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Astra News Magazine
July 2022

Welcome to the fourteenth issue of Astra News!

Imagine being a teen in 1961, when the first human flew into space, or in 1969 when we took our first steps on the Moon. What would it be like? Everything related to space happened for the first time then. And even though we haven't set foot on another cosmic body since then, our knowledge of space and technology has stepped far forward.

People who were our peers at the time are now major contributors to the possibility of humans flying to Mars for the first time. Listen to their voices back then **HERE**. This is how out-of-this-world they perform David Bowie's "Space Oddity". The story behind this recording, which took place in 1976, can be found here.

We dedicate this issue to all those who dream of space exploration!

To the stars!

Yours,
Max and Leonid

The cover/collage is by Leonid Vishnevskiy. Images are from the public domain including the first image from the James Webb Space Telescope and an image of Mars by NASA. The source for the image above is here.

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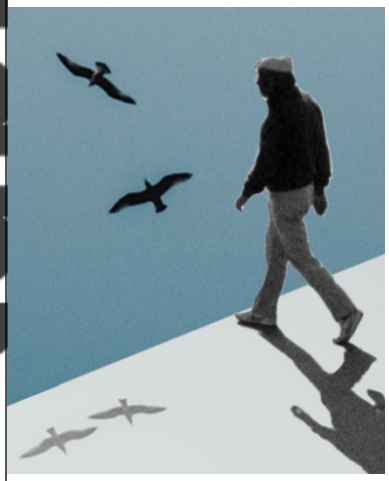

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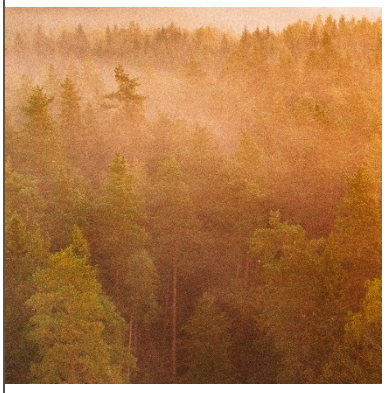

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On the left is an image from Official SpaceX Photos on Flickr

ABOUT NONFICTION
Never stop questioning and experimenting. That’s what defines nonfiction within *Astra News*.

AN INTERESTING FACT
Above is an image from “A Trip to the Moon” (1902). The film follows a group of astronomers who travel to the Moon in a cannon-propelled capsule, explore the Moon's surface, escape from an underground group of lunar inhabitants, and return to Earth with one of them. In this iconic image, you see the space capsule crashing into the Moon.

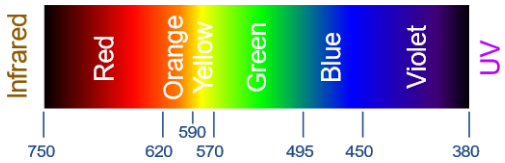
When we first reached the Moon in 1959, with the mission Luna 2, we crashed into it too. It was an unmanned flight, however.

IN THIS ISSUE
The telescope is our artificial eye in the sky, which we are constantly improving.

Today, the infrared James Webb Space Telescope is the pinnacle of this creation, and we will tell you about it, its predecessors, as well as the most unusual telescope, future missions, and what infrared astronomy is.

The collage to the right by Leonid Vishnevskiy contains an image scanned from a thrift book (here is more about it) and an image of the far side of the Moon by NASA.

A TRIP TO THE UNIVERSE



Infrared Astronomy. The James Webb Space Telescope and Special Remote Objects (LIGO and The Roman Space Telescope)

By Leonid Vishnevskiy

What is a Telescope?

A telescope is an instrument that helps us in the observation of remote objects by collecting electromagnetic radiation.

Electromagnetic radiation is a type of energy that is all around us and takes many forms ranging from very long radio waves to very short gamma rays (see the picture below). It travels in waves and spans a broad spectrum[1] where visible light is only a small part of the total range of light. That's why learning about modern telescopes is a little bit tricky when we are so advanced in technology because when we imagine a telescope, we tend to think of the simplest kind of it, which is based on the light visible to the human eye.

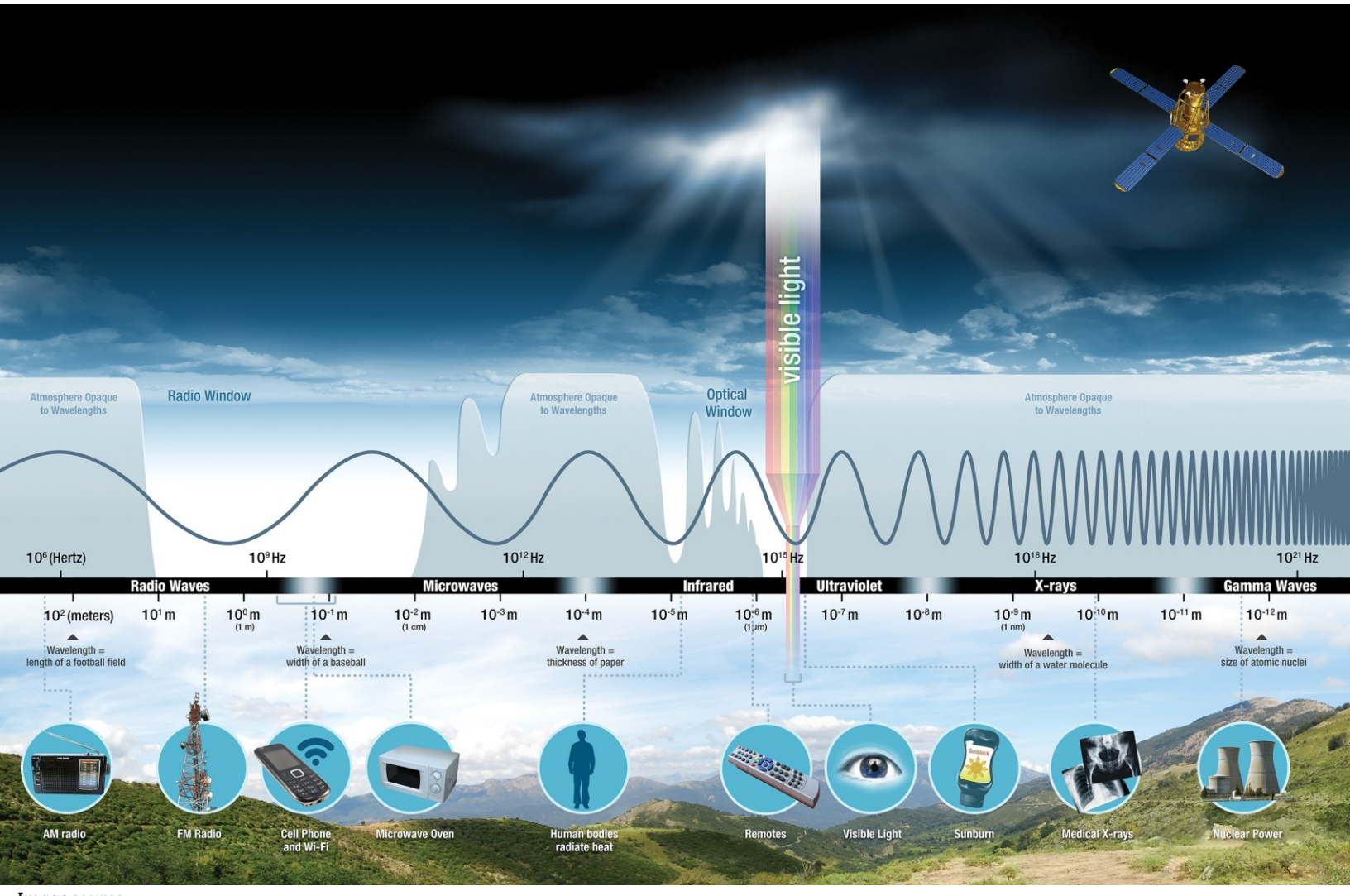


Image source

[1] The electromagnetic (light) spectrum is the range of intensities of light, varying with wavelength and frequency.

Special Remote Objects: Gravitational Waves, Dark Matter, and Dark Energy

We just defined a telescope as something that aids us to see remote objects. Take note, however, that we are uncertain of some of these objects' existences or know that they exist only by observing certain realities[2]. Firstly, I am talking about the recently discovered gravitational waves, and also about dark matter, and dark energy.

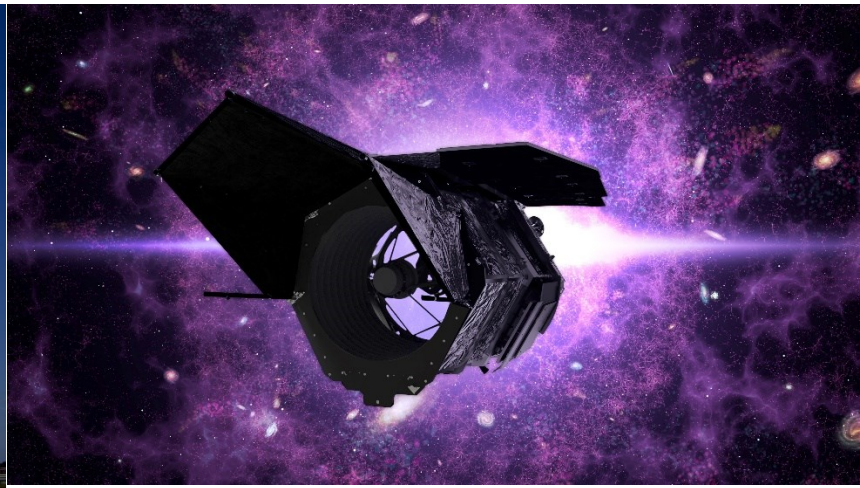
LIGO is the world's largest gravitational wave observatory. Gravitational waves are 'ripples' in space-time caused by the acceleration of very massive objects such as black holes, but they are not the only ones generating those waves. If you haven't heard of LIGO, check it out, from a general point of view it's probably one of the most unusual observatory/telescopes in its structure. For example, it has what are called "arms" 4km/ appr. 2.5 miles long each.

While LIGO is based on Earth, some gravitational waves can only be observed from space.

In his General Theory of Relativity, Albert Einstein predicted the existence of gravitational waves in 1916. Thanks to LIGO, they have been discovered. Gravitational waves are not part of the electromagnetic spectrum that you see in the picture to your left. "In fact, electromagnetic radiation is so unimportant to LIGO that its detector components are completely isolated and sheltered from the outside world." Click here to see the spectrum of gravitational waves[3].

The Roman Space Telescope is an observatory designed to answer key questions in the areas of dark energy, dark matter, exoplanets, and infrared astrophysics. The telescope's mission is currently targeted to launch in October 2026 on a Falcon Heavy rocket.[4]

The most powerful rocket in our history, the Falcon Heavy, is made by SpaceX. Find out more about the Falcon Heavy here.



Falcon Heavy and The Roman Space Telescope. *Image sources: SpaceX, NASA*

[2] "Dark Matter and Dark Energy", Astra News issue Nº12
[3] It's generally considered that gravitational waves are not part of electromagnetic radiation (30 sec. video).
[4] NASA Awards Launch Services Contract for Roman Space Telescope, NASA press release, July 19, 2022

First Telescope. Galileo Galilei

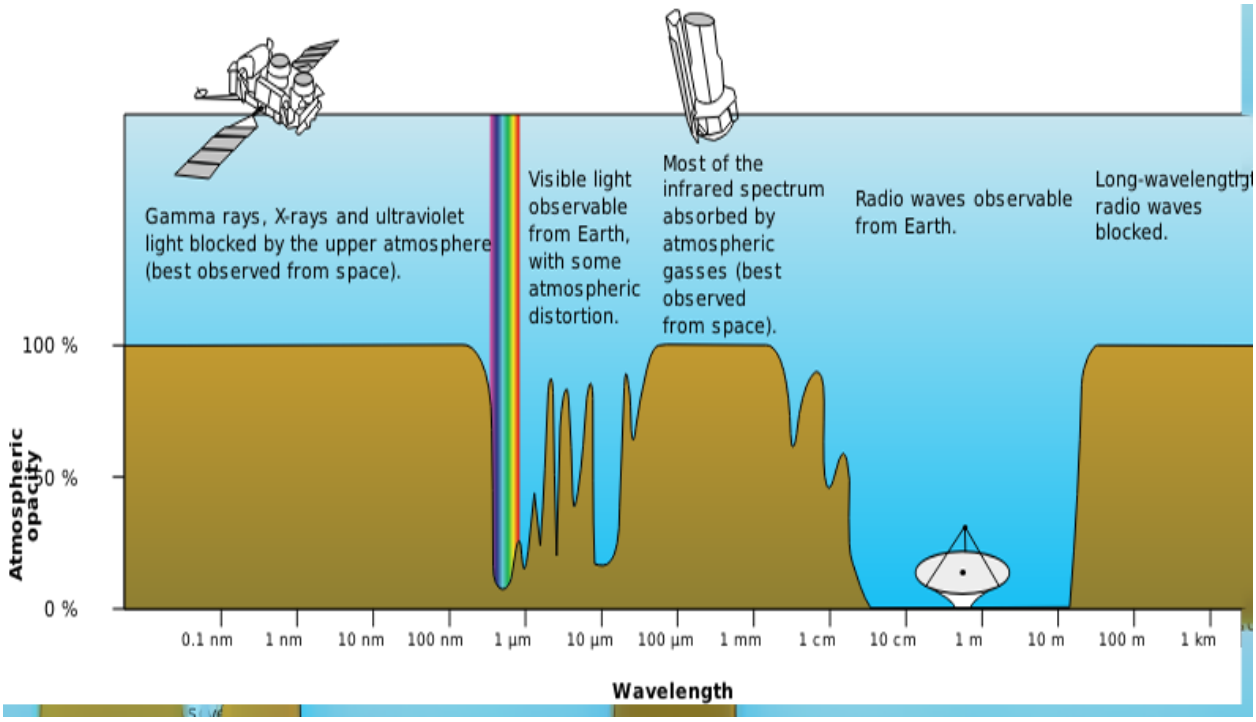
"Galileo Explaining Lunar Topography to Two Cardinals", by Jean Leon Huens

The telescope was one of the most important inventions in history, but we don't know exactly who to give credit to. But what is certain is that Galileo Galilei of Italy was first to point the telescope at the sky and made the first observations and discoveries.

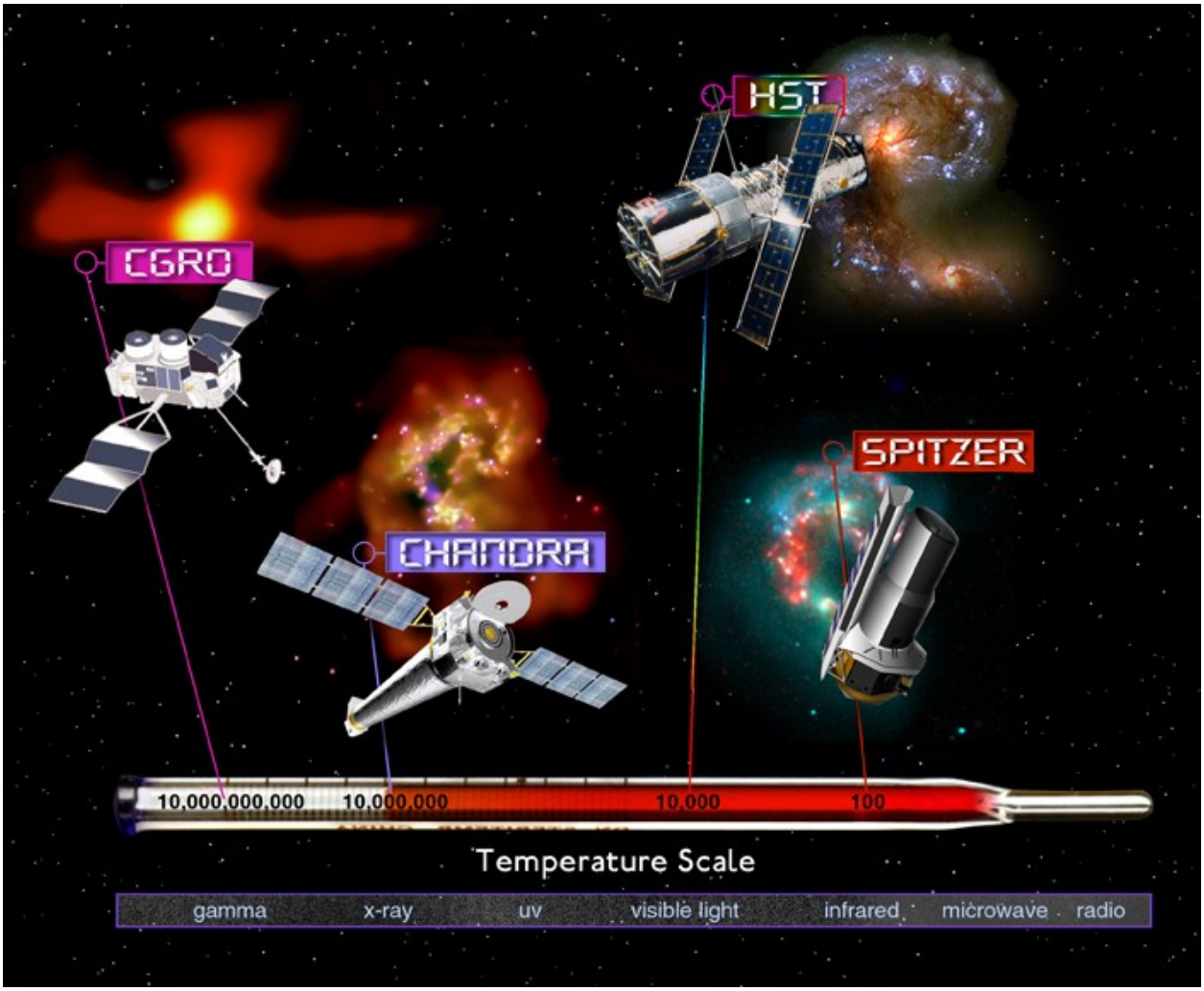
In the painting (this is part of it) on the left by the Belgian artist Jean Leon Huens, you can see Galileo explaining the lunar topography and the moons of Jupiter (Galilean moons) to two skeptical cardinals. By the way, the latter observations were used by Ole Roemer to first determine the speed of light.

Why Do We Need Space Telescopes? Windows Of Transparency

The Earth's atmosphere transmits electromagnetic radiation only in the range of certain wavelengths, called the windows of transparency. There are only two primary windows for ground-based astronomy: visible light and radio waves. In addition to this, some detectors (infrared, UV, and gamma) work only somewhat when they are high up on mountains. Observations at other wavelengths must be done from space/above the Earth's atmosphere. And one more reason for going into space is that ground-based telescopes can only see a limited portion of space. *Image source*



Great Observatories Program. Hubble (HST), Compton Gamma Ray Observatory (CGRO), Chandra, and Spitzer



"To grasp the wonders of the cosmos, and understand its infinite variety and splendor, we must collect and analyze radiation emitted by phenomena throughout the entire electromagnetic (EM) spectrum. Towards that end, NASA proposed the concept of Great Observatories, a series of four space-borne observatories designed to conduct astronomical studies over many different wavelengths (visible, gamma rays, X-rays, and infrared)."[5] *Image source*

These four telescopes, launched between 1990 to 2003, are not the only space telescopes or the first ones either. The first space telescope was the Orbiting Astronomical Observatory (OAO) launched in 1966. You can read more about OAO here.

The Hubble Space Telescope and Chandra X-ray Observatory continue to operate, and up until the launch of the James Webb Space Telescope on December 25, 2021, Hubble and Chandra were probably the two most important space telescopes.

[5] NASA's Great Observatories

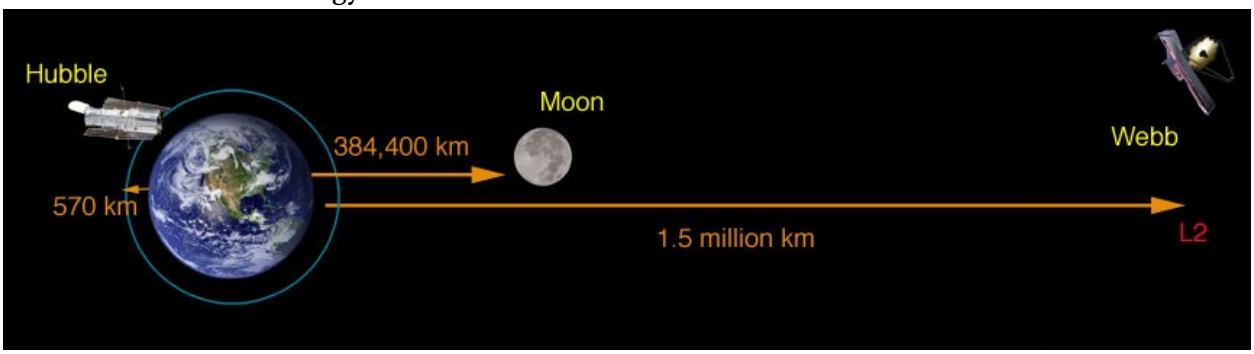
The James Webb Space Telescope (JWST)

JWST is a large, space-based infrared observatory and it is a milestone. It was a long-awaited mission and celebrated all over the world, and not just scientists celebrated its launch and the first images received.

Hubble, unlike the other three great space telescopes, is very well-known, so some might consider Webb to be Hubble's successor (or even replacement). Technically it's not. Talking about successors, Webb is rather replacing The Herschel Space Observatory that itself replaced Spitzer in 2009[6]. Those two telescopes worked much more similarly to JWST's wavelengths.

However, if we were to view it from a perspective other than technological features, we could say that JWST is Hubble's successor. They are the two most famous space telescopes.

Hubble has been in use for much longer than the other great telescopes. We all hope Webb will succeed Hubble in that regard as well. Although JWST benefits from all the new technologies developed since the launch of Hubble in 1990, it faces a far more difficult challenge because, in contrast to Hubble, Webb is not in orbit around the Earth and is therefore inaccessible for service with our current technology.



"Webb will orbit the sun 1.5 million kilometers (1 million miles) away from the Earth at what is called the second Lagrange point or L2. (Note that these graphics are not to scale.)"[7]

The Webb Telescope's mission was initially intended to have a lifespan of at least 5 years only, in contrast to Hubble, whose orbit of the Earth has lasted for 30 years.[8] However, the ultra-precision launch, or put alternatively, the saved fuel, has allowed NASA to say that it will now have enough fuel for "much more than a 10-year science lifetime"[9].

Webb can look deeper into space than Hubble because of a much larger primary mirror, giving it more light-gathering power. It also has infrared instruments with longer wavelength coverage and much more sensitivity than Hubble.

Here is a comparison of Webb with Hubble in all the details.

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[6] In 2013 Herschel's supply of liquid helium, used to cool the instruments and detectors on board, had been depleted, thus ending its mission.
[7] Webb Orbit, NASA
[8] Hubble was originally planned to last for 15 years, however. Though part of this extended lifespan was credited due to successful servicing missions.
[9] NASA Says Webb's Excess Fuel Likely to Extend its Lifetime Expectations

Infrared astronomy. IRAS, Hubble, Spitzer/Herschel and Webb

One of the breakthroughs in science occurred when astronomer William Herschel hypothesized that there is a relationship between light and heat some 220 years ago.[10] He also performed an experiment to see whether solar spectrum rays all produce heat in the same manner. While passing a sunbeam through a prism, he placed a thermometer on each strip of light and placed another thermometer beyond the red spectrum. He learned that the second thermometer warmed up as well. Thus, the conclusion followed: there are invisible rays. They were called infrared, that is, beyond red light. The development of infrared technology gave scientists a brand new vision.

Infrared light, which spans between radio waves and visible light, takes up a large part of the electromagnetic spectrum. The determination of the temperature of the solar system planets' surfaces and atmosphere marked the beginning of the use of infrared radiation in astronomy. For example, that is how we know that the highest and lowest temperatures on Mars, respectively, are 70 degrees F (21 degrees C) and minus 200 degrees Fahrenheit (minus 128 degrees Celsius).[11]

By the end of the 1960s and into the 1970s, telescopes were built for infrared observations, but there were limitations. Although ground-based observatories allowed long-duration observations necessary to receive the image of a very remote object, the number of infrared wavelengths was restricted by the Earth's atmosphere. IRAS (Infrared Astronomical Satellite), launched in 1983, was the first telescope to study space in infrared light.

Below is a picture showing that Hubble worked mostly in visible light, some ultraviolet, and a very small range of near-infrared, while Spitzer[12] operated in the mid-far infrared range. Webb was designed to cover what neither Hubble, Pitzer, nor Herschel (not shown) had yet observed.

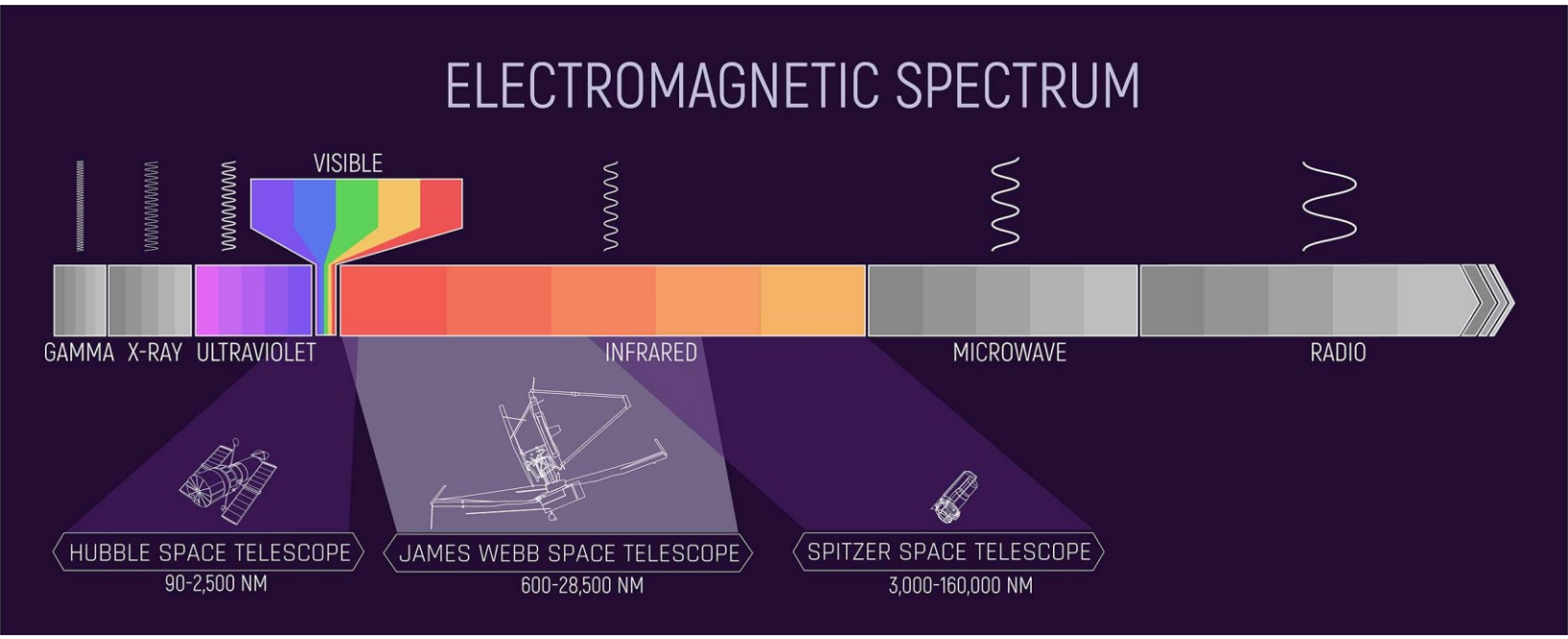


Image source

[10] "Herschel and the Puzzle of Infrared"
[11] "What Is the Temperature on Mars?"
[12] Herschel operated in far infrared and sub-millimeter wavelengths.

As was already noted, Webb is considerably more of a successor to Spitzer and Herschel than it is to Hubble, but it is also a completely new space telescope that would enable us to observe things that none of them could. No doubt, Webb is the successor to all space telescopes, marking a significant advancement in their development.

This is the first image made by Webb, released on July 11, 2022. On it, we are looking back in time 4.6 billion years ago. This image shows the galaxy cluster SMACS 0723 with many more galaxies in front of and behind the cluster. If you want to compare it with Hubble's image of the same cluster, here it is side by side, including other images.

Webb's Mission. Why is Webb Optimized for Near- and Mid-Infrared Light?

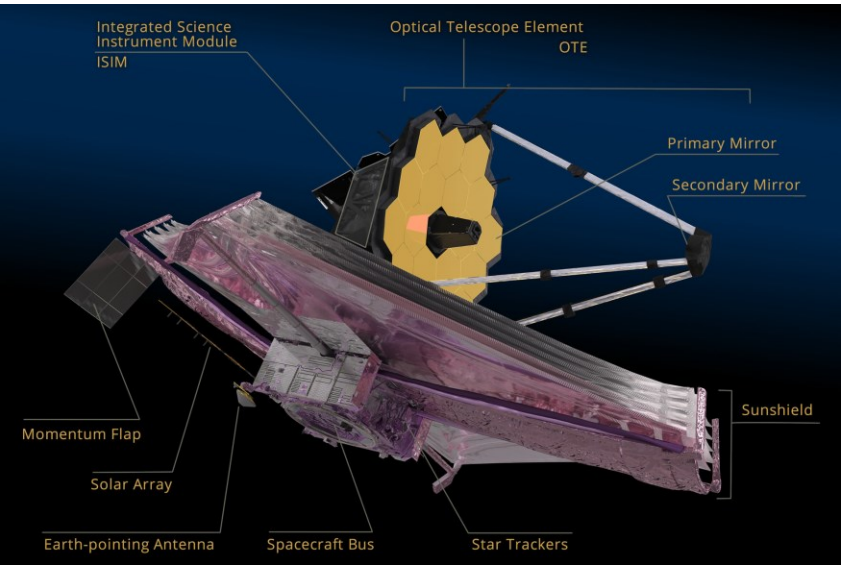
Primary goals of the mission:

- Study the evolution of galaxies from their formation to the present and search for the first galaxies or other luminous objects created after the Big Bang.
- Study the evolution of stars from the first stages to the formation of the planetary systems.
- Researching the potential for life to exist in planetary systems, including our Solar system.

So, why does Webb have to be infrared to fulfill this mission?

"To see the very first stars and galaxies form in the early Universe, we have to look deep into space to look back in time (because it takes light time to travel from there to here, the farther out we look, the further we look back in time). The Universe is expanding, and therefore the farther we look, the faster objects are moving away from us, redshifting the light. Redshift means that light that is emitted as ultraviolet or visible light is shifted more and more to redder wavelengths, into the near- and mid-infrared part of the light spectrum for very high redshifts.

Therefore, to study the earliest star formation in the Universe, we have to observe infrared light and use a telescope and instruments optimized for this light. Star and planet formation in the local Universe takes place in the centers of dense, dusty clouds, obscured from our eyes at normal visible wavelengths. Near-infrared light, with its longer wavelength, is less hindered by the small dust particles, allowing near-infrared light to escape from the dust clouds. By observing the emitted near-infrared light we can penetrate the dust and see the processes leading to star and planet formation. Objects of about Earth's temperature emit most of their radiation at mid-infrared wavelengths. These temperatures are also found in dusty regions forming stars and planets, so with mid-infrared radiation, we can see the glow of the star and planet formation taking place. An infrared-optimized telescope allows us to penetrate dust clouds to see the birthplaces of stars and planets."[13]



For anyone with a broad interest in learning more about the James Webb Space Telescope and its mission, this is a terrific beginning source that provides answers to many questions.

Image source

[13] "Webb. Frequently Asked Questions"

The Vitruvian Man

About the Vitruvian Man series

Stories about people who took their part in exploring space.

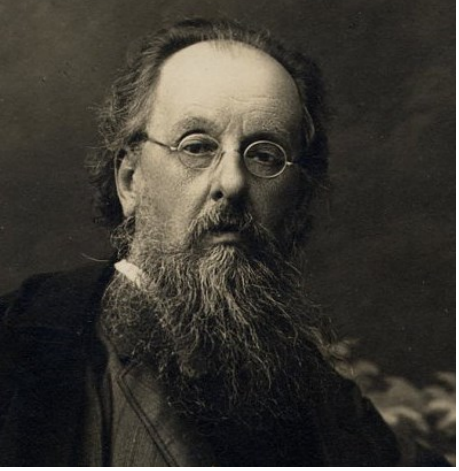
On your left is a collage by Leonid Vishnevskiy with images from the public domain including an image by Bernard Hermant from Unsplash.

In This Issue

In this issue, we'll continue talking about Konstantin Tsiolkovsky. We discuss Tsiolkovsky's perspective on space travel, as well as how to bring the human body to possibly adapt to it.

Then we'll talk about Konstantin Feoktistov, the world's first civilian cosmonaut. He also oversaw the design of the Vostok spacecraft, in which Yuri Gagarin, the first human in space, flew in. Then he oversaw the design of the spaceship that he would fly in with two others, Voskhod.

Finally, we will briefly discuss the Voskhod space program and we will have an initial introduction to Sergei Korolev. Korolev was the head of the OKB-1 (Special/Secret Design Bureau), which was in charge of designing Vostok, Voskhod, and other space programs and missions. In the next issues, we will return to Korolev. He was a major figure in human space exploration.



Konstantin Tsiolkovsky

Part III. Cosmic Biology

By Leonid Vishnevskiy

"Open Space" (1883)[1]

Tsiolkovsky's first scientific work on astronautics and the study of space can be considered "Open Space", a work written in the form of a diary in 1883. At that time, he was 26 years old and working as a teacher. He began writing it during the holidays in February and finished in the spring of that year.

In the Tsiolkovsky archive (in Russian, handwritten) this work can be found here.

In this work, he reached an important conclusion about the possibility of using jet propulsion to travel in space (however, he was far away from deriving the rocket equation), but in this article, we will focus on another aspect, namely the physical existence of a person outside Earth, and thus pay attention to a different aspect discussed by Tsiolkovsky in the same work - biological.

On the picture to your right, you see a drawing from "Open Space". This is how Tsiolkovskiy saw traveling in space back then. He goes into great detail (which we will not go into here), and a brief introduction to this description: "The projectile for open space movement that I will now describe will be used to move a person and various objects without a path, that is, without a fixed support, and in the desired direction."

Tsiolkovsky defines "open space" as:

"Open space is such a medium, within which the forces of gravity either do not act on the observed bodies/objects at all or act very weakly in comparison with the gravity of Earth near its surface. Observable bodies/objects placed in open space are naturally called free.

In theory, such an environment could have no boundaries, in which case I will refer to it as unlimited. In reality, the existence of open space appears unthinkable because the forces of gravity cannot be eliminated."

Furthermore, "if a person is a participant not only of Earth but also space, then open space phenomena should be of special interest to him."

In "Open Space", Tsiolkovsky discusses the effects of weightlessness on animals and plants, how to protect a person from rarefied outer space, and proposes building greenhouses on spaceships.

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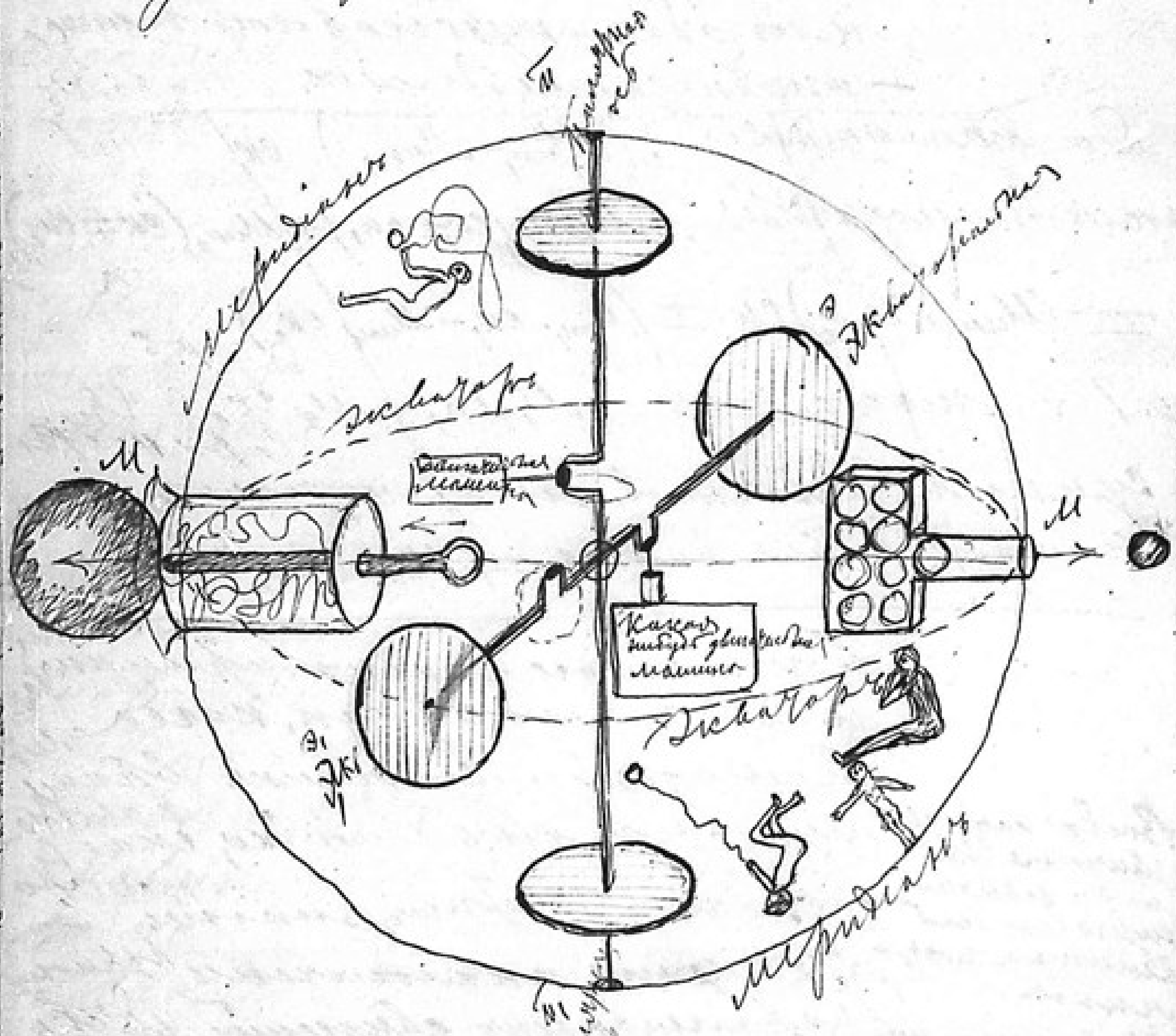
[1] Often translated as "Free Space". But unlike in English, the word "free" in Russian has a slightly different connotation in this respect, which I believe is relevant here. I think that "Open Space" is a more accurate translation. Everything in this article is translated from Russian by me.

Заглавие
Описание снаряда
Приспособленность снаряда
Устойчивые циклоидальные движения (прямые)
неустойчивые (круговые)

Снарядъ для путешествій въ свободномъ пространствѣ, который я сейчасъ опишу, будетъ служить для передвиженія человѣка и различныхъ предметовъ въ абсолютной пустотѣ и безъ пути, т.е. безъ неподвижной опоры и по желаемому направленію.



Пустота абсолютная и свободное пространство.

Weightlessness

Some (if not many) of the facts we now understand about space might have us assuming they were clear or easily understood from the start of space travel. Weightlessness is one instance when this is not the case.

1965. Gemini 7, a crewed spaceflight in NASA's Gemini program. The major goal of this mission was to develop plans for a lengthy space stay to secure the future lunar program. The astronauts spent almost 14 days in space, and upon returning to Earth they felt well.

1970. Soyuz 9, Soviet space program. The cosmonauts spent almost 18 days in space. Even though in space their health remained good, upon returning to Earth it became critical. Just four extra days in weightlessness had such an impact on the human body.

According to some scientists, before the first human went into space, a person's stay in weightlessness could be fatal due to the body's unusual blood distribution. Tsiolkovsky experienced the same uncertainty, but he came to a different conclusion. He asserted that because there are adaption mechanisms in the body that can sustain normal blood circulation if a person maintains normal vital activity both in a vertical position of the body and in a horizontal one, and even after immersion in water, then that mechanism should assist humans in weightless as well. But to what degree?

Tsiolkovsky proposed two methods for studying the effect of weightlessness on the body. The first is the reproduction of weightlessness in free fall, the second is the simulation of physiological processes when immersed in a liquid. Both of these methods were subsequently developed and used by scientists.

He emphasized the need to develop methods of moving a person, and direct their movements when they are weightless because “an inanimate object in open space, being motionless, is always motionless. And what about people and animals? If there is no support nearby, will their moving limbs from birth—limbs that were born on Earth—help them leave their current location? ... In this instance, the helplessness of the animate/living object in comparison to the inanimate is equal.”[2]

He further said that “A human's current form is tailored to a set of opposite and equal forces, and without gravity on Earth's surface, this form would be entirely different. ... Legs, which are required for locomotion in a gravity environment, would most likely atrophy or be transformed into some other limb useful in this environment.” We now know that in space, our muscles atrophy, and our bones lose calcium.

In 1895 Tsiolkovsky first proposed creating artificial gravity by rotating the cockpit of a spacecraft to help people adapt to the conditions of weightlessness. This concept is based on the principle of equivalence of gravitational and inertial forces[3]. If you've seen the films “2001: A Space Odyssey” (1968), “Interstellar” (2014), or some others, you have already seen what it may look like.

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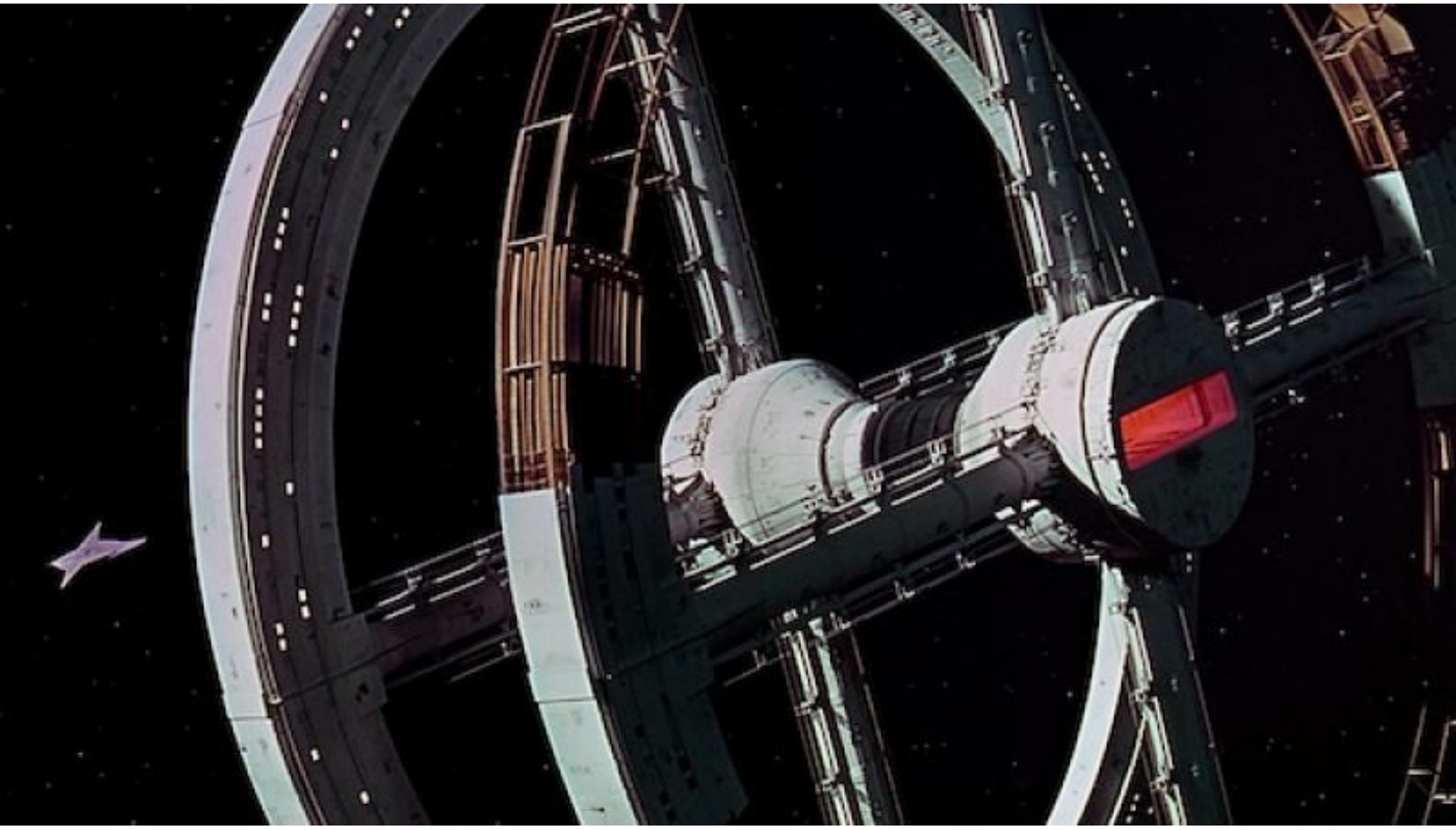
[2] “Open Space” (1883), Tsiolkovsky

[3] The forces of gravitational interaction are proportional to the gravitational mass of the body, while the forces of inertia are proportional to the inertial mass of the body. If the inertial and gravitational masses are equal, then it is impossible to distinguish what force acts on a given sufficiently small body - gravitational or inertial force.



A movie scene from "2001: A Space Odyssey"

However, there are no current applications of artificial gravity in space for humans. I'll briefly explain why it is so.

In the case of a device with a small radius, different forces will act on the lower limbs, and - the farther from the center of rotation, the stronger the effect of artificial gravity. Moreover, in the case of the small size of such device, the person will be affected by the Coriolis acceleration, which can cause motion sickness when moving relative to the direction of rotation. So, this device, part of the spacecraft or spacecraft itself would have to be huge.

A movie scene from "2001: A Space Odyssey"

Another issue is the device's extremely complicated design. Unless we make a beautiful decision by looking at it in a completely different way to design it, it is critical right now when designing such a mechanism to allow crew members access to compartments with artificial gravity while also ensuring the smooth rotation of this massive unit.

Greenhouses On Spaceships

"Just as plants cleanse Earth's atmosphere with the help of the Sun, so can our artificial atmosphere be renewed."[4]

This practice has not taken root: now, complex technical life support systems are used to maintain the optimal gas system on orbital stations.

Protection of Living Organisms from Overloads

Once Tsiolkovsky said[5]: “For thousands of years, we have been rushing through space in a wheelless carriage at 27 miles per second, and possibly faster, without shocks or noise. But before Galileo and Copernicus, this movement went unnoticed because our backs did not hurt.”

In other words, he understood that the speed itself, no matter how great (the first and second cosmic velocities), should not have an adverse effect on the body with uniform motion. However, the effect on the human body during spacecraft launch, acceleration, deceleration, and landing, should be studied. And it is especially important to determine not only the safe limit of overloads but to correlate it with the time of exposure to the body. That is, he stated, why any launch system resembling a cannon cannot be accepted while the characteristics of the rocket can be adjusted in accordance with the capabilities of living organisms.

Noting that once in case of poor health, a person tends to take a horizontal position in order to more easily endure the usual overload, that is, gravity, it is reasonable to assume that the same body position will be most correct with large overloads. Tsiolkovsky was not mistaken. Centrifuge tests have revealed that the highest stability of a person occurs when the load acts in the transverse direction. That is why, as suggested by Tsiolkovsky, the astronauts take a position on their backs in the rocket before launch.

In 1920 he wrote the novel “Out of the Earth”, here is an excerpt from it. “Our friends will remain safe and sound because they are placed in a supine position in a liquid of the same density as the average density of their bodies." This method was later named immersion (and now includes dry immersion).

But he also pointed out that the increase in resistance to overloads when immersed in a special liquid has limitations, primarily because of the different densities of tissues in the body. That is, denser tissues will move down, and lighter ones will move up, which will lead to ruptures in the tissues.

Tsiolkovsky's work on space biology is far from limited to “Open Space”, or weightlessness, or greenhouses, or protection from overloads. Over time, he returns to reflect on these and other important issues which I didn’t mention. To your right is a model of the Tsiolkovsky rocket, where, among other things, you can see immersion baths (*Image source*). The model was made on the basis of descriptions and drawings by Tsiolkovsky that he made in the period 1896-1923.

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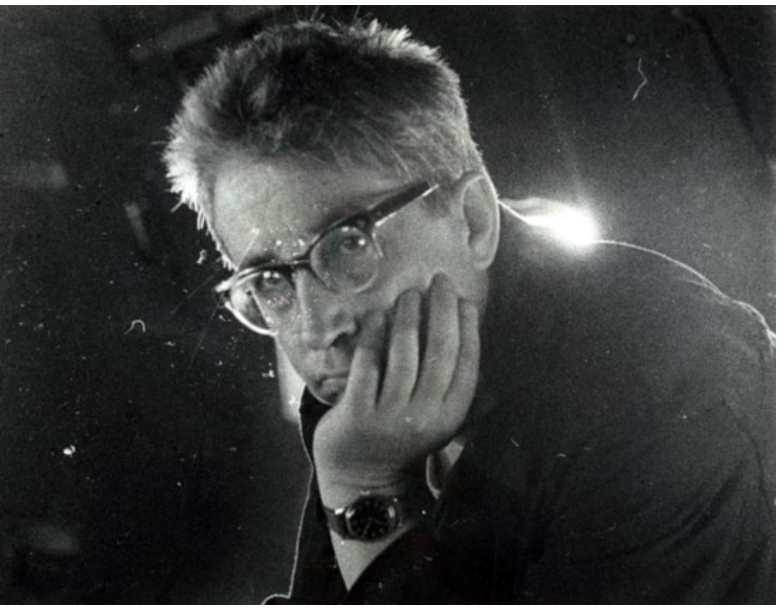
[4] “The Exploration of the Universe with Jet Propulsion Instruments” (1911), K. Tsiolkovsky
[5] Source

Konstantin Feoktistov. The First Civilian Cosmonaut

by Leonid Vishnevskiy



K. Feoktistov in 1964. *Image source: The Museum of Cosmonautics*

Everyone knows the name of the first cosmonaut, Yuri Gagarin. But sadly, because the development of spaceflight from the very beginning was very military-oriented, the first humans in space were military men, including Yuri Gagarin. This article is dedicated to the first civilian in space. His name was Konstantin Feoktistov[1], and his spaceflight was in 1964 on the spacecraft Voskhod[2]. Voskhod was also the first multi-manned flight.

You might be wondering, what am I talking about? Because we all know about the Inspiration4 mission, the world's first all-civilian spaceflight to orbit in September 2021. But while Konstantin Feoktistov was the first civilian in space, the flight itself was not all-civilian. And in fact, Sergei Korolev[3] had to strongly insist on the inclusion of a civilian in the crew.

When we read someone's biography there is always a detail that draws our attention more than others, and we start to draw the portrait of a person from there.

Konstantin Feoktistov was born in 1926 in Voronezh, Russia. When the Second World War approached his hometown, although only sixteen years old at the time, he volunteered to join the resistance against Nazi occupation as a scout in 1942. Konstantin was captured by a Nazi Waffen-SS patrol and quickly sentenced to death. However, the bullet only grazed his chin and throat, after which he feigned death and managed to escape from his burial trench.

K. Feoktistov in 1942. *Image credits: RIA Voronezh*

K. Feoktistov and Y. Gagarin. *Image credits:* GCTC

Roughly twenty years later he would fly into space on the spacecraft Voskhod (translated as Sunrise or Dawn). But before that he supervised the design of the single-seat spaceship Vostok (East) and proposed the spherical shape of the descent vehicle for it, which was used by Yuri Gagarin in 1961. Feoktistov also then supervised redesigning the Vostok capsule to accommodate more than one cosmonaut, and that spaceship was Voskhod.

[1] He was also the only non-member of the Communist Party in Soviet history to become a cosmonaut.
[2] Later it would be known as Voskhod 1. Voskhod 2 would be known for the first spacewalk.
[3] Sergei Korolev was a legendary Soviet rocket engineer and spacecraft designer. And up until his death all Soviet space engineering was done under his leadership and supervision.

This is how Georgy Grechko, a famous Soviet pilot-cosmonaut, remembers Feoktistov[4]:

"Feoktistov was an engineer from God. Our spaceships and first orbital stations were all Feoktistov's projects. When our first group of civilian cosmonauts was formed, Sergei Korolev nominated Feoktistov for the flight first. This was Korolev awarded Feoktistov for his engineering genius.

Feoktistov was a brilliant, knowledgeable, and thoughtful man. He published several books[5]. He was very consistent. All his decisions he defended to the point that sometimes he even made Sergei Pavlovich Korolev lose his temper. Then Korolev would take away his access ID card, tear it up, and say: "You are fired."

But after a day or two would go by, without Feoktistov there would be no more progress. "Where is Feoktistov?" - asked Korolev. "But you fired him." "I didn't fire anyone. He should go to work."

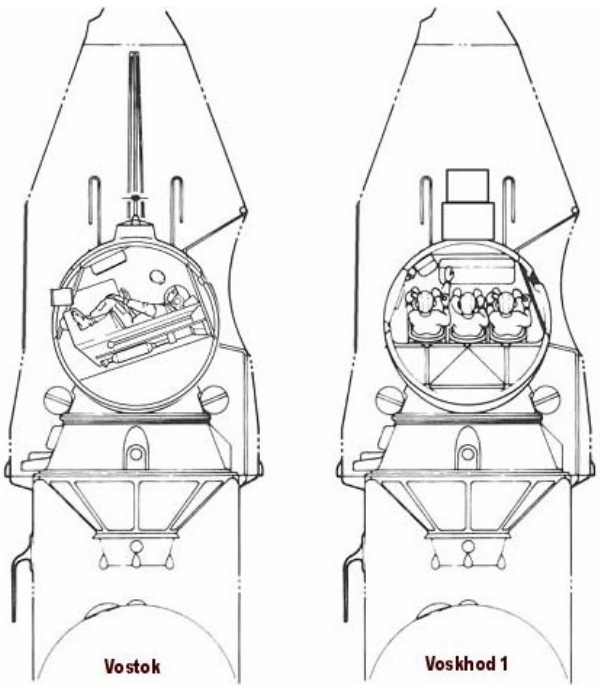
Feoktistov was a fierce arguer. I could disagree with his position; I always had my own. But I always respected his position, his views, his approach."

Now consider how Feoktistov remembers Korolev. In 2000 Feoktistov wrote the book "Trajectory of life"[6], and there is a section dedicated to Korolev. You can read it using Google Translate. In short, he held Sergei Korolev in high regard and admired him greatly. Here is some more interesting content from his book.

Sergei Korolev, chief designer, with the crew of the spaceship Voskhod before the flight. The Baikonur Cosmodrome, 1964.
From left to right: commander pilot Vladimir Komarov (he was also an engineer), Sergei Korolev, civil engineer Konstantin Feoktistov, and military physician Boris Yegorov. Image source: GMIK

[4] Source. Translated by Leonid Vishnevskiy.
[5] At least eight books according to this website, including being the co-author of a few.
[6] ISBN: 5-264-00383-1

First cosmonaut Yuri Gagarin with the crew of the spaceship Voskhod before the flight. October 12, 1964. From left to right: civil engineer Konstantin Feoktistov, Yuri Gagarin, command pilot Vladimir Komarov, and military physician Boris Yegorov. Image source: GMIK



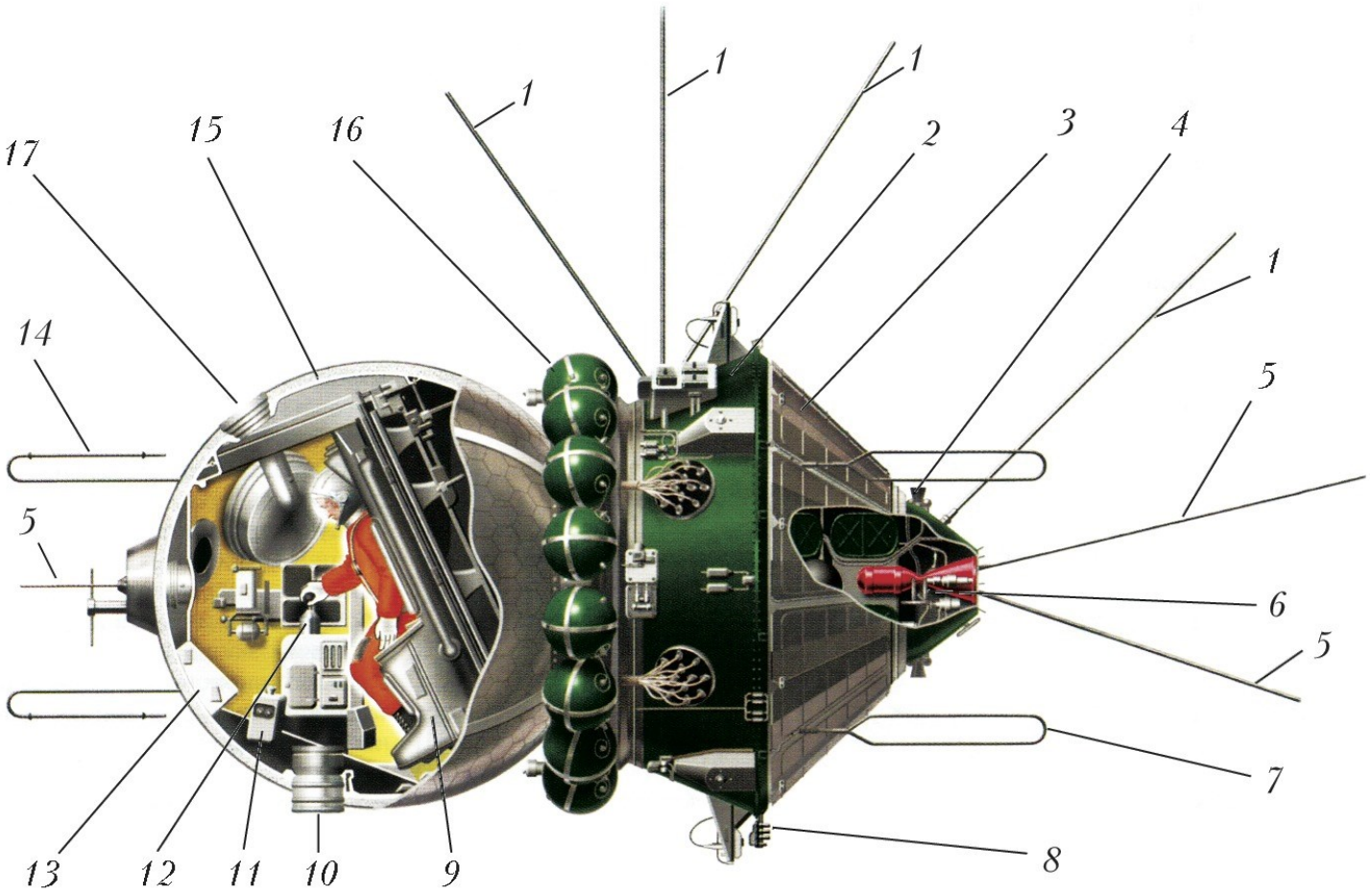
On the picture:

Cosmonauts V.M. Komarov, K.P. Feoktistov, B.B. Yegorov in the cabin of the spacecraft "Voskhod", 1964.
Image source: GMIK

On the drawing:

Seating in Vostok and Voskhod.
Image source

Vostok was a single-seat spaceship that carried Yuri Gagarin into space and was used as a model for redesigning it into a multi-seat spaceship Voskhod. *Image source: bigenc.ru (description translated by Leonid Vishnevskiy)*



1 - **Earth communication system antennas** (антенны системы связи с Землей)

2 – **instrument/equipment compartment** (приборный отсек)

3 - **thermostatic control system shutters** (жалюзи системы терморегулирования)

4 - **solar orientation sensor** (сопла ориентации СДУ)

5 – **Signal's system antennas** (антенны системы «Сигнал»)

6 – **braking engine** (тормозная двигательная установка)

7 – **telemetry antennas** (антенны телеметрии)

8 – **solar sensor** (солнечный датчик)

9 – **cosmonaut in ejection chair** (космонавт в катапультируем кресле)

10 - **viewer "Vzor"** (визир «Взор»)

11 – **TV camera** (телекамера)

12 – **orientation control handle** (ручка управление ориентацией)

13 – **dashboard** (приборная доска)

14 – **command radio-lines antennas** (антенны командной радиолокации)

15 – **descend module** (спускаемый аппарат)

16 – **pressurized gas/nitrogen tanks** (баллон с азотом)

17 – **porthole**/(иллюминатор)

October 12, 1964. Vostok and Voskhod Distinctions

Voskhod was one of the riskiest Soviet space flights.

Why take the risk? Because the Soviet Union and the United States were competing in the space race. The US was working on Project Gemini at the time, which would allow the Gemini spacecraft to contain two people instead of just one.

The Soviet Union decided to send three cosmonauts despite having only the single-seat Vostok at the time. A fundamentally new Soviet spacecraft, with which they anticipated flying to the Moon, was still in the design stage at the time. To fit three cosmonauts in Vostok, they had to wear light training suits and could only sit on cramped individual chairs in highly uncomfortable positions - reclining on their backs with knees bent to their chests.

Without space suits, nothing could save the crew in case of depressurization of the spacecraft in orbit. There was also no room for three ejection seats, so there was no possibility of emergency rescue in the case of rocket explosion or booster failure at launch and during the first 27 seconds of flight.

There was also no reserve parachute, meaning that if the main parachutes failed it would inevitably lead to the death of the crew[7].

To soften the impact during landing, the seats were equipped with additional shock absorbers. Furthermore, a system of a soft landing with two domes of the main parachutes and powder engines located on slings was developed. A remote stylus-type contact device was added to activate them. Also, an additional backup braking engine weighing 145 kg was installed.

Voskhod had the same external dimensions and layout as the Vostok (length - 5 m/appr. 16.4-foot, diameter – 2,43 m/appr. 8 foot), but was around 595 kilograms/appr. 1312 pounds heavier than Vostok.

On October 12, 1964, Voskhod carried three cosmonauts: Vladimir Komarov, Konstantin Feoktistov, and Boris Yegorov into Earth's orbit. It was the first multi-manned space flight. The trio landed after 16 orbits of the Earth, 24 hours 17 min 03 sec after they had left, on October 13, 1964. Everything went smoothly. A large amount of scientific data was obtained. It was a complete success.

October 12, 1964. From left to right: Feoktistov, Komarov and Yegorov in light training suits before the flight.
Image source: The Museum of Cosmonautics

[7] The Vostok descent vehicle lacked a reserve parachute as well, but it landed without a cosmonaut. Yuri Gagarin landed on his own, with his own reserve parachute.

More to Know

Voskhod was designed in three configurations: for three cosmonauts for a short space flight (Voskhod 1), for two cosmonauts with a gateway for spacewalks (Voskhod 2), and two-seated for long flights (Voskhod 3). The Voskhod program was intended to take flight several more times, but it was brought to an end to speed up the lunar program. The Voskhod spacecraft was launched into orbit using a Soyuz launch vehicle.

Vladimir Komarov with his family. *Image source*

On April 24, 1967, Vladimir Komarov, the Voskhod-1 commander, died during the first flight of the Soyuz spacecraft.

"This was the first in-flight fatality in the history of human spaceflight. This tragedy was a scant three months after the Apollo 1 accident that occurred on Jan. 27, 1967, in which astronauts Gus Grissom, Edward White, and Roger Chaffee lost their lives when a fire swept through the command module during preflight testing."[8] Read more about Soyuz's mission here.

Konstantin Feoktistov and Boris Yegorov no longer flew into space. Feoktistov was involved in the development of new space systems and was the deputy general designer of RKK Energia (translated as Energy), as well as a professor at Bauman Moscow State Technical University. Yegorov was the director of the Research Institute of Biomedical Technology and worked at the Institute of Biomedical Problems (IBPM).

A few words about Bauman University. Sergei Korolev and Konstantin Feoktistov were among their graduates. Korolev also taught there. In fact, he taught Feoktistov. And Andrei Tupolev, who was taught by Nikolay Zhukovsky, taught Korolev. Korolev also regarded Konstantin Tsiolkovsky as his teacher.

The flight lasted only a little more than a day, but during this short period in 1964, the country experienced a "palace coup", which resulted in Nikita Khrushchev's removal from the position of country leader. Despite voluntarism, "Kuzma's mother," corn, etc., the time of his rule was also known as Khrushchev's Thaw and he actively backed the advancement of Soviet cosmonautics. Brezhnev, the new country leader, was more concerned with the economy. Kosygin, the new prime minister, was attempting to implement progressive economic reforms that could have benefited the country and sponsored advanced space exploration in the future. Those reforms failed for a variety of reasons, and this period would be known as the beginning of The Era of Stagnation in the Soviet Union, which would eventually lead to its fall.

Sergei Korolev died unexpectedly during an operation in January 1966, at the age of 59. Only then did the world learn his name and the significance of his role in space exploration.

From the Interview with Konstantin Feoktistov

This was taken between 1964-1966.[9]

[8] Vladimir Komarov and Soyuz 1, NASA
[9] Translated by me for Astra News.

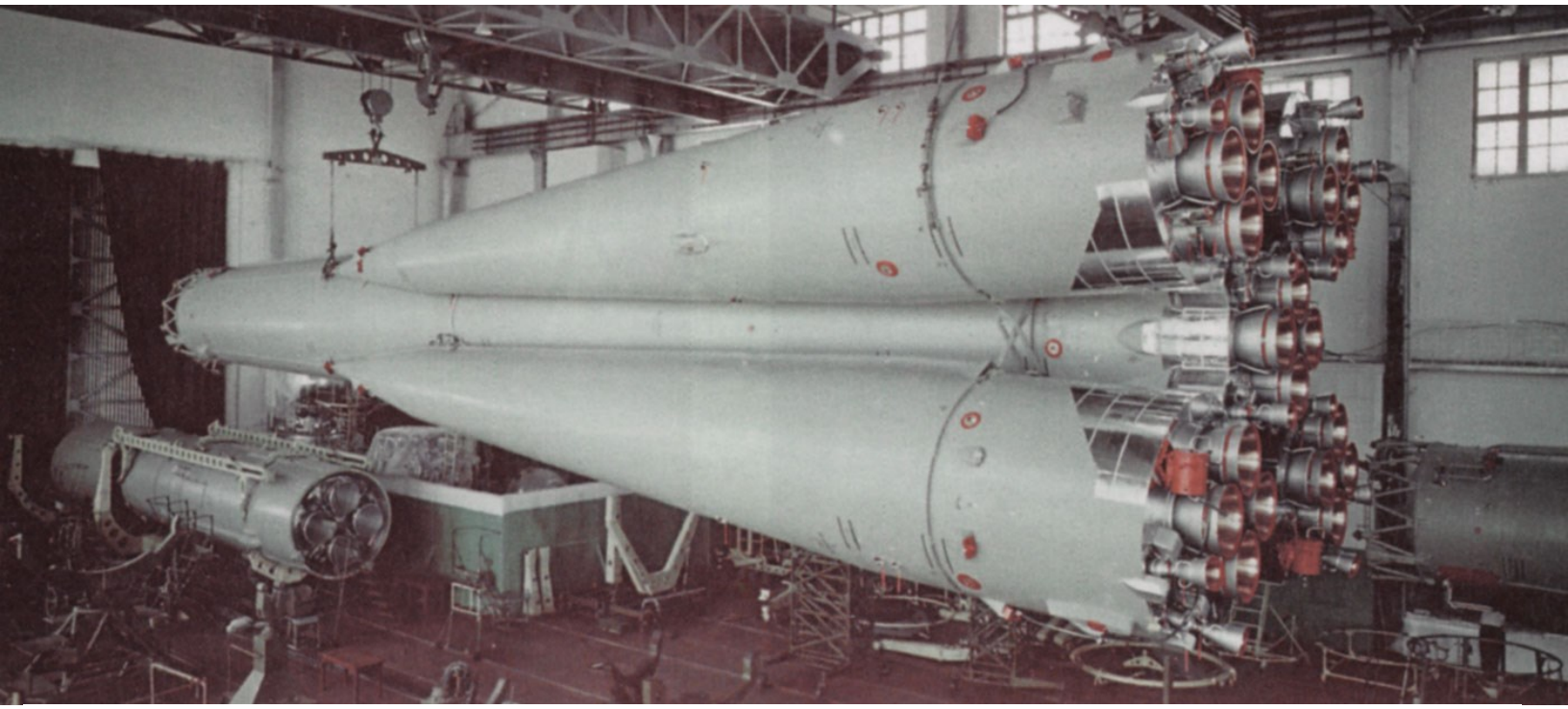
“Could it be that the world made a mistake and began the expansion into space prematurely? … Perhaps it is reasonable first to arrange life on Earth, and space will wait?

- But, first of all, - Feoktistov replies to these doubts, - it is impossible to open the door to a new sphere of life and immediately close it, even for economic reasons. This process is irreversible: if there are technical possibilities for exploring the Universe, they cannot be ignored. Second, contrasting the work of space exploration with the efforts of people to improve their standard of living is a clear delusion. These are different sides of human progress, not contradictory. …

Humanity needs great goals that mobilize its spiritual and physical energy. Because of the flaws of the old social formations, much of this energy went to war. In its last five thousand years, humanity has been at peace for only three centuries. Fifteen thousand large and small wars have cost billions of lives and many hundreds of trillions of rubles. An era of such barbarism cannot last forever.

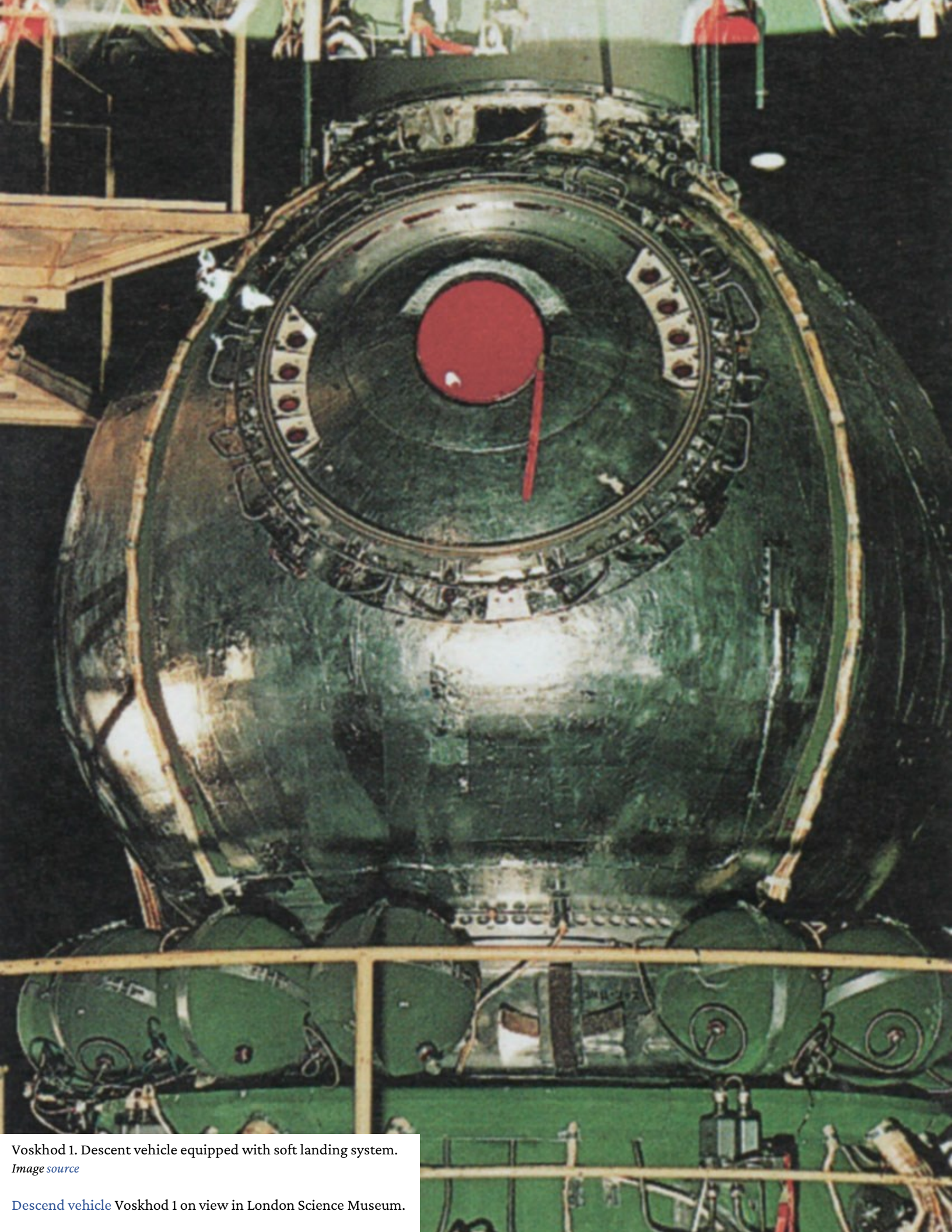
The conquest of the Universe is a goal truly worthy of Man.”

More Images



11A57, Launch Vehicle Voskhod, Assembly. *Image source*

October 13, 1964.
The crew of the spaceship Voskhod after landing.
Image source



Voskhod 1. Descent vehicle equipped with soft landing system.
Image source

Descend vehicle Voskhod 1 on view in London Science Museum.

Sergei Korolev. Space Program Voskhod

by Leonid Vishnevskiy

When writing an article about the first civilian cosmonaut Konstantin Feoktistov, I found a lot of interesting material about the Voskhod spacecraft, which he was responsible for redesigning from the Vostok spacecraft (that he also designed). Then he flew on it and tested it during space flight. I want to share this material in the form of a short review of the Voskhod space program.

Sergei Korolev

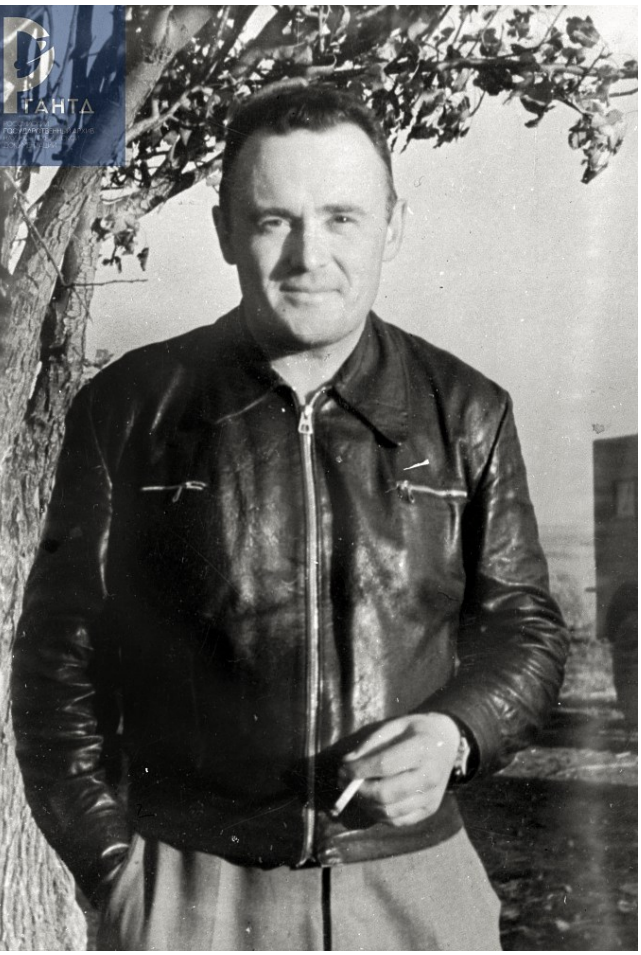


Image source

But first, to avoid confusion, why do I call Feoktistov the designer of Vostok and Voskhod, and at the same time pay so much attention to Sergei Korolev? Korolev headed the design bureau OKB-1, responsible not only for the design of Vostok and Voskhod but also for many other space programs and missions. All the main supervision and final decisions were done by him. He was also determining the course of development of Soviet cosmonautics, or at least was making a significant impact on it.

Korolev's role is difficult to overestimate; there was a widespread belief that whatever he had in mind would come true regardless of the obstacles. But that doesn't mean, of course, that he was the only talented, genius engineer. As always, it was the work of many. Also true, regardless of the latter, that when he died it was an irreparable loss. He was a legend not merely because he was a talented, genius engineer; there were quite a few of them in Soviet cosmonautics.

On the internet, you can often find a quote attributed to Sergei Korolev, the original source of which I have not yet been able to locate (perhaps it was in some speech or interview that is not digitized), but which equates precisely with what I have learned about Korolev. Here's the quote (translated by me).

"A person who believes in a fairy tale eventually will be in it because he has a heart." Sergei Korolev was one of those men who expand our horizons and make dreams come true.

Space Program Voskhod[1]

The Voskhod multi-seat spacecraft was to be used for orbital flights to conduct technical, scientific, and medical experiments. The program ran from 1963 to 1966. It was brought to an end to speed up the lunar program and was not completed. Voskhod was designed in three configurations.

- ✓ The first modification of the ship was intended for an orbital flight of a crew of three cosmonauts without space suits. Two spacecraft of this modification were launched: the unmanned Kosmos 47 and the manned Voskhod (crew: Komarov, Feoktistov, and Yegorov)

[1] *Main source*

- ✓ The second modification differed from the first one in the presence of a life support system for spacesuits for two cosmonauts and an airlock with an airlock system for a spacewalk. Two ships of this modification were launched: the unmanned Kosmos 57 and the manned Voskhod 2.

- ✓ The third modification was intended for a long flight (up to 20 days) of a crew of two cosmonauts without spacesuits. The Voskhod spacecraft of this modification was launched into orbit in an unmanned version in 1966 under the name Kosmos 110 with animals on board. In manned mode, this modification of the ship was not launched.

In total, 7 manned Voskhod spacecraft were to be launched. The Voskhod-3 spacecraft was supposed to make a long flight with a scientific research program, and then another flight with military tasks planned. On the following Voskhod spacecraft, there was supposed to be a flight of a female crew with the first spacewalk of a woman in the history of cosmonautics, then a flight of a two-seat spacecraft with a medical research program, which included a surgical operation in space flight on an experimental animal (a rabbit).

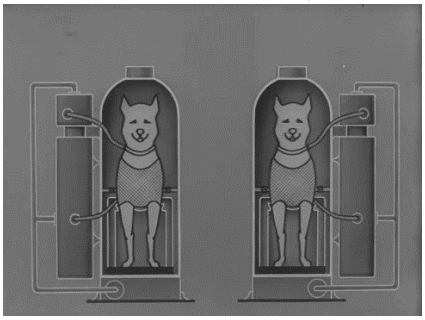
It was also planned to carry out a flight to conduct an experiment in space to create artificial gravity by spinning the Voskhod spacecraft with the 3rd stage of the launch vehicle, connected by a cable.

Biosatellite Kosmos 110

"The Kosmos-110 flight program included a study of the factors affecting biological organisms during a three-week flight in orbit passing through the Earth's inner radiation belt, as well as testing a life support system for future long-term manned expeditions. Two dogs were selected … The "passengers", Ugolyok [translated as Little Ember] and Veterok [Breeze], were seated in sealed containers with a given gaseous environment, they were put in "suits" that had sensors and kept the animals' bodies from excessive movements. Feeding was carried out through a special fistula, which allowed liquid food to be automatically fed directly into the stomach. In addition to dogs, other biological research objects (bacteria, plant seeds, yeast, etc.) were on board. … The mission with constant flybys through the radiation belts lasted 21 days 18 hours 51 minutes and became the record for the longest time spent in space by an animal for the time. … Space travel greatly weakened the dogs: they looked thin and lethargic, quickly tired, preferred to lie down, and were constantly thirsty. As a result of exposure to cosmic radiation, their hair thinned and came out in clumps. However, after three days they came to their senses, and after a few weeks, they fully recovered. They lived a full life as inhabitants of the IBMP [Institute of Biomedical Problems] vivarium and left behind healthy offspring."[2]

Some documentary film fragments (all silent) about the flight of the biosatellite Kosmos 110.

Launch and landing



Cartoon explaining the mission

A few days after landing

[2] *Source*

ROM The Republic of Mars

About ROM

If you dream of us humans becoming multi-planetary beings and see Mars as our chance to build a better world for humankind, this project is for you.

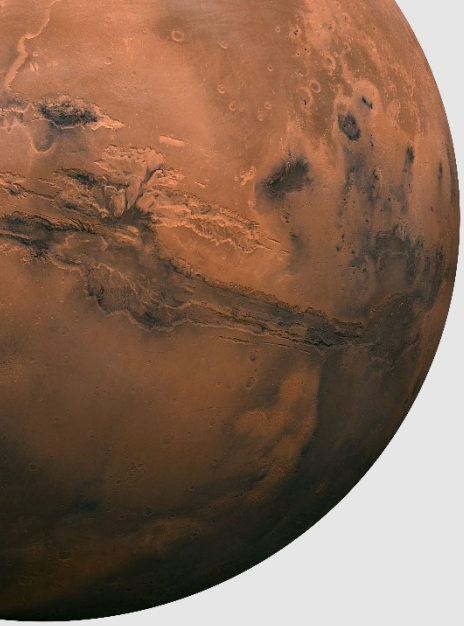
In this Issue

The rubric begins with Neil Vivo's article "The Leaders of Mars". What kind of a leader should Mars have? Should we have only one leader? How do we prevent wars on Mars? Neil addresses these and other very important questions and invites you to participate in the conversation. Join Neil! We are eager to hear your thoughts!

The rubric continues with the impression of the movie "Dead Mountaineer's Hotel". We didn't put this article in the Impressions rubric of Astra News because the film raises questions directly related to the Republic of Mars. For example, how should we judge other planets' inhabitants if we ever meet them? We also wish to begin a discussion with this film of what philosophy a person preparing to become a multi-planetary being should adopt. We invite you to participate in this discussion as well!

On the left is a collage by Leonid Vishnevskiy, with images from the public domain including an image from Official SpaceX Photos on Flickr and the painting "Rescue of Emperor Maximilian I from Martinswand" by Friedrich Krepp.


MARS



Leaders of Mars

By Neil Vivo

I was thinking about Mars colonization when this thought flashed in my mind and hence this article. I hope you'll enjoy reading it and maybe someday when we get a chance, we can together ponder about it. I was thrilled to write this article! I am 11 years old; I love to make games with 3D animation, I'm interested in AI and robotics, coding, and Rubik's cubes.

Once we colonize Mars and make it suitable for human and animal life we would come across a problem and that problem would be who would lead Mars? Will there be more than one leader? Will we even have a leader on Mars? These questions may not seem too big but they are worth thinking about.

Let's think for now that we will have a leader for Mars. When we choose a leader for Mars, we should most likely make sure that there are multiple leaders. Because a whole planet is too much for one person to handle. Now let's try to find out what leaders should do. Leaders' jobs and goals should be to stop a war, make sure people have enough resources like food and water, and make important decisions for the people of Mars. Each leader should have their own job. Like one leader makes sure we have enough resources for Mars civilization. Another leader should be, to stop any wars, and all the leaders should make decisions for Mars.

Now let's think that we will have no leaders on Mars and see how we can make that work. Well, if this is the case, we should just have some jobs assigned to common people that do the jobs of the leaders. For example, a group of people will be vested with a job to find out if we have enough resources and if we don't have enough resources, they will alert the people who make the resources to try to make more. And to stop war we should simply just make Mars one whole place that's all united. So, since everything is united and voted on, there will most likely be no wars. And if we want to make an important decision for Mars, people can show their idea to the public and people can vote on what to do.

And these are all the ways and fixes for the problem on who will be the leader of the people of Mars. Even if we can make leaders for Mars or even have no leaders at all and make everything work out just as fine and have a nice happy community for all the people who live on Mars.

On the left images by David East, Alex wong and Triston Dunn from Unsplash were used.

The Dead Mountaineer's Hotel

Movie impression by Leonid Vishnevskiy

Inspector Glebsky arrives at The Dead Mountaineer's Hotel.

You may have heard about Andrei Tarkovsky's film Stalker. It was an adaptation of a novel written by Arkady and Boris Strugatskie. In this article, we will discuss the film adaptation of another of their novels, “The Dead Mountaineer's Hotel”, which was published in 1969 and adapted into a movie in 1979 by Grigori Kromanov.

Like all the Strugatskie brothers’ stories and novels, “The Dead Mountaineer’s Hotel” was written in Russian. The movie’s original language, however, is Estonian. In 2015 the book was translated into English, here it is on Goodreads. There is also an English version of the movie, but it is hard to find.

Here is the plot in a nutshell. Arriving on an urgent call to a hotel, the police inspector Glebsky doesn't find anything criminal. But soon the inspector discovers the body of a murdered guest, who was still alive when the inspector arrived. Suspicion falls on everyone who lives in the hotel. It looks like a classic detective story when a crime happens in a closed and cut-off area from the rest of the world. However, the ending will be unexpected for a genre like this. If you want to read the book or watch the movie, please, stop reading now because there will be spoilers later in the article.

Let us begin our visual acquaintance with the film.

Glebsky arrives at the hotel to solve the crime, only to discover that there was none. Maybe it was someone's joke? He is happy to spend the night at the hotel though. The hotel owner, Alex, is friendly, the scenery is stunning, and the guests appeared to him to be pleasant. They all gather in the evening for dinner, except for one of the guests. Alex asks whether they believe in aliens. Both the physicist, Simon Simone, and Glebsky say no. The owner claims that one must be a poet to believe in aliens. Olaf Andvarafors takes a close glance at Glebsky.

The guest who did not come to dinner, is Hinckus. He prefers to be apart from this company. But there are two empty chairs.

The guests play billiard after dinner. Simon Simone is puzzled by Olaf's naiveté and suggests that he does not understand jokes.

Later that evening, here is Simon Simone. It will eventually be our turn to be puzzled.

Mr. Moses is not the most pleasant gentleman. He is married to the lovely Mrs. Moses.

Inspector Glebsky is curious about Mr. Moses. "Who exactly is this Mr. Moses?", he asks. Alex replies, "He signed up as a traveling merchant, but there is nowhere to go from here; you can only go back."

An avalanche falls in the mountains, and events take a tragic turn. Mrs. Moses suddenly becomes dead, according to Simon Simone, and Olaf has also been found dead.

Near the dead Olaf lies some kind of briefcase.

No one believes Simone, because soon Mrs. Moses is seen alive. Olaf remains dead.

Glebsky finds Hinkus bound and helps him free himself. Hinkus is scared and later tells Glebsky everything he knows, including that Mrs. Moses can turn into him, Hinkus.

Glebsky may soon be convinced of Mrs. Mose's paranormal ability,

but instead, he exclaims, "Stop your hypnosis!"

Now it’s time to explain everything, to save Olaf, who is not dead

and to see the other missing guest during the dinner, Mr. Larvik.

“I may not have chosen the best mask, but I cannot show you my true face.”

We will never know where Mr. Moses, his “wife”, Larvik, and Olaf came to Earth from. Perhaps from another galaxy, or perhaps from another dimension.

Six months ago, they arrived here to study the Earth and they were forbidden to make contact with people, however, seeing how badly people live here, Moses decides to help. Unfortunately, the first people he comes into contact with on Earth are terrorists.

They convince Moses that they are fighting for justice, and he helps them pull off a series of big heists using technology not yet discovered on Earth. However, Moses refuses to show violence towards other people, and this results in a conflict with the terrorists. Moses realizes who he has contacted, and decides not only to run away from them but also to leave the Earth.

Hinkus was sent by the terrorists to track down Moses. It was Moses who called Glebsky from the hotel, asking for help, hoping that he would understand Moses.

All this coincides with what Hinkus himself told Glebsky.

Nevertheless, Glebsky, tormented by doubts, is opposed to such a fantastic explanation. His biggest dream right now is to have the hotel phone working again so that he can call the chief and ask him what to do, to relieve himself of the responsibility for decision-making.

Mr. Moses also tells Glebsky that Olaf Andvarafors and his "wife" are both robots and Larvik is their pilot. Their power station was damaged during the avalanche, and the robots were turned off, but only Olaf could not be switched to a backup power source. Their launch site is here in the mountains, but Hinkus was preventing them from leaving Earth.

He asks Glebsky to give them the briefcase, which is a backup power source for Olaf, so they could bring him back to existence and leave Earth altogether.

Everyone in the hotel is now pleading with Glebsky to at least try to save Olaf and see for himself whether Moses is being honest or not, whether Olaf is a robot or not.

All but Glebsky are now eager to help the aliens, and so the guests temporarily immobilize Glebsky. However, it’s too late. The aliens are unable to flee far because a terrorist helicopter approaches and shoots them.

Olaf is now really dead, as well as Mr. Moses, his “wife”, and Larvik.

The faithful dog of the dead mountaineer mourns their death along with the people.

Another strong avalanche occurs in the mountains. During an avalanche some time ago, the mountaineer had died, after whom the hotel had got its name.

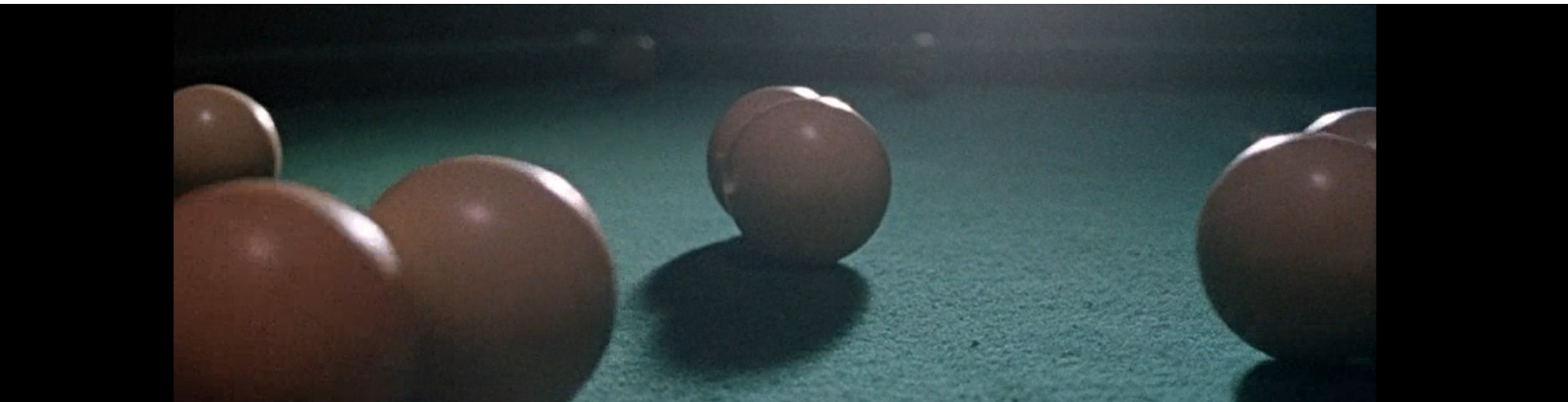
It's been twenty years. Inspector Glebsky has been asking himself the same question all along: did he do the right thing? At the end of the movie, he delivers a monologue to us, and although we cannot undoubtedly put a question mark at the end of this monologue ("Did I act correctly?"), everything in Glebsky suggests that he torments himself over his actions from two decades prior.

"*Why are you looking at me? I could not have done otherwise. I have done my duty without violating either the letter or the spirit of the law. You say that this whole strange group is dead. Well, let's be logical. If these are people, then they are criminals and got what they deserved. And if they are not criminals, then they are not people. But what do I care about them, these non-humans, hidden under human form? Is it logical? It's logical. I'm right. I acted correctly*."

The music for the movie was written by Estonian composer Sven Grünberg. Listen to one of the compositions, “Ball”, **HERE**.

Some More Images and Quotes From "The Dead Mountaineer's Hotel"

Inspector Glebsky: And none of your robots are actually robots.
Mr. Moses: That is, you want to say that our robots are too similar to people.



Simon Simone to Glebsky. So, this is how the two worlds met. And they flew in from who knows where for this. First, they meet terrorists, and then such a law enforcer as yourself.

Alex to Glebsky. *Human conscience lives not by law alone.*

TELL US

SEND YOUR SURREAL COLLAGES, DRAWINGS, PAINTINGS, OR PHOTOS FOR PEOPLE TO IMAGINE STORIES AROUND.

THE NAME OF THIS RUBRIC IS "THE HILL THAT DUG ITSELF OUT".

IF SOMEONE WANTS TO SHARE A STORY THEY CAME UP WITH, WE WOULD LOVE TO PUBLISH IT!

In this issue collages by Leonid Vishnevskiy, images from the public domain including the painting "The Hunters in the Snow" by Pieter Bruegel the Elder, and images by Kristaps Ungurs and William Topa from Unsplash.

SCIENTISTS WATCH MOVIES

AND SOLVE PROBLEMS

The Case of the Burning Pine Cones (see issue 13). Physics problem solving on thermodynamics:

Mr. Fox and his friends throw 28 pine cones, each of which was heated to a temperature of about 685°C from 10°C. Assuming that the pine cones are out of wood, and each one's specific heat would be 2300 J/gK.
If the mass of each pine cone is 300g, what is the total thermal energy absorbed by the pine cones as they heat up?

Solution:

First, let's write down all of our variables.

t_i = 10°C

t_f = 685°C

c = 2300 J/gK

g = 300g

N = 28

Q_{total} = ?

Now, we can calculate the thermal energy produced by each pine cone, using the specific heat formula:

$$Q = mc\Delta t \tag{1}$$

So, inserting this into the equation produces:

$$Q = mc\Delta t = 300 * 2300 * (685 - 10) = 4.6575 * 10^8\ J$$

You may be wondering, why did we put 300 into the equation, instead of 0.3? Usually, we would convert grams into kilograms. Here we didn't because the units for the other variables were already adjusted to be compatible with grams. Specifically, it is the variable c, which is in Joules/(gram*Kelvin).

Since we found the total thermal energy released by each pine cone, we can find the total energy released by multiplying the thermal energy released by each pine cone, Q, by N, the number of pine cones.

$$Q_{total} = NQ = 4.6575 * 10^8 * 28 = 1.3041 * 10^{10} J$$

So, our final answer is Q_{total} = 1.3041*10^{10} J. In other words, approximately 13 billion Joules, or 13000 MJ! About 6.1 billion Joules is the energy stored in one barrel of oil.

Victory SONG[1] from the movie!

[1] Part of "Great Harrowsford Square" by Alexandre Desplat. From the movie "Fantastic Mr. Fox"