KONSTANTIN TSIOLKOVSKY

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1. Introduction

We were introduced to Konstantin Tsiolkovsky in the article *From Stalin to Sputnik and Beyond*, and he was also represented in the film that we have watched *Cosmic Voyage*. As we learned from the article and the movie, he was a soviet rocket scientist, who pioneered many of the modern theory for rockets and space travel. For my presentation I wanted to research him further so that we can understand his long lasting influence on the science fiction genre as a whole.

2. Life

He was born in Izhevskoye on September 17, 1857. When he was 9 years old, he caught scarlet fever and as a result his hearing became impaired. Then only two years later at the age of 13 his mother died. He was not accepted into elementary schools because of his hearing problem, so he was home schooled, and spent much of his time reading books. This is the time when he first became interested in mathematics and physics, and began to consider space travel.

He became a teacher at a school in Borovsk near Moscow. The married his wife Varvara Sokolova during this time as well. He continued to read fiction, and do his own research during his time as a teacher.

Inspired by fiction, Tsiolkovsky began to construct theories about rocketry and spaceflight. He would later be commonly considered the father of spaceflight. He was also the first person to conceive of the concept of a space elevator, apparently being inspired by the Eiffel Tower.

Tsiolkovsky experienced a number of unfortunate years at the start of the 20th century. In 1902 his son Ignaty committed suicide, then in 1908 many of his papers were lost in a flood, then in 1911 his daughter Lyubov was arrested for revolutionary activities.

Tsiolkovsky supported the Bolshevik revolution, but he did not become prominent, partially due to his support of eugenics making him politely unpopular. He continued as a high school teacher until his retirement in 1920. It was not until the mid 1920s that his theories gained traction, and the importance was acknowledged. Then he only became popular is Soviet Russia in 1932. This was only three years before his death on September 19th 1935. He died during an operation for his stomach cancer.

3. Scientific Accomplishments

Tsiolkovsky first began by outlining the basics of the kinetic theory of gases in this paper "Theory of Gases", but these discoveries had previously been made 25 years earlier. His second work was titled "The Mechanics of Animal Organism". Tsiolkovsky's major works focused on four subjects: an all-metal airship, airplanes and trains, hovercraft, and rockets.

In the 1890s Tsiolkovsky primarily focused on an attempt to construct an all-metal airship. To do this, he developed the first aerodynamics laboratory in Russia, and constructed the first wind tunnel in Russia. In 1900 he made a survey of the coefficients of drag for several simple shapes. He developed descriptions of airflow around different geometric shapes, this would later results in modern aerodynamics.

After failing to gain support for the construction of an all-metal airship, Tsiolkovsky then moved his research to heavier the air aircraft. He first developed then idea in an article called "An Airplane or a Birdlike Flying Machine" in 1894. Many of the designs present in the article are similar to the designs that were used in the beginnings of air flight. Unfortunately this again did not gain enough support to continue with this research.

Starting in 1896 Tsiolkovsky studied the theory of motion for a rocket. In 1897 he developed the famous classic rocket equation, which is commonly used today for rudimentary models of rocket propulsion.

$$\Delta v = v_e \ln\left(\frac{m_0}{m_f}\right) = I_{sp} g_0 \ln\left(\frac{m_0}{m_f}\right)$$

In 1903, Tsiolkovsky published his work titled "Exploration of Outer Space by Means of Rocket Devices". In this paper, he utilized his rocket equation to determine the minimum orbit around the earth, and explained a process that using a multistage rocket it would be possible to achieve this orbit. This is the first time

that it was proved that a rocket could preform space travel. He continued to develop ideas on the use of liquid rocket engines for space travel. This initial design that Tsiolkovsky proposed is the bases of modern spaceship designs.

He continued to develop theories on rocketry and new ideas. He also studied a large number of different rocket fuels, and determined which combinations of oxidizers and combustibles would be most effective for space travel. Much of his research has gone on to lead to the research necessary to develop modern space travel.

Although many of his ideas were considered impractical, they were of great influence to many of the early rocket scientists, and marked the path for the later researchers to continue on. This all eventually lead to the construction of the first successful spacecraft.

4. Philosophy

Tsiolkovsky also did a large amount of philosophical work, he published a book, titled *The Will of the Universe. The Unknown Intelligence* in 1928. Then throughout the last five years of his life, he wrote many articles on his philosophical theories. Showing that he was not only a scientist but an active philosopher.

5. Influence

Tsiolkovsky's theories and research has had a tremendous influence in popular culture, and science fiction. Much of science fiction with space travel can be traced back to Tsiolkovsky's theories, and ideas. He developed ideas for airlocks, and closed biological systems for growing food and producing oxygen in outer space. And the development of the concept of the space elevator is quite extensive in modern science fiction. He was also consulted for the script for *Cosmic Voyage*, and wrote several of his one works, such as *One the Moon*. To name a few works that Tsiolkovsky has had an influence in are:

- StarTrek
- International Space Station
- Mass Effect
- Doctor Who
- The Mars Trilogy

- Old Man's War

There are too many different works that have some influence from Tsiolkovsky, almost all of modern science fiction, that exists in a setting with space travel, has a large number of elements which were originally considered by Tsiolkovsky.

In the film *Cosmic Voyage* his influence is clearly notable. The design of the space ship **Stalin** very closely follows his designs. One key development that Tsiolkovsky created is the use of fins on a rocket. For the design depicted in the film, the rocked is mainly made of fins. He also had notable influence in the entering of the special chambers for launch. In some of his papers he made some proposals similar to this on how to best survive the extrema forces that can happen during takeoff and landing of a rocket ship.

Even in the flim that we watched for today, there is insperation from Tsiolkovsky. At one point they directly reference him, and the land vehical that they use is some kind of hovercraft. Incidentily hovercraft is yet another of Tsiolkovskys major works, and he wrote a couple papers describing their function and design.

Much of modern space science fiction would not be as it is today without Tsiolkovsky. Without his theories, ideas and research, much of modern space travel, air travel, and science fiction would be year behind, or be completely different.

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