cart devised for use in theatrical settings.

Two large central springs underneath the central horizontal cogwheels provided the motive power and caused the wheels to go into motion.

There was also another device which served as a remote handbrake.

The cart could go forward and could be programmed to steer either straight or at pre-set angles.

The size of this thing is certainly consistent with its use as a theatrical device. It was probably one meter by one meter and probably not even a meter high.

Regardless of its uses, this cart can be considered as one of the first automated mobile devices ever created.

In 2006, the Italian Institute and Museum of the History of Science built a model based on da Vinci's design and it worked!

Outro

That brings us to the end of this episode. I hope you enjoyed our brief coverage of some of the inventions and discoveries of the great da Vinci! We only had time to cover but a few and perhaps one day we will come back and cover some more.

But, for now, our brief tour of the genius of Leonardo da Vinci is over.

Next episode will be entitled "Life 3.0, A Slow Death" Part One. The first of a series of reviews covering the awful book "Life 3.0" and its arguments for Strong AI.

In April we will be launching our subscription content. This will be content which can be accessed for the very small monthly fee of $2.

Thanks for listening!

Remember to check out the website and subscribe if you like our podcast, sign up to our mailing list or follow us on Facebook or Twitter to get the updates!

As always, you are welcome to send in questions about any of the things talked about in this episode or about irrational stuff in physics or the philosophy of science in general. Send them to questions@metaphysicsofphysics.com.

Please tune in for the next episode and start thinking of some questions! Until then, stay rational!