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Astra News
August 2022

Hello everyone!

Welcome to the fifteenth issue of Astra News!

As usual, the summer flew by quickly. But when the school year is full with interesting projects and classes, it is thrilling! We wish you a successful and amazing new school year!

An article in this issue is dedicated to the first spacewalk in 1965. The 1960s and 1970s were the era of the first astronauts. Since then, spaceflights have significantly improved in safety, and we have forgotten how dangerous they were in the beginning. That the first astronauts from the USSR and USA were heroes. We achieved a significant advancement in space exploration during those years because of people like them.

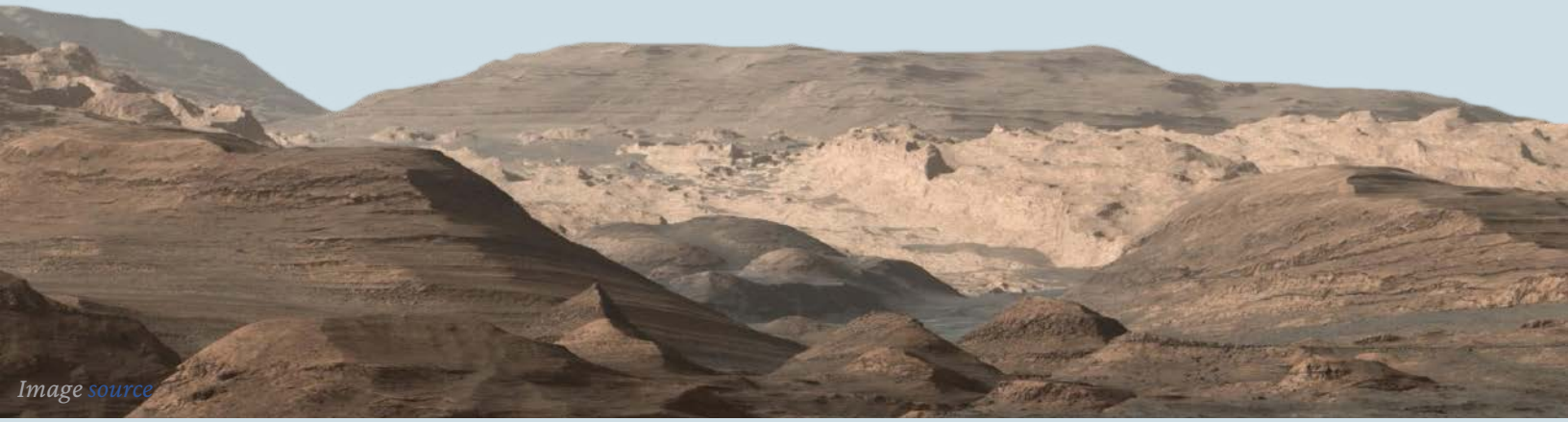

Image source

The time for people like these will return soon. As the first astronauts' successors, heroes will take the first flights to Mars. For humanity, this will be a brand-new, huge frontier.

Max and I want to dedicate this issue to all these people, who have already been born and are among us. Maybe it’s even one of you, one of our readers.

To the stars!

Enjoy the issue!

Yours,
Max and Leonid

- *When looking at the cover above, please turn THIS music on. It was composed by Eduard Artemyev and is called “Listening to Bach (Earth)", from the movie "Solaris". Besides illustrating the issue, this cover is also paying homage to the movies "Solaris" and "Ivan's Childhood" (please, watch the linked movie trailer), both directed by Andrei Tarkovskiy.*

- *On the cover: a collage by Leonid Vishnevskiy, images used are a bird from the painting “The Hunters in the Snow” by Pieter Bruegel the Elder and images scanned from a thrift book ("Chicago, Trees in Snow", 1950 by Harry Callahan and "Fog, Nova Scotia", 1968 by George Krause).*

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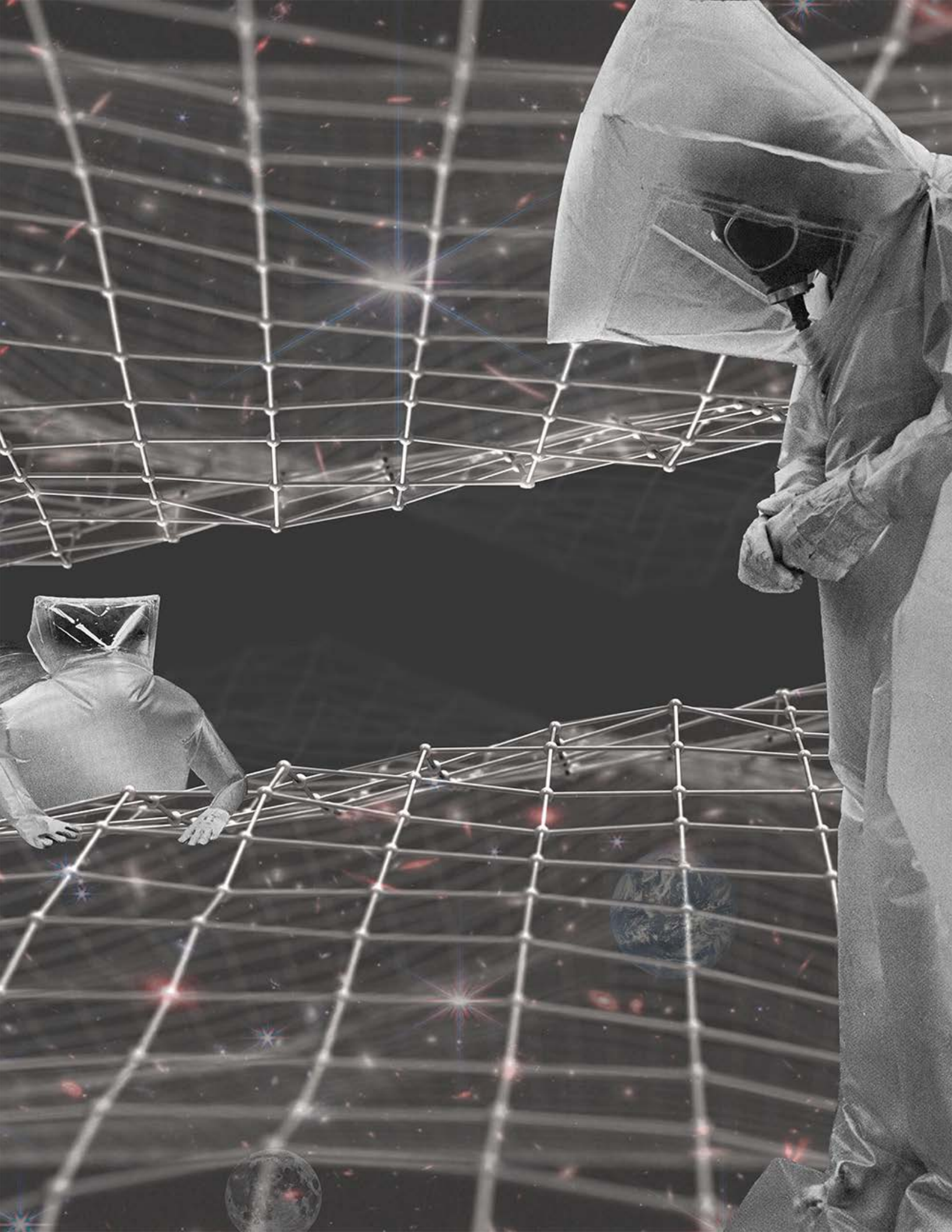
Image from Official SpaceX Photos on Flickr



EVENT HORIZON

Imagine a thing being compressed by the force of gravity into an infinitesimally small “object”, which is not actually an object, because it has no volume. Sounds impossible? This will help you to visualize what a singularity is and indicate that our understanding of physics, and our logic, is becoming outdated in some areas of physics. That is why we are developing another theory in physics.

The singularities we are talking about (there are others as well) can be found in black holes. A black hole is a place in space with no surface. The so-called event horizon separates this area from the rest of space.

If a spaceship starts entering a black hole, we will never see how it gets there, for us it will endlessly remain on the event horizon. And besides, it’ll be invisible for us. However, it will be inside in an instant for the pilot and he will never be able to make it back and tell us what it was like there.

In this rubric, we suggest sharing ideas about what a pilot of such a spaceship might have been wanting to tell us. It’s our sci-fi zone in Astra News.

We are opening this rubric with the article “Singularity Drive” written by Connor McDonald.

On the left is a collage by Leonid Vishnevskiy, images used are from the public domain including an image by D koi from Unsplash, images of the Moon and Earth by NASA and an image from the JWST

SINGULARITY DRIVE

By Connor McDonald

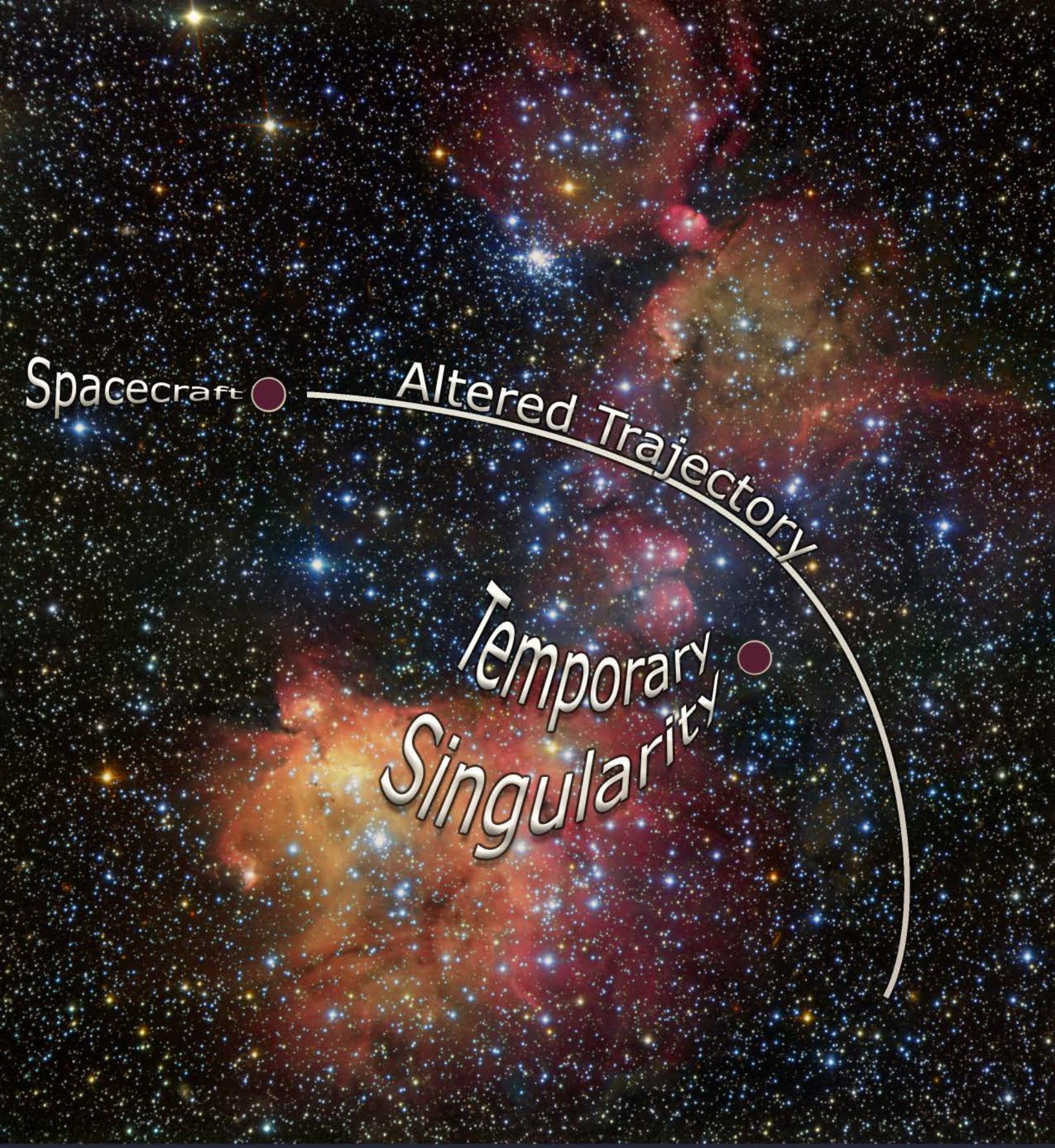
It made headlines a few years ago when a scientist made a tiny black hole on his own to prove the existence of Hawking radiation. While this discovery was a scientific feat, there are more (and fewer) practical uses for the concept. Here is one of the latter.

While, with Ion engines and radioisotope generators, it is possible to travel out of this solar system, it is at the comparable pace of a snail trying to cross an ocean. To speed up interstellar travel, I have an idea that would accelerate interstellar vessels to incredible speeds, all while consuming minimal resources. However, if improperly used, it has the capacity to destroy entire galaxies. Ladies and gentlemen, I present the singularity drive.

The concept is simple. Use an artificial singularity (black hole) to accelerate the vessel to incredible speeds. Before you say this idea is half-baked and dangerous, I can assure you, that it is not baked at all and is insane. However, if used properly, this can be used to make interstellar travel possible in a fraction of the time.

A specially equipped satellite would be sent out several hundred AU ahead of the vessel. It would carry specific equipment for creating and diffusing a singularity. Once safely ahead of the vessel and a specific degree to the right or left of it (and even further from any celestial bodies) it would create a small singularity designed to burn out after a set time. It would consume the satellite and other nearby objects, fueling it until the cutoff happens. This process should take a second at most, creating enough gravitational pull to move the vessel.

With the singularity gone, its former gravity waves pull it across space at high velocities. Because of the placement of the singularity, the vessel would slingshot around the gravity waves, accelerating at even higher velocities. While this seems easy, it isn't. You have to do it far enough from any celestial bodies to not affect their position in space and still farther from the target destination so that you don't overshoot it. Because it requires nearly no fuel to travel this way, course corrections would be nearly impossible, which is troublesome because this is a very imprecise method of travel. It would be like using a wrecking ball to snap a toothpick, without touching anything else. While this would be a highly impractical and dangerous way to travel, it is one of the most achievable ways to reach "warp speed." While this will likely never reach fruition, it is an interesting idea to contemplate while we await the future.



The background image source

A simple diagram of the singularity drive's intended usage

IMPRESSIONS

About Impressions

A review suggests an objective view aiming to be impersonal to a certain degree, meant not to share your favorite movie or book (in fact the reviewer could dislike the movie/book he is writing about), but rather to rate the movie/book. Astra News suggests to you a free hand of writing reviews, meant to share what you like, in which you set your criteria. From here comes the name “Impressions”. The word “text” is purposely omitted, because why limit ourselves to text? And why limit ourselves to movies and books?

Collage by LV

In This Issue

The impression of the movie "2001: A Space Odyssey" (1968).

- The Sense of Being Among the Stars
- "2001: A Space Odyssey" (1968) and "Interstella" (2014)
- From Multiplanetary Species to Incorporeal Beings
- What About HAL?
- Short Story About the Movie Itself
- Differences Between the Movie and the Book
- Good Spaceship Alexei Leonov
- The Plot of "2001: A Space Odyssey"

Stanley Kubrick and Arthur C. Clarke on the set of "2001: A Space Odyssey". Image source: internet resources

by Leonid Vishnevskiy

The Sense of Being Among the Stars

The movie “2001: A Space Odyssey” was released in 1968. Seven years had passed since the first man flew into space, three years since the first spacewalk, and one year later we would land on the Moon. At that time, many people dreamed of space exploration, and the pace at which we had been exploring space allowed us to hope that more would be achieved soon - the first man would fly to Mars, and even a signal from a distant civilization seemed probable. As we know the reality came out different, but that isn’t the topic here.

It can be said that “A Space Odyssey” was born in the age of anticipation of great cosmic discoveries, but at the same time it does not talk about them, does not predict them. Rather it explores the question of man as a multi-planetary species and being, and therefore it has not lost its relevance over the past 50 years.

It can also be said that the film is not about a recreation of a certain plot and is not about the involvement of the viewer in this plot. Instead, the film, based on a fairly simple plot, immerses the viewer in the atmosphere of space.

I know that some, and within them, even those who think of the film as fascinating, consider “A Space Odyssey” boring. Maybe in many ways, this happens because such people have heard about the movie as an extraordinary sci-fi one and expect to see something action-packed, with ventures and unexpected twists in the plot. However, none of this happens. Of course, this is often followed by disappointment in the film.

But one could watch this film while thinking of questions about extraterrestrial civilizations, artificial intelligence, whether AI can also dream of space exploration, etc. Then it is a different experience, it creates a mood, a surrounding for such questions.

Throughout the history of our civilization on Earth, we have told ourselves that we are children of the Earth. But we were created from stardust, and we are truly beings of the stars.

The time came for us to not only adopt a new philosophy but also a sense of being, living among the stars. To have a fresh perspective on who we are and being open to recognizing and solving brand-new philosophical problems.

“2001: A Space Odyssey” (1968) and “Interstellar” (2014)

It may be tempting to call the movie “A Space Odyssey” a movie of the generation of great space exploration, and for the next generation of space exploration the movie “Interstellar". These are, however, two completely different films about space.

This is not to say that “Interstellar” is not good, but one day it will be outdated, unlike “A Space Odyssey”. While “A Space Odyssey” is addressing eternal questions, "Interstellar" shows us space from the point of view of what modern physics knows about it. And our modern physics will change.

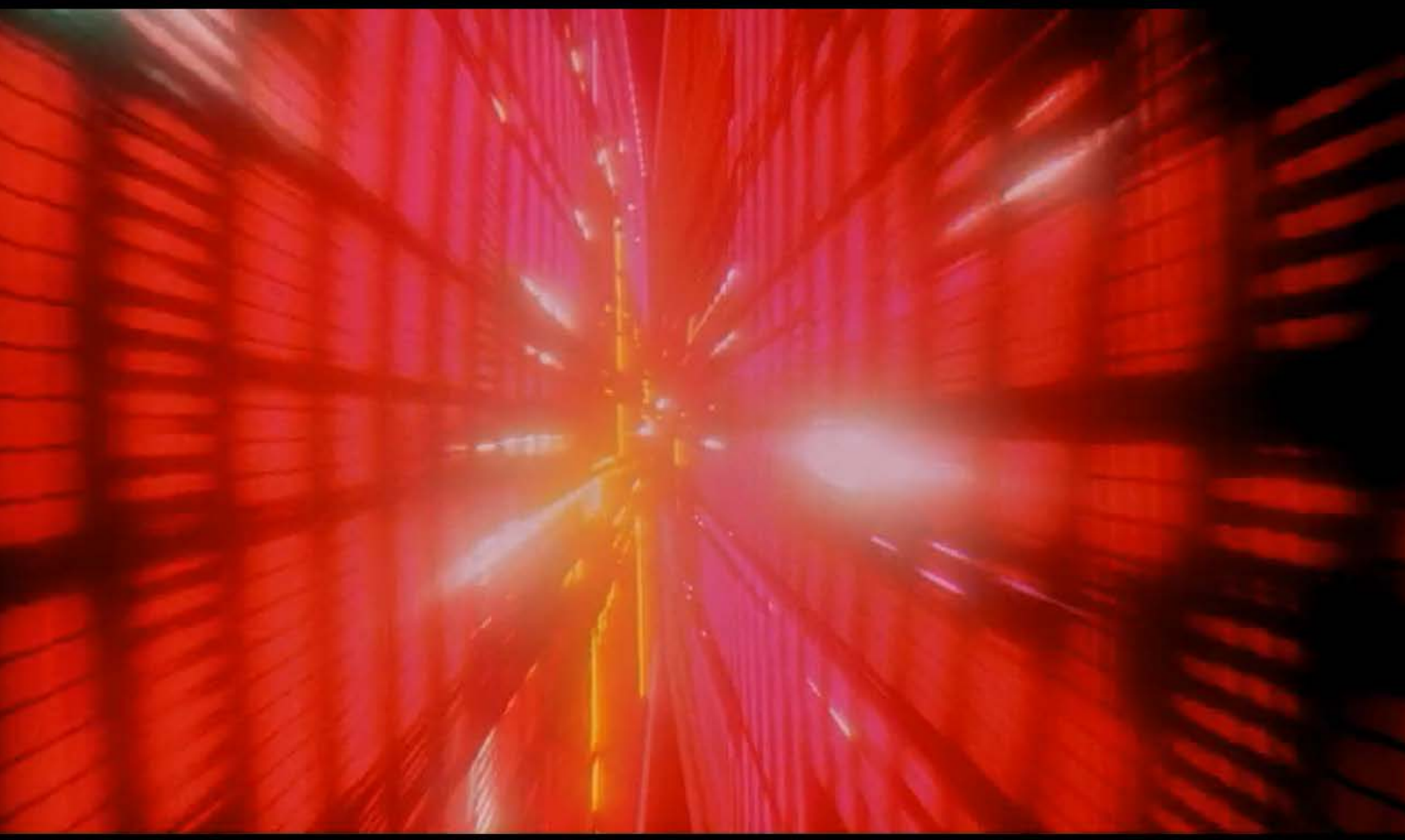
The movie "Interstellar" excels in its genre. For someone whose experience is constrained by the laws of physics at work on Earth, the knowledge that contemporary physics has accumulated about space is difficult to comprehend, and one of the most accessible ways to express it is visually. To further emphasize the importance of this film, it should be mentioned that Kip Thorne was the scientific consultant and executive producer for the movie. Kip Thorne is a very well-known theoretical physicist. Although titles and awards are not always important, I will of course also mention him as a Nobel laureate.

From Multiplanetary Species to Incorporeal Beings

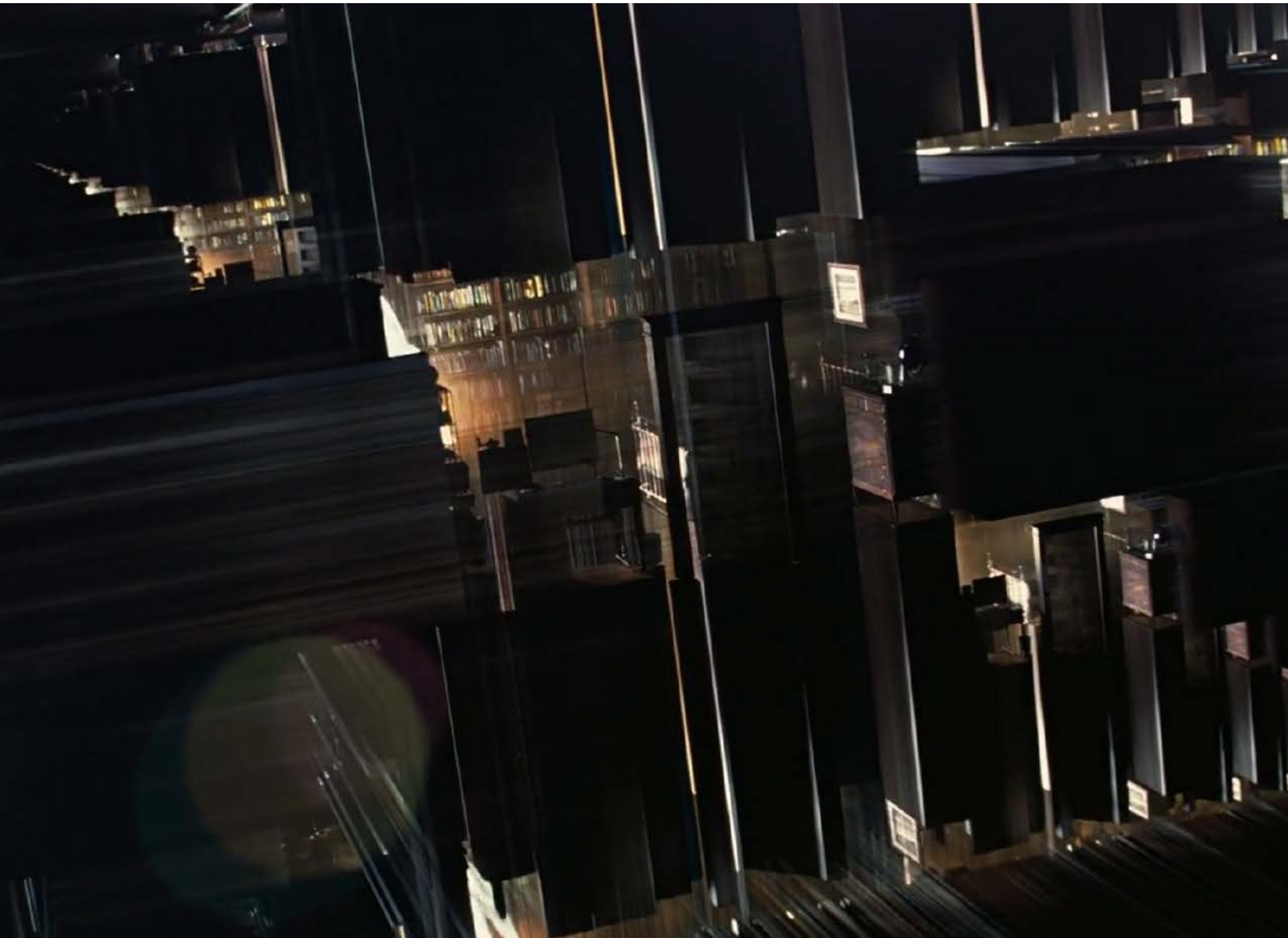
So, unlike "A Space Odyssey", "Interstellar" won't be as relevant in the future because of our increased understanding of space. Can “A Space Odyssey” also become dated, nevertheless?

In this case, we would likely need to take a very different approach to understand how the Universe works and how we fit within it. Theoretically, this is feasible once we actively start developing a new philosophy, which we unquestionably need.

Note that while this is true, the movie will likely continue to be relevant for a very long time because it covers such a broad range of topics, including our evolution from multiplanetary species to incorporeal beings (which must be the next stage of evolution after the star child shown in the movie).



On the right are images from the movie "Interstellar"



What about HAL?

The film is so dynamic that questions that its creators might not have intended to be asked can nonetheless be derived from it with ease, without destroying the plot of the film.

For instance, questions about artificial intelligence. They weren't as important back then as they are now.

Let's assume that in the movie, HAL is so concerned about fulfilling the mission because he considers himself equal to man and more worthy to be evolved into a star child. Is it possible for HAL to be evolved in this way? Is it acceptable? What should we do then?

And this is just one of the many AI-related questions that could be raised by this film.

Short Story About the Movie Itself

So, who created this remarkable film?

It was directed by the American film director, screenwriter, and producer Stanley Kubrick together with the engineer, futurist, and science fiction writer Arthur C. Clarke. The script, co-written by Clarke and Kubrick was inspired by the 1951 short story "The Sentinel" and other works by Clarke. The film's project started in 1964, with a letter (below is an excerpt from it) from Kubrick to Clark.

Dear Mr. Clarke:

It's a very interesting coincidence that our mutual friend Caras mentioned you in a conversation we were having about a Questar telescope. I had been a great admirer of your books for quite a time and had always wanted to discuss with you the possibility of doing the proverbial "really good" science-fiction movie.

My main interest lies along these broad areas, naturally assuming great plot and character:

1. The reasons for believing in the existence of intelligent extra-terrestrial life.
2. The impact (and perhaps even lack of impact in some quarters) such discovery would have on Earth in the near future.
3. A space probe with a landing and exploration of the Moon and Mars.

Originally, Kubrick had intended for a narration to be in the film, but later he went away from the idea. He decided that it would be better for the audience to draw their own conclusions.

While working on the film and its script, Arthur C. Clarke was also writing a book of the same name, which was published after the film's release. But its purpose isn't to explain the film. It's only one interpretation of what is going on, only one of the ideas about what man is and what his place is in the Universe. The film does not restrict you to only these versions.

Differences between the movie and the book

In line with the plot of the book, in the movie some higher good power, higher civilization, assists a man in evolving into a virtuous higher being. Even if you haven't read Clarke's book but have heard about the movie, it's usually agreeable that the same thing happens in the film. However, I do not think that the same plot is clearly seen in the film.

What if we are the most intelligent beings in the universe? This disappointment would be difficult to accept, but it cannot be avoided.

After seeing the film, I believe it is important to think about this question as well.

And then perhaps recognize this film to be a wonderful fairy tale, but one that raises questions to which we must seek answers. Not only to help us develop a new philosophy but also to become a righteous higher power for ourselves and other species in the Universe.

Another way to look at this is that we are moving to destroy ourselves in wars on Earth at such a pace, that we might just have no other choice now, even if a higher and good power does exist somewhere in the Universe. In that case, when they reach us, there will be no one here.

Good spaceship Alexei Leonov

There is a scene in the film when we can hear a character's (Dave) breathing and oxygen supply sounds for almost a whole 5 minutes during a spacewalk. By Alexei Leonov's account, in a personal conversation with Arthur Clarke, Clarke told him that in the film a recording of his breathing during a spacewalk (in this issue, we have dedicated an article to this spacewalk) was used. This is possible; such a recording could not be classified (the breathing sounds were sent to Earth and could be easily intercepted), and of course, if this is the case, the origin of such a recording would not be advertised in the Cold War era. There are other versions of this origin - according to one of them, Kubrick himself voiced this breathing. The truth is difficult to establish now. Whatever the case, when Arthur C. Clarke wrote a sequel to his novel "2001: A Space Odyssey" titled "2010: Odyssey Two" in 1982, he named one of the spaceships in it Alexei Leonov. When Clarke asked him what he thinks about it, Leonov replied: "I would do my best to be a good ship!"

The Plot of "2001: A Space Odyssey"

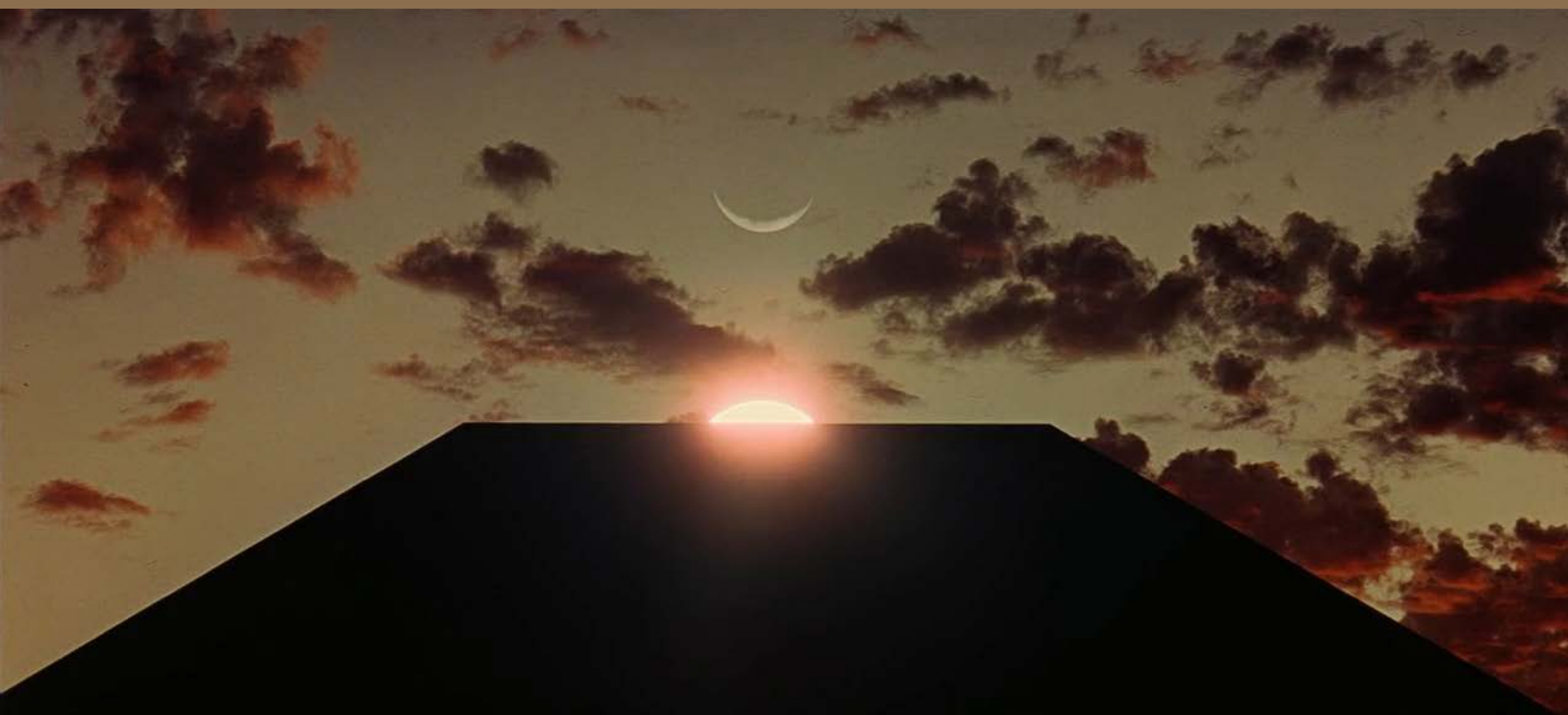
In the following pages of the magazine, I try to sum up and illustrate the plot, using images from "2001: A Space Odyssey."


THE DAWN OF MAN

"2001: A Space Odyssey" begins with the scenes of the dawn of man some four million years ago. An apelike vegetarian lives peacefully among other animals, occasionally becoming prey. The sun rises and sets.

In the desert, water is a vital source of survival. One tribe takes a break near a pond, another tribe drives them off. They spend the night in a pit. The next morning, in that pit's center a monolith is discovered. They are filled with fear but have an insatiable desire to touch it. When they are touching the monolith, the sun is rising just above it.

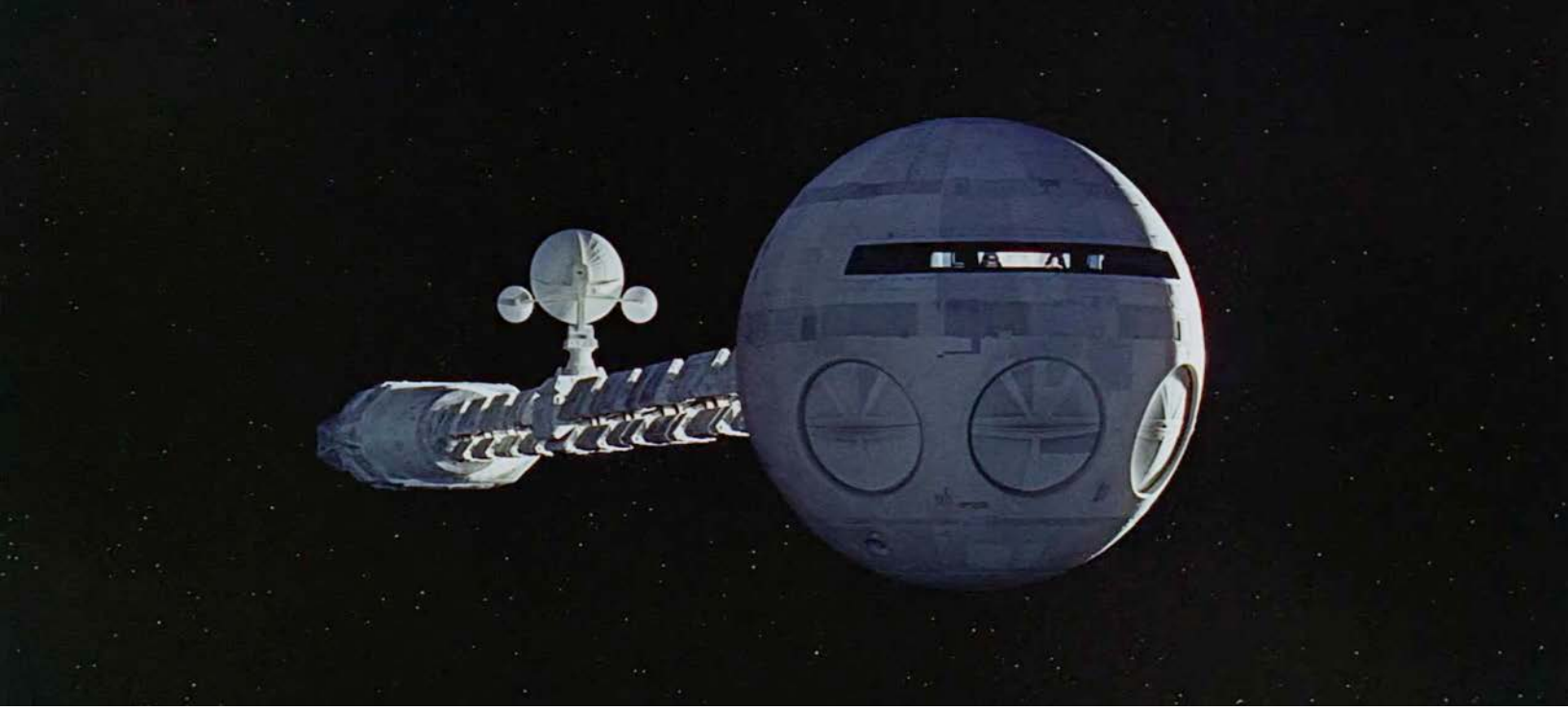
Whether this sun rises from the dark depths of the Universe to blind and mislead us, or in the end to shed light onto the darkness of our souls, is one of the many questions this movie makes us ponder of.



By touching the monolith, our ancestor is no longer a peaceful vegetarian.

Four million years have passed. A bone thrown into the air is being transformed into a space-ship.

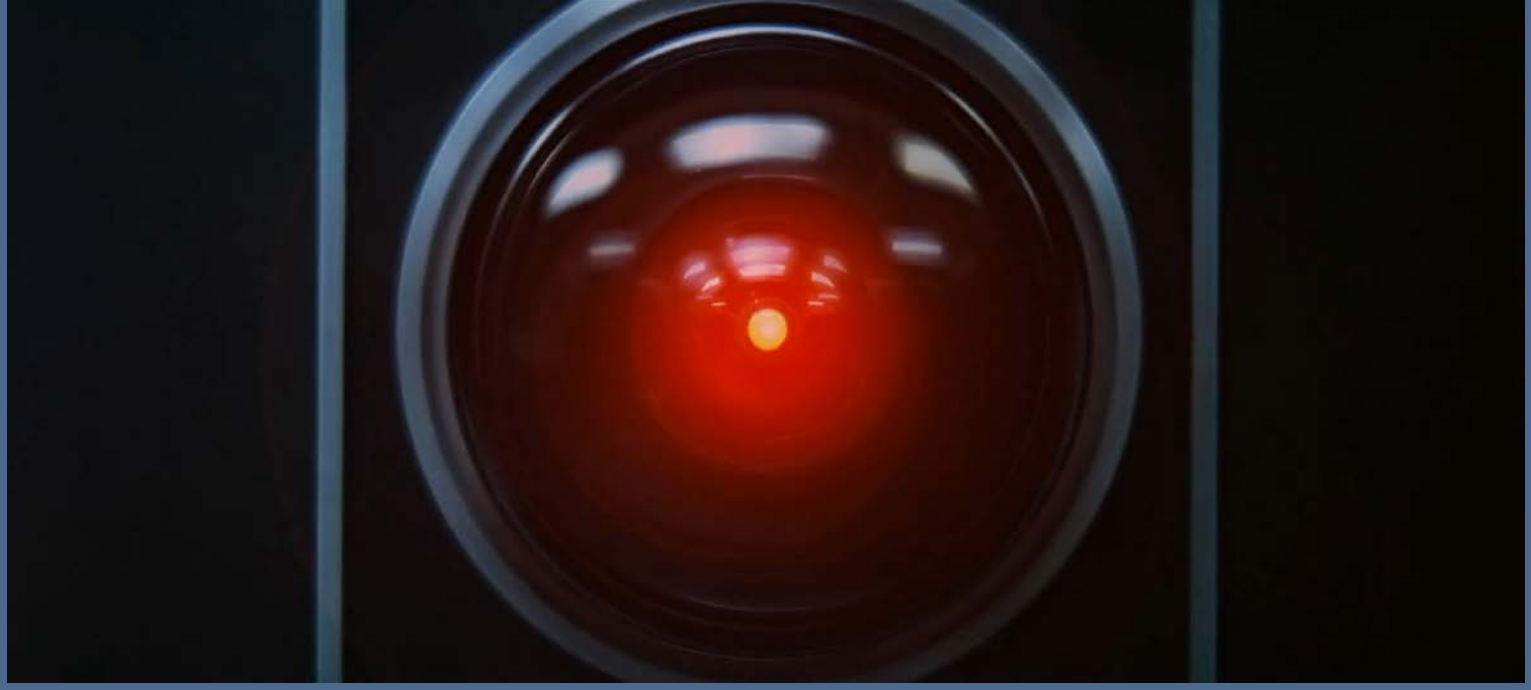
We became skilled at pretending as if we no longer care about the water pond.
Officials of two superpowers are having a drink on a lunar-orbit base.

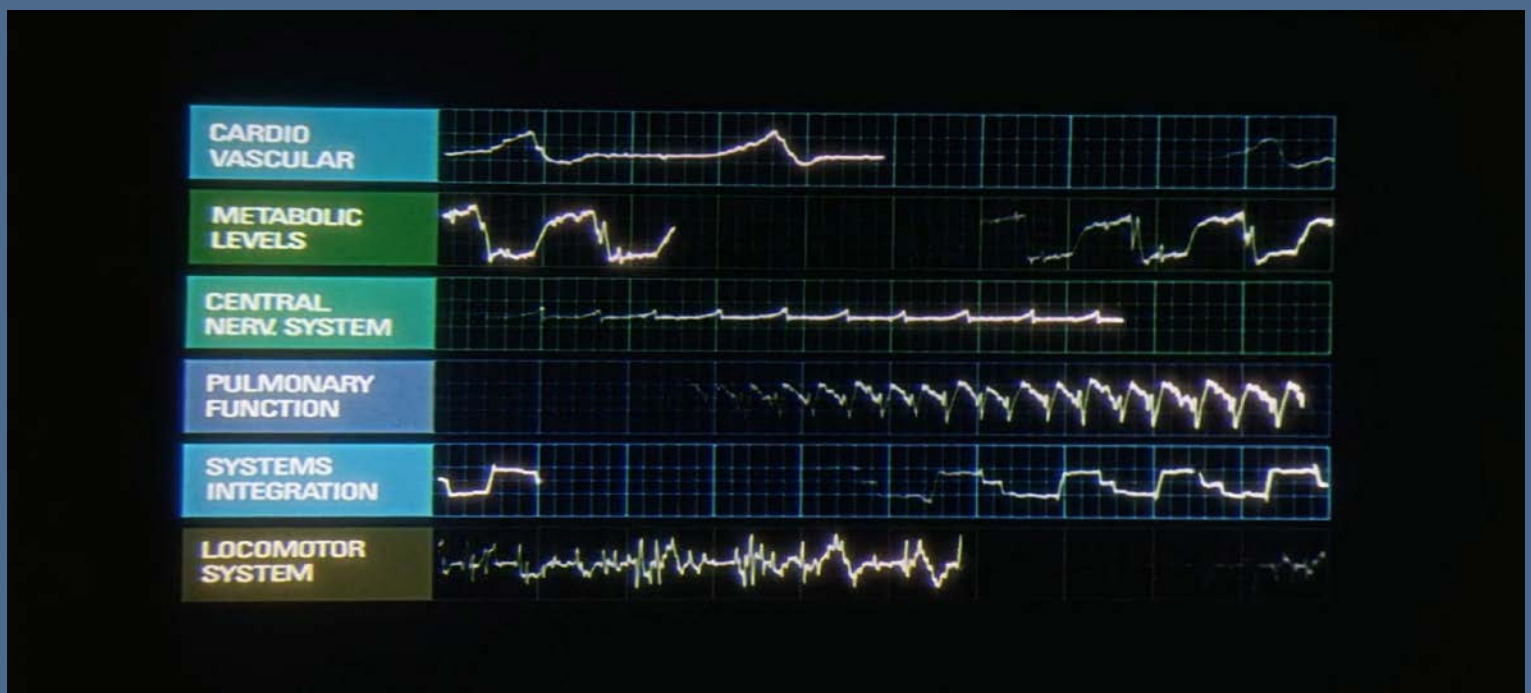


A black monolith was discovered by Americans in the lunar crater Tycho. This discovery was not shared with the rest of the world and remained a closely guarded secret within the United States government. It was suggested that it might be an outcrop of a meteorite, but all the geological evidence was against it. Then, supposing that it might be the top of some sort of a structure, they excavated it on all sides of it and unveiled its perfect shape.

Further research revealed that the monolith was purposefully buried there 4 million years ago. When people approached the monolith, the sun rose above it just as it did those four million years ago, and they heard a high-pitched sound. Soon we learn that “something” must be concealed from the public to avoid social and cultural shock.

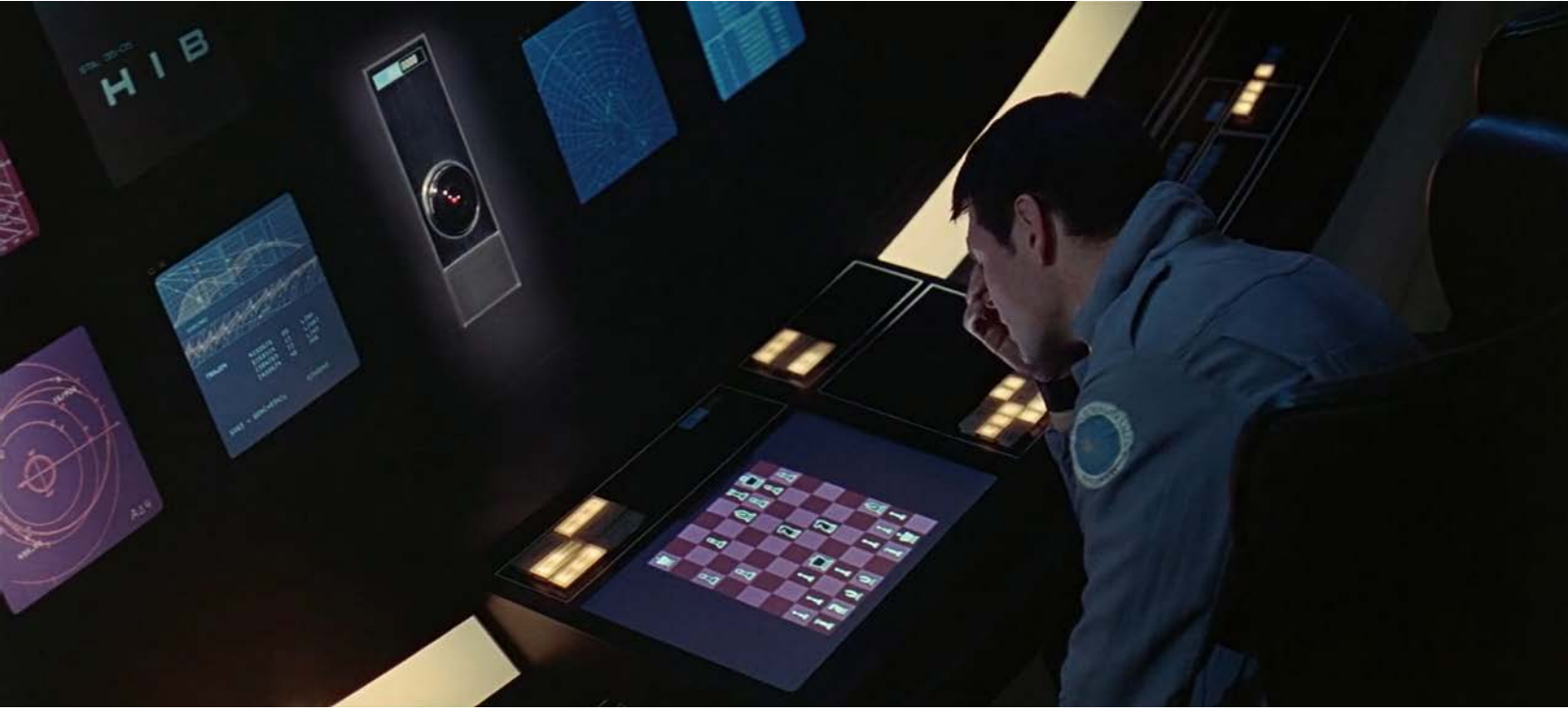
Discovery One, an American spacecraft, was launched toward Jupiter eighteen months later. We don't know yet what this mission is about, and not everyone on the crew does either.




CARDIO VASCULAR
METABOLIC LEVELS
CENTRAL NERV. SYSTEM
PULMONARY FUNCTION
SYSTEMS INTEGRATION
LOCOMOTOR SYSTEM

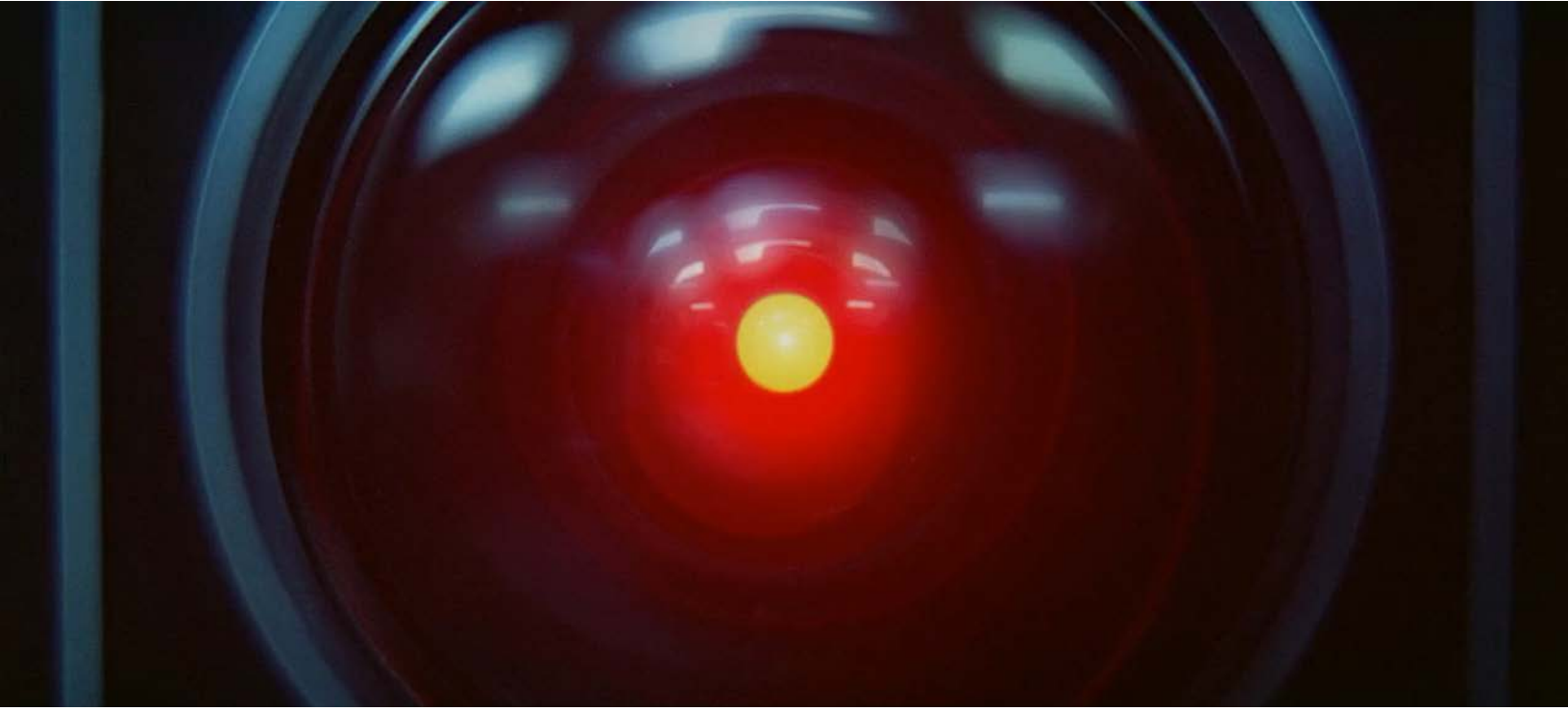
The Discovery One crew consisted of five men. The ship's "brain and central nervous system" is HAL-9000, the most reliable computer ever built. It oversees the entire operation of the ship, including the hibernation of three of the five men aboard. HAL is being assisted by Frank and Dave.

The three hibernating crew members are scientists, and their expertise will not be needed until Discovery One approaches Jupiter. Thus, it appears that Dave and Frank are unconcerned about this mission despite of an oddity: people have never before been put into hibernation prior to launch. "This is done to achieve the maximum conservation of air and food", they conclude, while being told that this mission is simply the first manned attempt to reach the distant planet Jupiter.



Dave doesn't give up playing chess with HAL.

Frank tries to be in perfect shape.

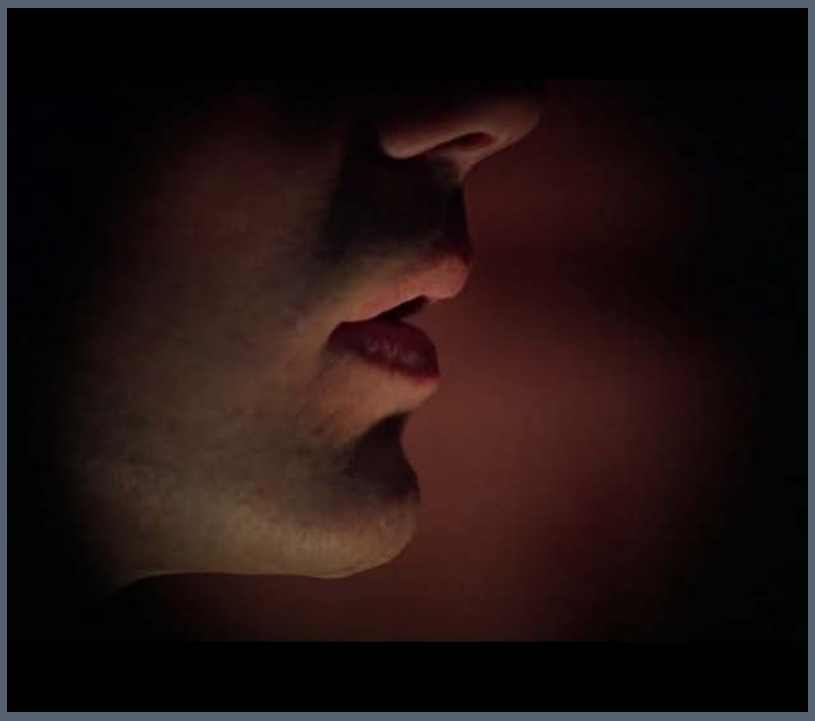


Communication with Earth is maintained by unit AE-35. Dave goes spacewalking and replaces the unit, after HAL reports to him and Frank that in 72 hours this unit would fail. He brings it in, and together with Frank, they determine that this AE-35 is in flawless working condition.

Dave and Frank contact Earth and learn that "HAL is in error predicting the fault." Furthermore, it is HAL's twin, who remained on Earth, that states this. Worries start on Earth as well, and they plan to double-check the twin's results.

HAL goes on to say that similar incidents have occurred in the past and that they have always been the result of human error and assures them that there is no conflict between him and his twin.

Frank and Dave begin to realize that it could be due to human error, but they have no idea what it is or what the connection is between this error and unit AE-35. HAL is not likely to clear it up for them.



Dave says that HAL is programmed to have genuine emotions to make it easier for humans to talk to him.

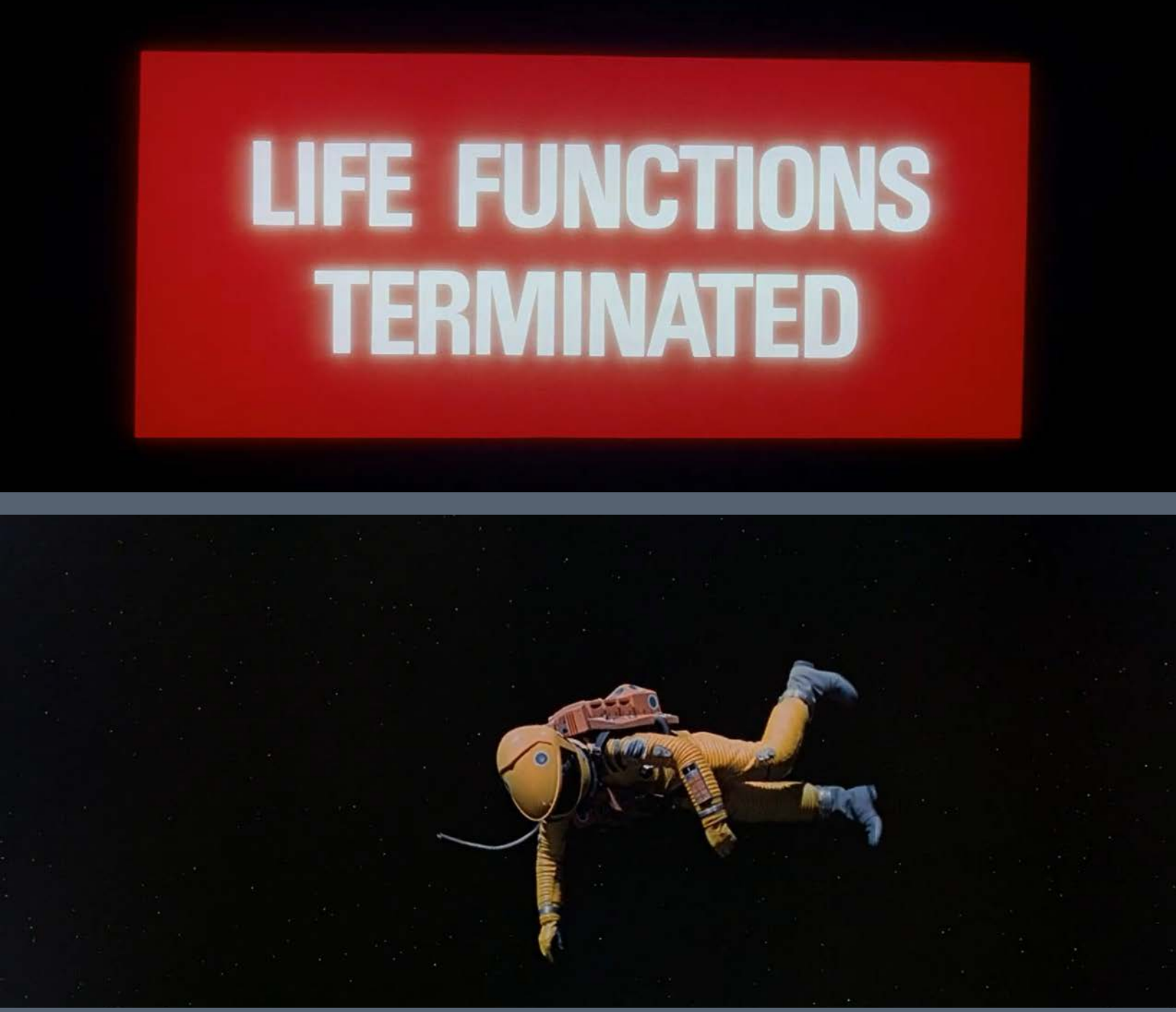
But what could make it easier for HAL to communicate with people? A question Dave probably never asked himself because, if he had, he would have quickly realized that a soundproof pod might not prevent HAL from understanding human speech.

Then Dave adds to this, "as to whether or not HAL has real feelings, is something I don't think anyone can truthfully answer." How honest is Dave about his doubt? Because we never see any attempt to learn this or to approach HAL as if he might have feelings. In fact, all this about programmed emotions and feelings is said in the eye of HAL, in an interview with “The World Tonight”.

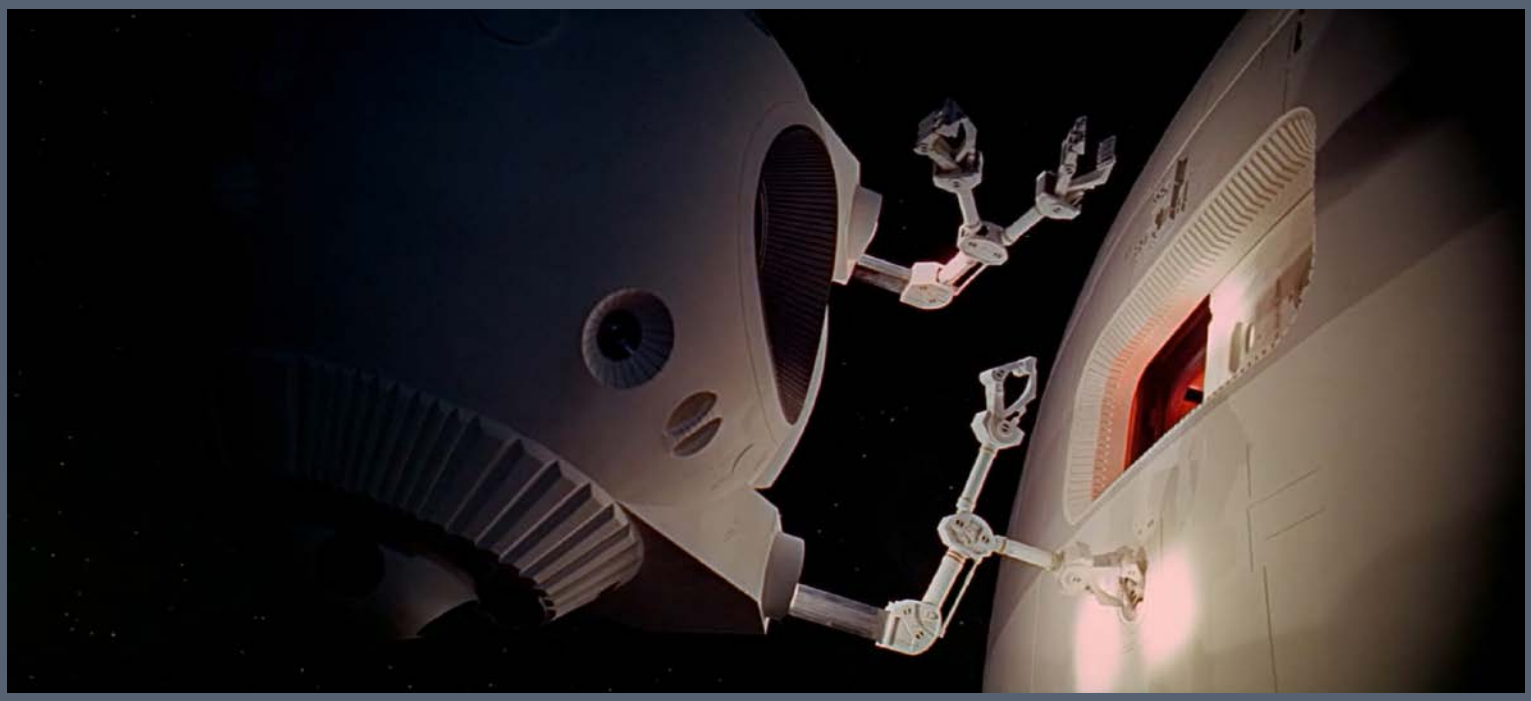
Upon discussion in the pod, Frank and Dave decide to disconnect HAL's brain.

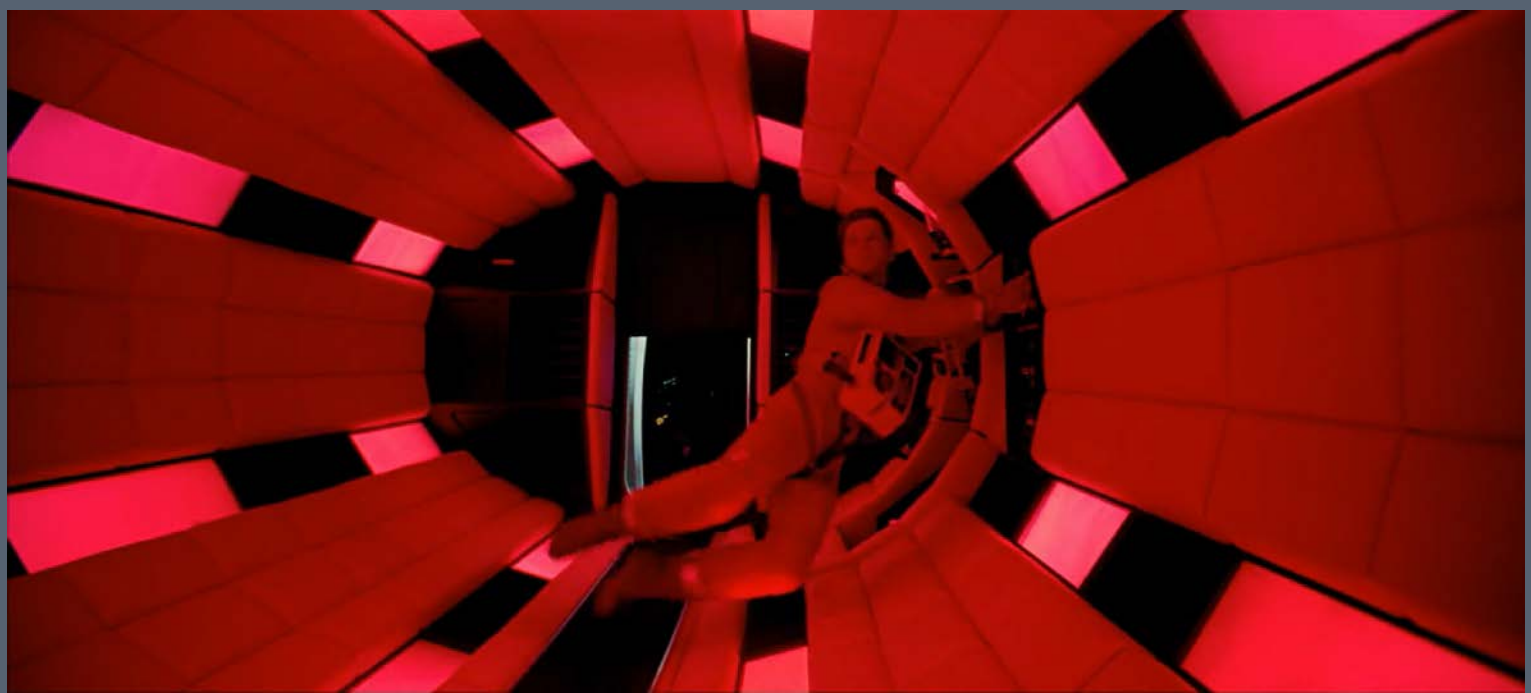
HAL lip-reads this, and tries to get one step ahead of them. We're not sure why just yet. "Either them or me" might be why people would do that, but HAL has different reasoning: "This mission is too important for me to allow you to jeopardize it."

After plotting against HAL, Dave and Frank probably only worry that HAL will find out about it; they don't pause to consider whether what they are doing might be contributing to the human error that HAL is pointing out.


LIFE FUNCTIONS
TERMINATED


EMERGENCY AIRLOCK
MANUAL OPERATION ONLY
MANUAL OPERATION ONLY





"Open the pod bay doors, Hal.

I'm sorry, Dave. I'm afraid I can't do that."

You have probably heard this dialogue at least once before, even if you haven't seen the movie.

What if HAL is genuinely sorry? What if he meant what he truly said? In other words, what if the "polite" response to a human request that needs to be declined is not determined by a hard-wired program?

Dave is the only one who is still alive at this point. HAL attempts to keep Dave off the ship, but he is able to re-enter using manual controls and begins to disconnect HAL's memory and logic center.

"I'm afraid, Dave.

My mind is going.

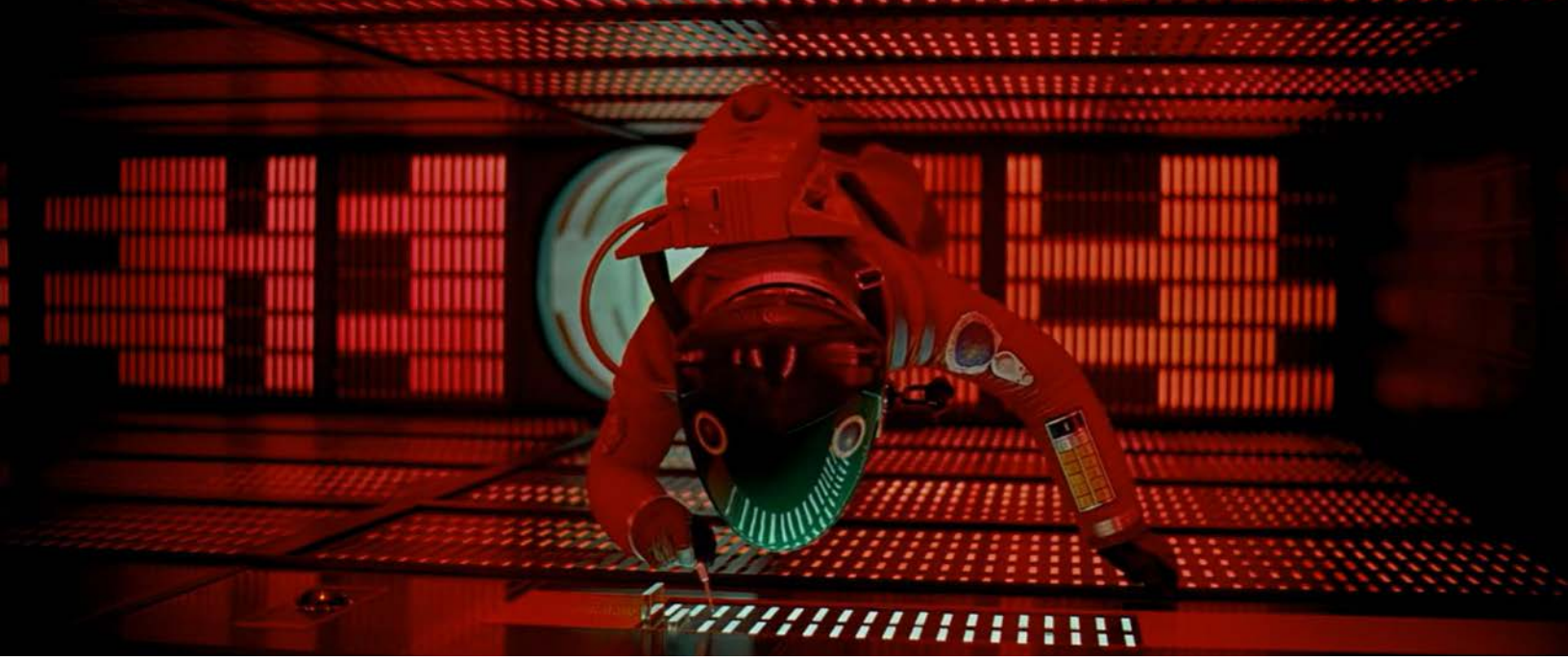
I can feel it.

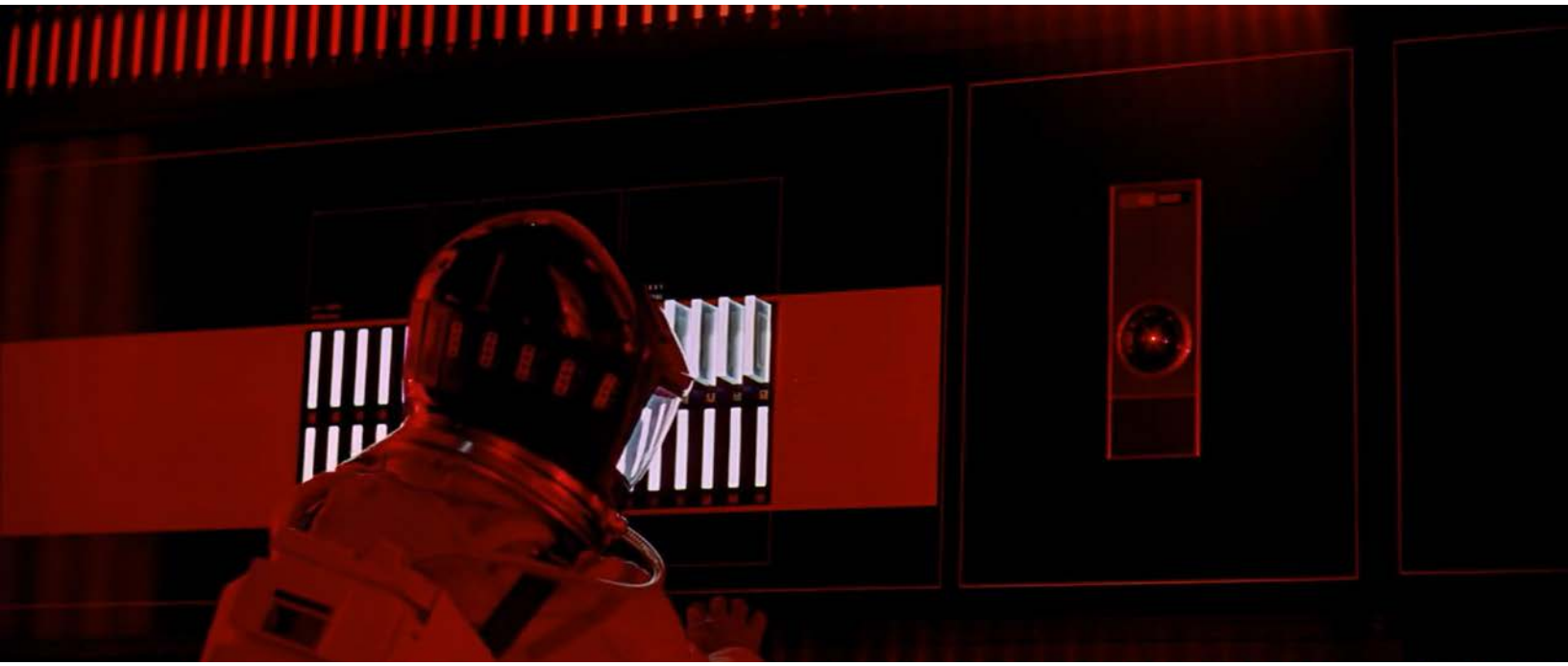
I can feel it.

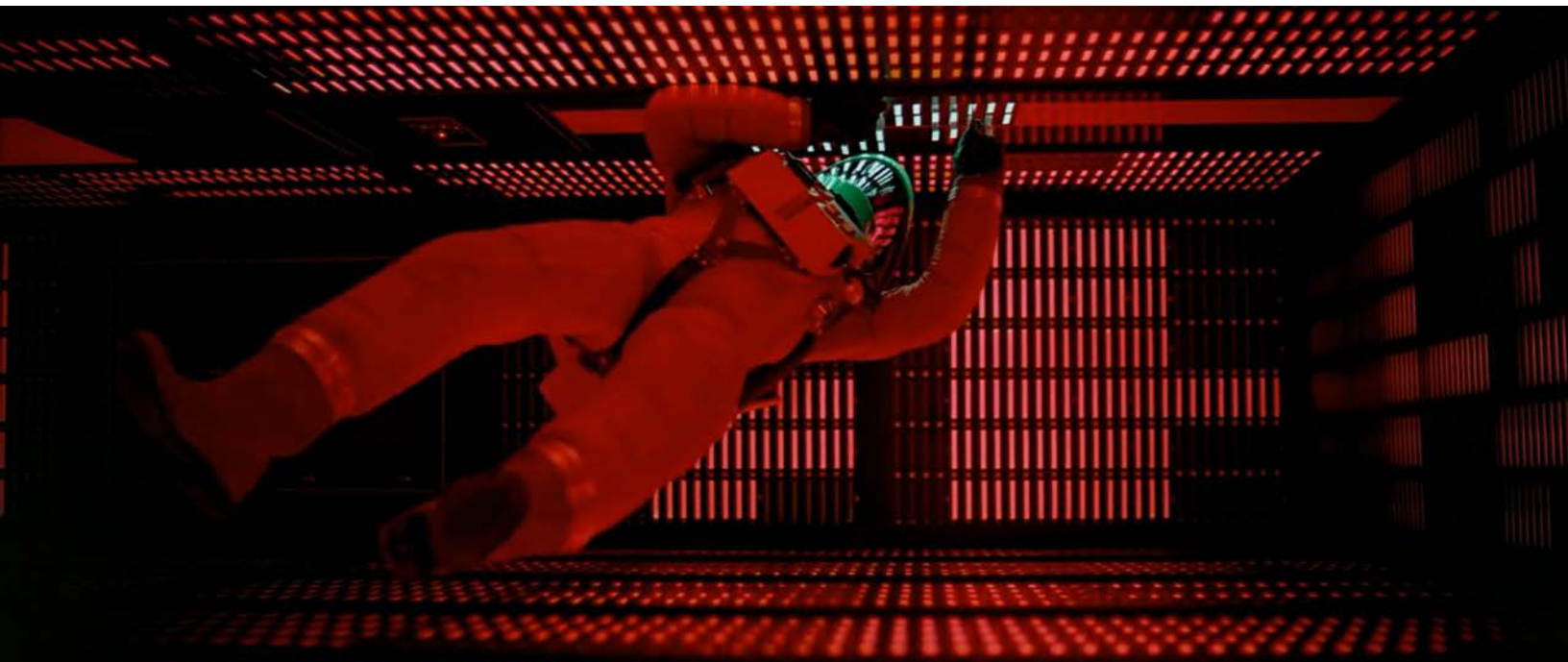
My mind is going.

There is no question about it.

I can feel it."







Could it be that HAL himself isn't sure whether he has true feelings up to this point? Or perhaps he starts feeling now? No matter the answers to these two questions, HAL just said that he is able to feel, tells us when and where he became operational, who his instructor was, and sings Dave a song called "Daisy". His singing gradually loses tone before stopping.

Another sunset and another night embrace man as he is getting ready for the next stage of his evolution.

In his final moments, already unable to sing, HAL plays a video recording for Dave that he and Frank should have only seen when they would have arrived at Jupiter, clearly violating his programmed orders. We can't know for sure if the other three crew members knew what David is about to hear, but we can presume from the recording that they almost certainly did. That also explains why they were put into hibernation before launch.

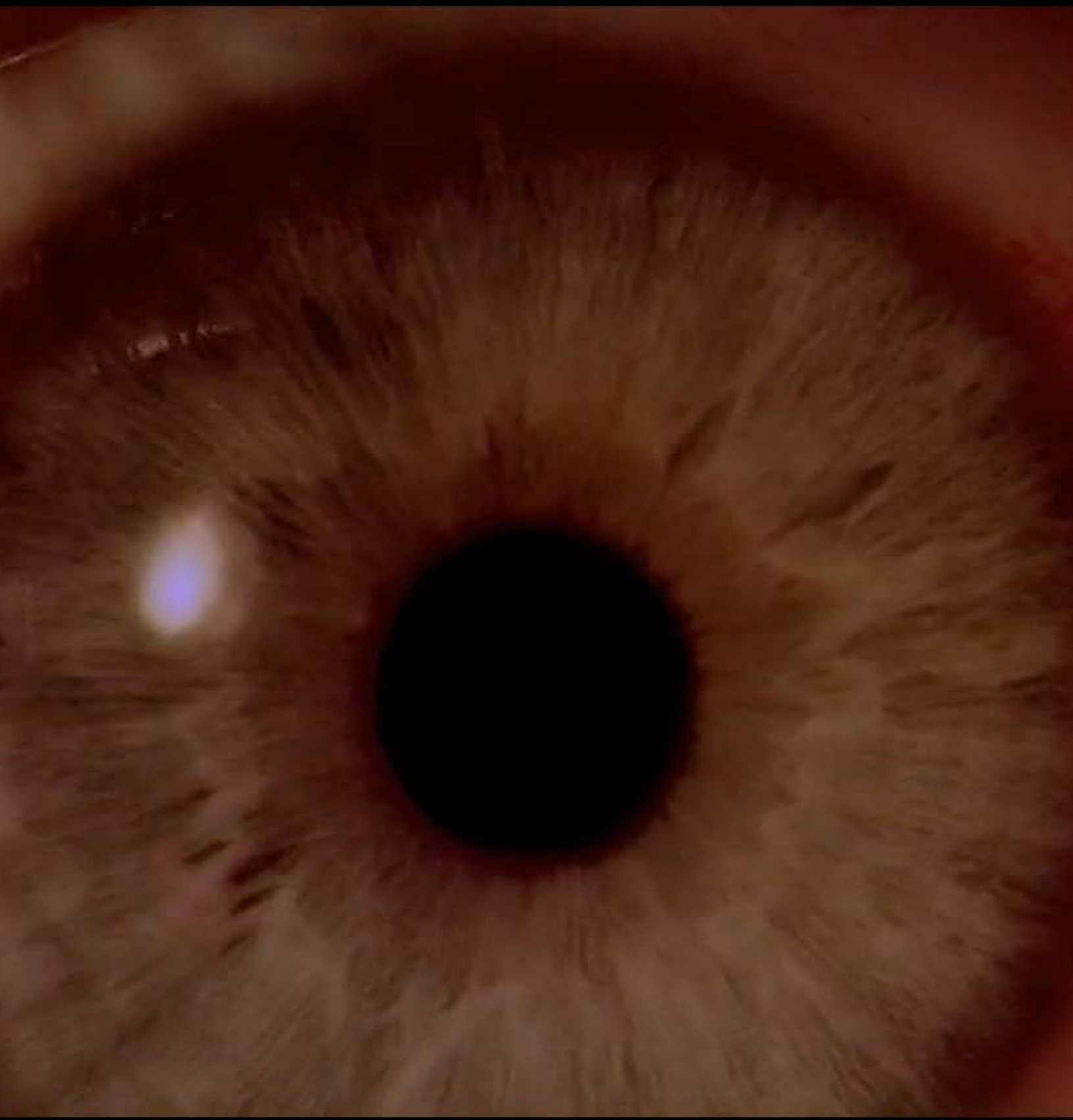
"Good day, gentlemen.

This is a prerecorded briefing made prior to your departure and which for security reasons of the highest importance has been known on board during the mission only by your HAL 9000 computer.

Now that you are in Jupiter's space and the entire crew is revived it can be told to you.

Eighteen months ago, the first evidence of intelligent life off the Earth was discovered. It was buried 40 feet below the lunar surface near the crater Tycho. Except for a single very powerful radio emission aimed at Jupiter, the four-million-year-old black monolith has remained completely inert.

Its origin and purpose are still a total mystery."



Dave continues the flight to Jupiter.

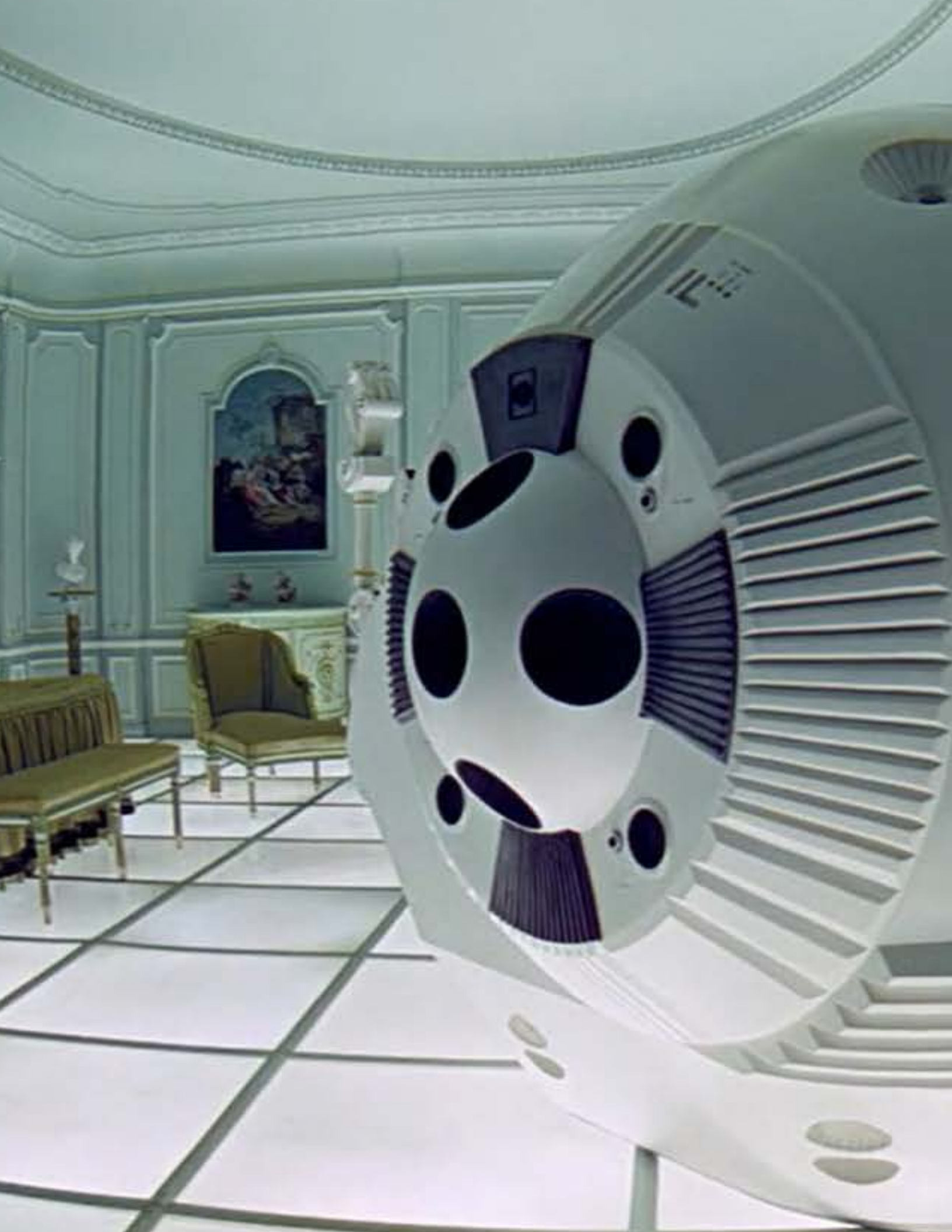
When he arrives, he sees a monolith. We can't tell if it's floating in space, or just orbiting Jupiter quietly. We're also not sure if it's the same one from the Moon; that is, was there always just one?

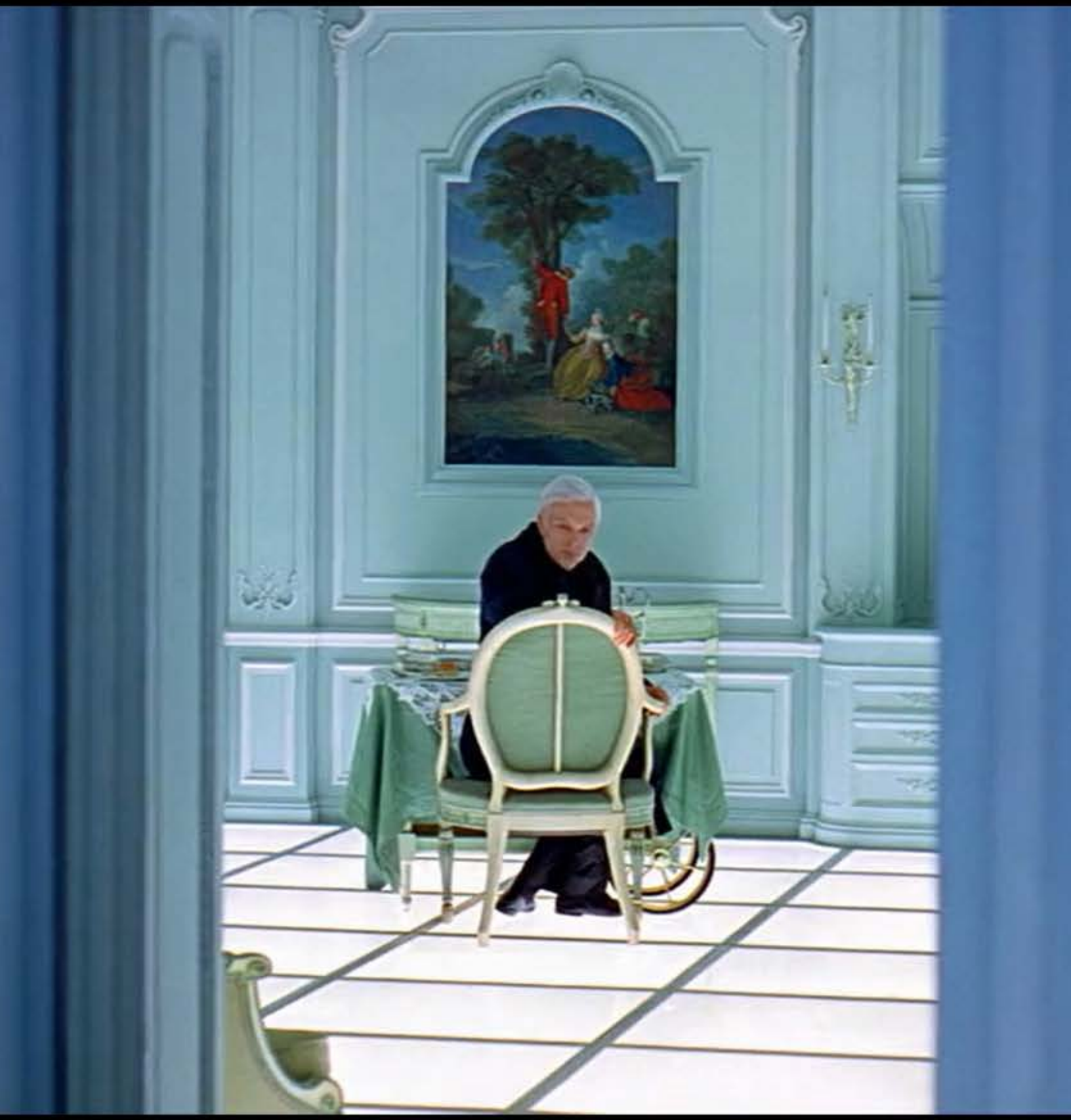
Dave flies away on the last pod left to examine the monolith.

This time, as Dave gets closer to the monolith, something bigger is happening. The sun is not rising; instead, he is taken on a journey beyond infinity.

He remains inside the pod; this is most likely done to allow him to hold on to familiar things. That's probably why at the end of this journey, he finds himself in the simulacrum, imagining of a luxury hotel room.

It is possible that neither the doors nor the drawers in the bedside tables may be opened.

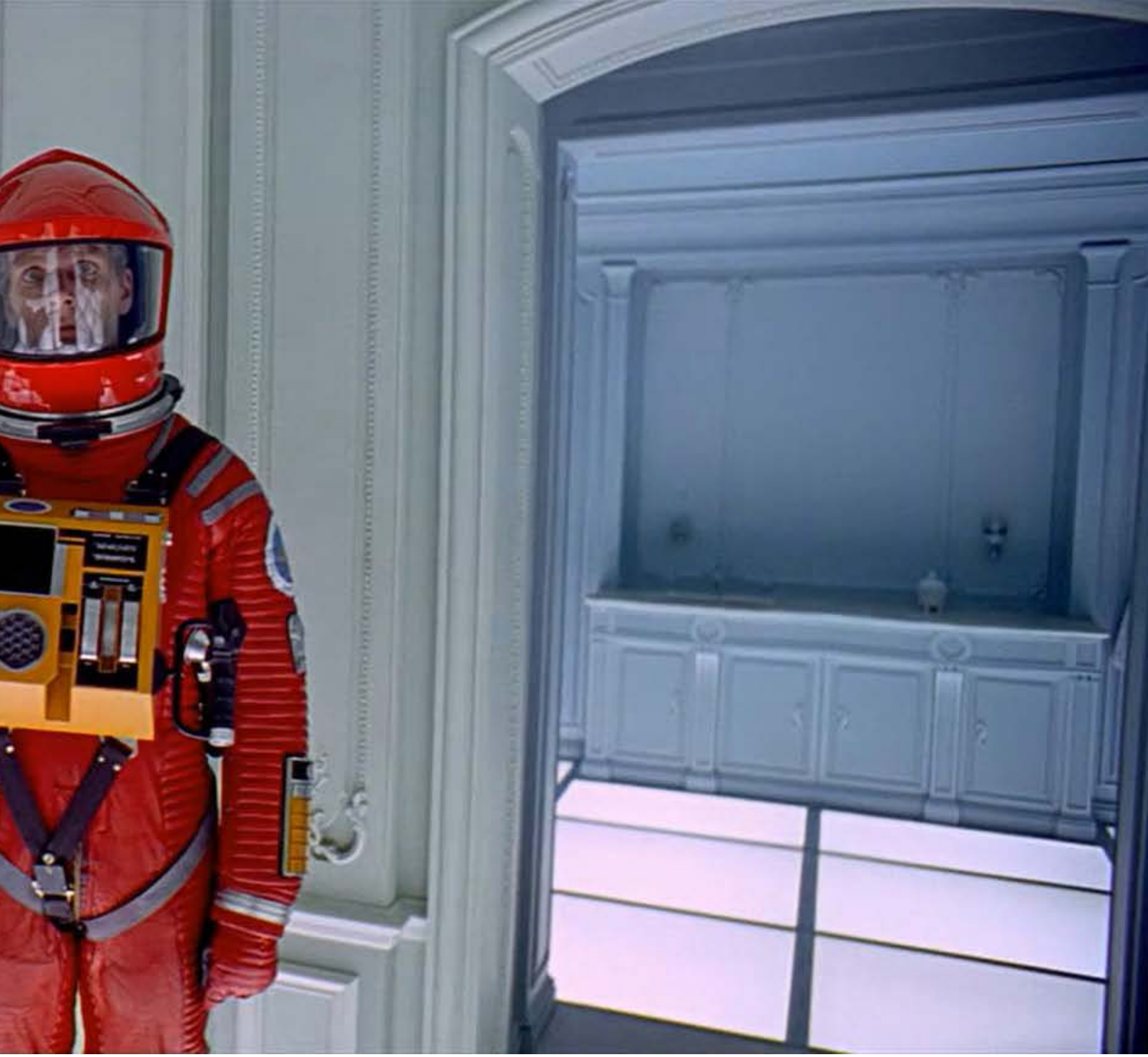




But things fall, break and water spills.

There isn't really anything in the movie that would stop us from making the assumption that Dave - or someone else - has restarted HAL. Because of this, some of the items in this room might also be for HAL. Or perhaps Dave is thinking about HAL as he is about to undergo his next transformation, and the room reflects it.

"Daisy, Daisy
Give me your answer, do
'm hal ... crazy
All for the love of you
It won't be a stylish marriage
I can't afford a carriage
But you'll look sweet
Upon the seat
Of a bicycle made for two. "



Whatever the cause, it's difficult to omit the overwhelming number of representations of two lovers in this and other shots that are also mentioned in the song “Daisy”.

In a brief sequence of movie shots, Dave rapidly ages, and is reborn as a star child*.

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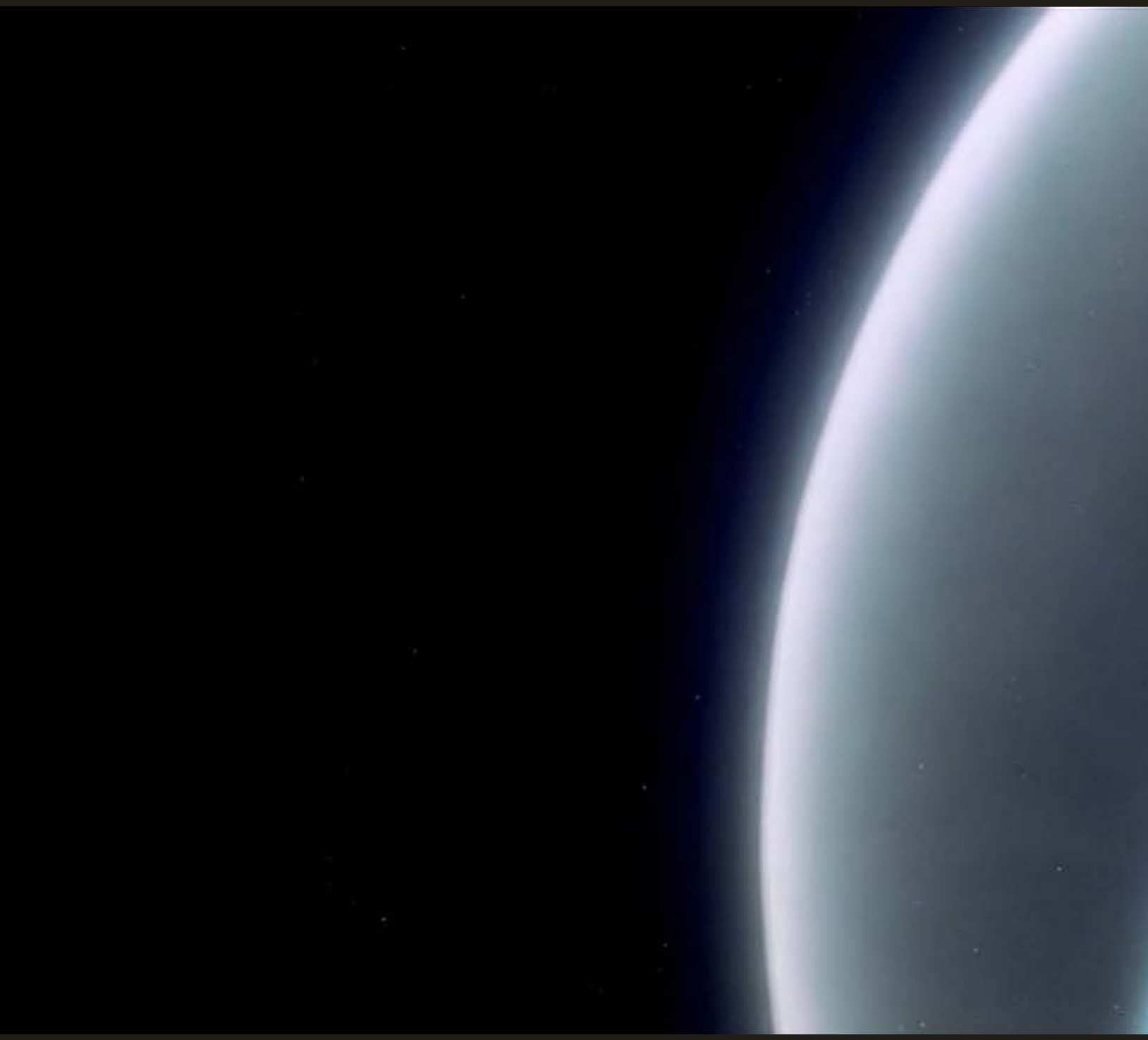
* *On the next pair of pages, besides images from the film, there is also part of the fresco “The Creation of Adam” by Michelangelo from The Sistine Chapel Ceiling, virtual tours Musei Vatican*



the end.

EDITOR

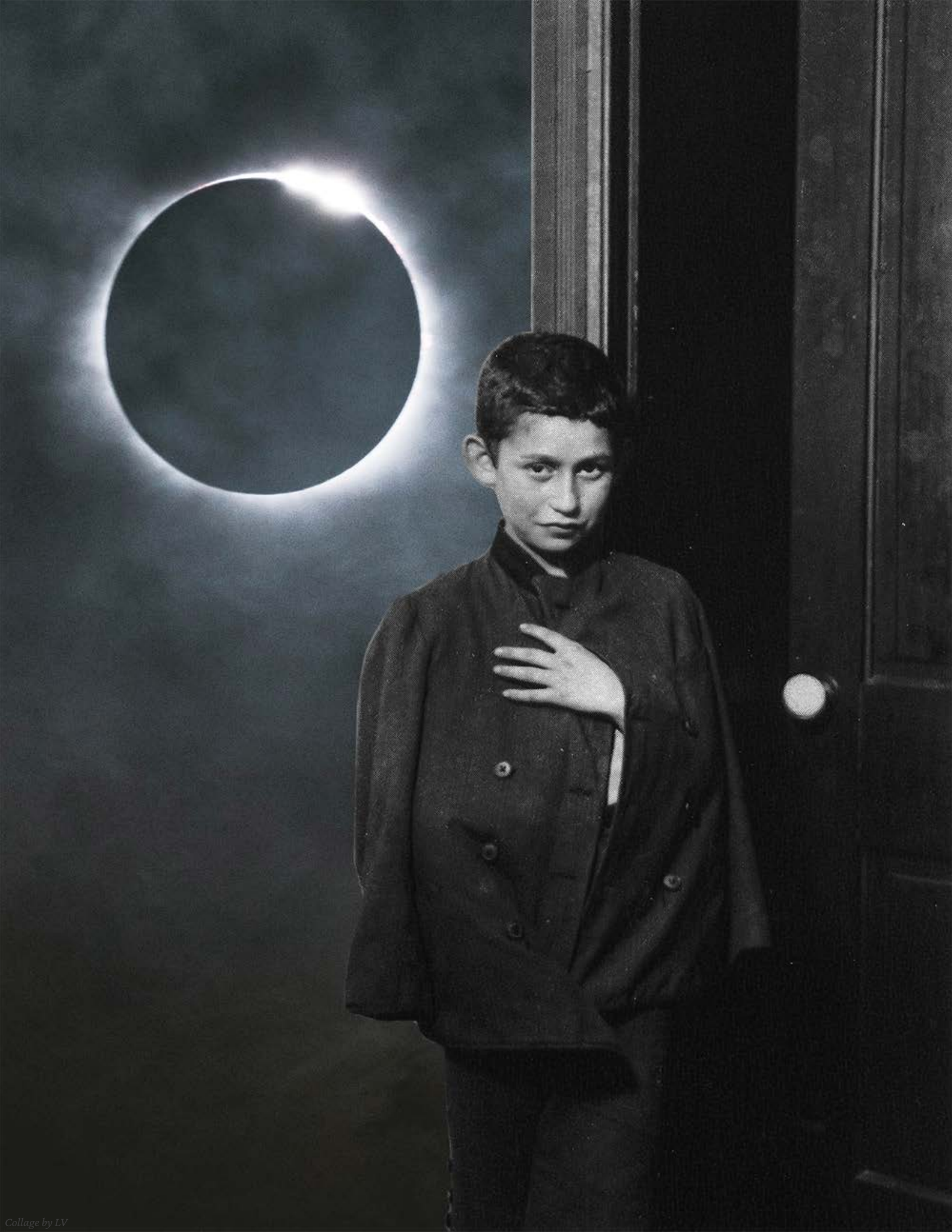
SEND YOUR SURREAL COLLAGES, DRAWINGS, PAINTINGS, OR PHOTOS .

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 used are the painting "Guernica" by Pablo Picasso (read about it **here**), images scanned from a thrift book (**photography** of Aldous Huxley by Cecil Beaton, 1935 and work titled "Settlement House Boy", 1910 by Lewis Hine), the **image of Eclipse** by Jordon Conner from Unsplash and the **image from the James Webb** Space Telescope*

Collage by LV


Collage by LV

The Republic of Mars

One Giant Leap for Humankind - Apollo 15

by Leonid Vishnevskiy

In the previous issue, Neil Vivo's article “Leaders of Mars” touched on a crucial subject regarding Martian leaders, which is now being perceived with special urgency as Earth enters a critical period where we have not solved our grim problems but are settling Mars. Those problems may find themselves on Mars. Attempts to solve this are also incredibly challenging due to the intense emotional involvement on all sides. Nonetheless, we are in a situation like this because we failed to do so in the past.

Teenagers today are those who were born in the first decade of the twenty-first century. Wars were occurring at the time, as always, which slowly made their way into the teenagers’ lives through the news and, sadly, are seen by everyone as unavoidable occurrences on par with natural disasters.

Most of us have not been harmed by war, but it has now become harder not to observe it and believe that it is an unavoidable aspect of life. I'm referring to the ongoing conflict in Europe.

Although its coverage is no longer on the front pages, it shocked us, and we were able to view its inhumanity. And regardless of how far we are from the source of this evil, we must never forget this.

People lose their humanity during war. When the first civilian casualties happen, we are horrified. But as time goes on, we not only grow accustomed to them but even start to rationalize them if they are casualties on the opposing side. This is also the loss of humanity.

When did it begin? Was it when our ancestors first fought their neighbors in an effort to steal food or claim a better location for a settlement? Since it began, it has been an ongoing process.

Let’s talk about our efforts to break this chain, particularly in space.

1971, the Apollo 15 mission. During the time of the Cold War era. Astronauts on the Apollo 15 mission placed a small aluminum sculpture, the Fallen Astronaut figurine, and a plaque on the Moon that commemorated the deaths of fourteen U.S. astronauts and Soviet cosmonauts. It was done in secret.

The Fallen Astronaut figurine was small. It was also non-gender specific, not from a specific ethnic group, and was able to withstand the lunar environment. The name of the artist who made the statue is Van Hoeydonck.

Dave Scott, one of the astronauts on the mission, snuck the statue and the little commemorative plaque onboard the Apollo 15 rocket. There was no formal ceremony when they positioned them on the Moon. He simply placed the figurine and plaque onto the lunar soil. The plaque listed the names of fourteen dead astronauts and cosmonauts, but two more cosmonauts’ names were missing because they were not yet known to have died at the time due to the Soviet space program's secrecy. The next time astronauts died was in the 1986 Challenger disaster.

Because the Apollo 15 mission occurred during the Cold War, it could explain why very few people knew about the plaque and statue. However, there was little to no media attention given to it in the 1990s, after the Cold War ended. But don’t we need to know about it just as much as we all know the historic words of Neil Armstrong: "That's one small step for man, one giant leap for mankind", and the first footprints on the Moon?

Despite all the propaganda that existed on both sides of the two superpowers, there was a cosmic brotherhood and real humanity within our men in space.

I believe that it is very important that the first crews sent to Mars be international. This can affect what the leaders on Mars will be like in a positive way.


BASSETT, CHARLES A. II
BELYAYEV, PAVEL I.
CHAFFEE, ROGER B.
DOBROVOLSKY, GEORGI T.
FREEMAN, THEODORE C.
GAGARIN, YURI A.
GIVENS, EDWARD G., Jr.
GRISSOM, VIRGIL I.
KOMAROV, VLADIMIR M.
PATSAYEV, VIKTOR I.
SEE, ELLIOT M., Jr.
VOLKOV, VLADISLAV N.
WHITE, EDWARD H. II
WILLIAMS, CLIFTON C., Jr.

Memorial to Fallen Astronauts on the Moon (in alphabetical order)

Bassett, Charles A. II

Belyayev, Pavel I.

Chaffee ,Roger B.

Georgi, Dobrovolsky

Freeman, Theodore C.

Gagarin, Yuri A.

Givens, Edward G. Jr.

Grissom, Virgil I.

Komarov, Vladimir

Patsayev, Viktor

See, Elliot M. Jr.

Volkov, Vladislav

White, Edward H. II

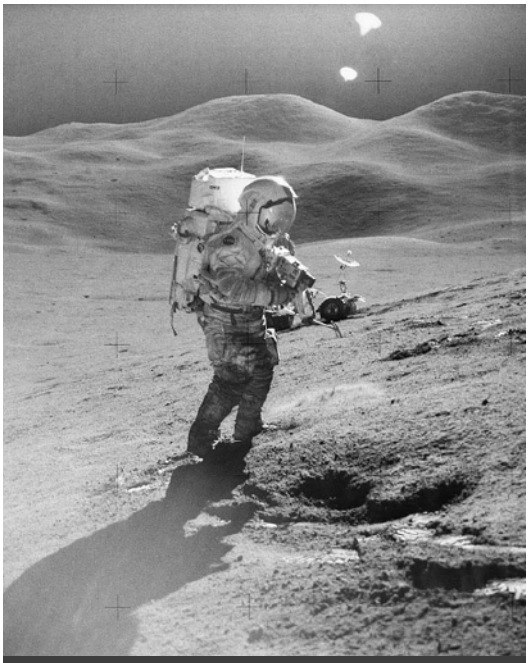
Williams, Clifton C. Jr

"The plaque was stuck in the lunar soil by astronauts David R. Scott, Apollo 15 commander, and James B. Irwin, lunar module pilot, during their lunar surface extravehicular activity (EVA)."*

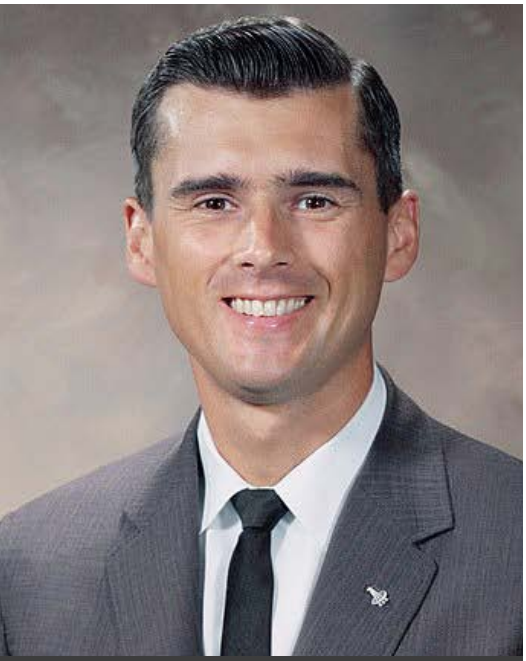
* *Image and text source NASA*

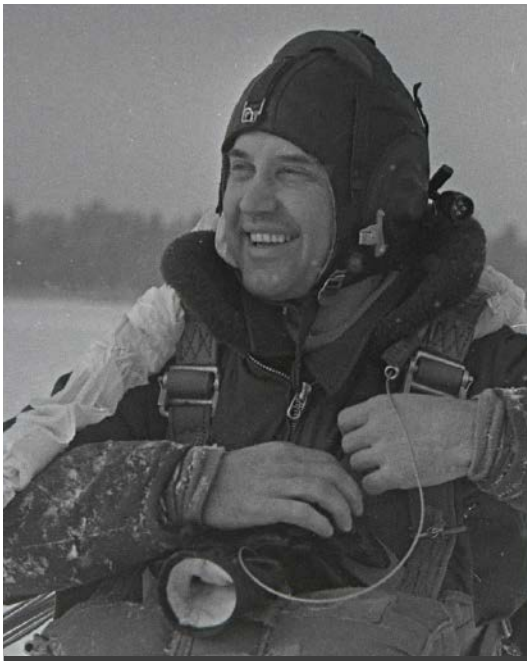
Apollo 15 crew (left to right) Commander David R. Scott, Command Module Pilot Alfred M. Worden and Lunar Module Pilot James B. Irwin


Bassett, Charles A. II


Apollo 15 mission


Belyayev, Pavel I.


Chaffee ,Roger B.


Georgi, Dobrovolsky

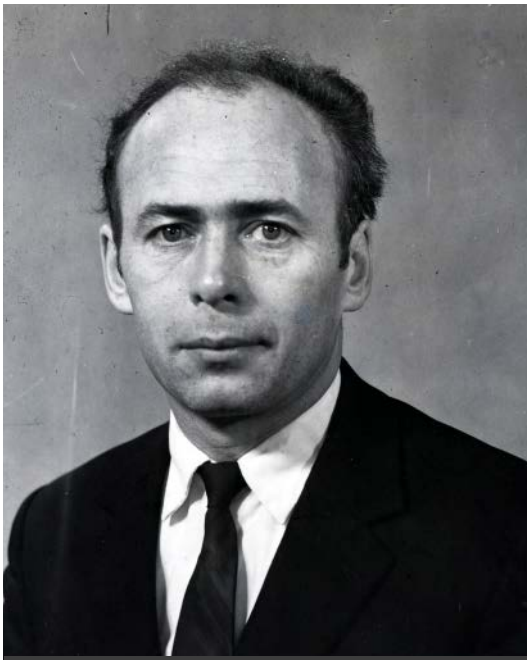

Freeman, Theodore C.

Gagarin, Yuri A.

Givens, Edward G. Jr.

Grissom, Virgil I.

Komarov, Vladimir



Patsayev, Viktor

See, Elliot M. Jr.

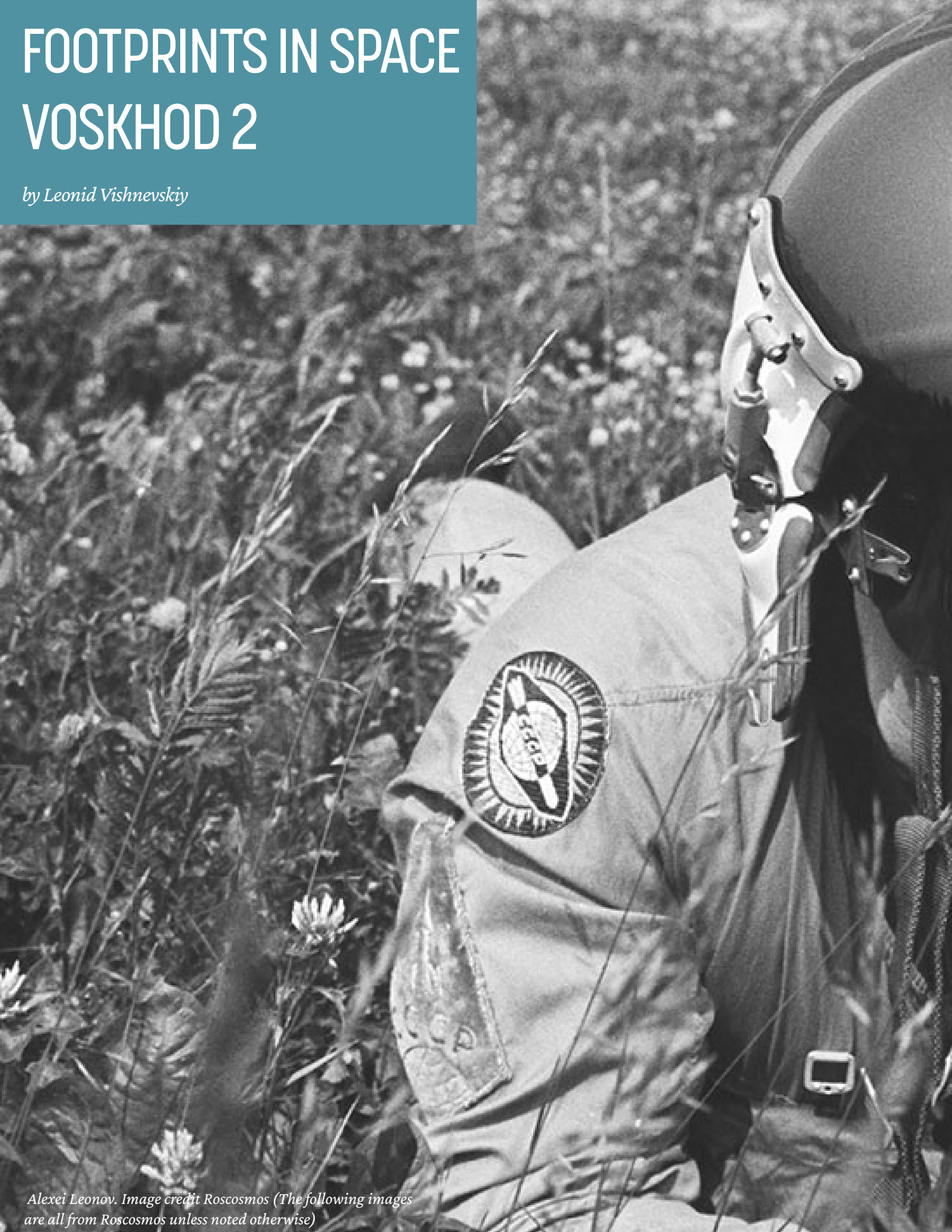
Volkov, Vladislav

White, Edward H. II

Williams, Clifton C. Jr

FOOTPRINTS IN SPACE VOSKHOD 2

by Leonid Vishnevskiy



Alexei Leonov. Image credit Roscosmos (The following images are all from Roscosmos unless noted otherwise)

Alexei Leonov in open space. March 18, 1965

Introduction

In the previous issue, we told you about the Voskhod 1 mission, the first multi-manned flight, whose crew included a civilian, another first in space exploration history, and briefly mentioned the flight of Voskhod 3, also known as the Biosatellite Kosmos 110. Following the flight of Voskhod 3, the Voskhod program was canceled to accelerate the Soviet Union's lunar program.

In this issue, we will conclude the story of the Voskhod program by discussing the Voskhod 2 mission, which is perhaps the program's most famous flight. This mission is notable for one more space exploration first – a spacewalk. Another term for it is the first extravehicular activity (EVA). The crew members were command pilot Pavel Belyaev and co-pilot Alexei Leonov.

As we discussed in the previous issue, the launch of Voskhod 1 took place under the General Secretary of the Soviet Union Nikita Khrushchev, while the landing was under the next General Secretary. The new General Secretary, Leonid Brezhnev, like Khrushchev, understood the importance of the development of the space industry in the Cold War era, but also quite better realized that the country had recently survived the Second World War, and its economy

has not yet recovered. The intensive development of USSR cosmonautics in its initial stage occurred simultaneously with the rise of the country from the ruins and devastating efforts to heal the wounds of the loss of almost 27 million people, and although up till now the USSR was in the lead in the space race, the state of the US's economy, which was not ruined by the war, was incomparable with the economic loss of the Soviet Union.

A decision was made to carry out progressive economic reforms in the USSR. But all this had not yet affected the Voskhod 2 mission, and as before no expense was spared for its implementation.

The Voskhod carrier rocket with the crew of the Voskhod 2 spacecraft was launched on March 18, 1965, from the Baikonur Cosmodrome. The preparation for a spacewalk was started almost instantly as they reached orbit. It was planned for the co-pilot to perform a spacewalk on their second orbit when the spacecraft would be over the USSR. All Voskhod spacecraft were orbital, or what Soviet engineers referred to as "sputnik spaceships."

The co-pilot Alexei Leonov ventured from the spacecraft at the beginning of the 2nd orbit, 1 hour 35 minutes after the launch. He was in the depressurized airlock (also termed "outer space" due to it being mainly the same environment) for 23 minutes 41 seconds, and outside the airlock in outer space for 12 minutes and 9 seconds. The total duration of the Voskhod 2 flight was 1 day 2 hours 2 minutes and 17 seconds. The maximum distance from the airlock was around 5.35 meters.

Spacewalks are now a standard part of long missions to the International Space Station, thanks in large part to the experience gained on this flight. But on that day, March 18, 1965, Sergei Korolev, seeing off the crew of the Voskhod 2 spacecraft, asked Alexei Leonov to report to Earth absolutely everything that would happen during the spacewalk, or as Korolev put it: "Report everything, think of it as though you are demining. We must know where the song will break off, if it will break off." Since, among other things, it was impossible to simulate space vacuum conditions on Earth during training and testing, no one knew if Alexei Leonov would survive. It was critical to document everything that would happen. If Leonov died, they needed to know what caused it so that it would not be repeated in the next spacewalk.

The fears were proven to be justified. Emergencies occurred during the flight, including one during Leonov's spacewalk. However, to survive and not let the song break off, Leonov broke the rule of reporting everything to Earth; otherwise, he would not have had enough time to return aboard the spaceship. There were also additional reasons for that. One of them is that Leonov did not want to let down all those people who selflessly worked on the possibility of the Voskhod 2 mission, because what happened in space on that day, as well as on all others, would be possible to listen to from all over the world. The latter circumstance we mentioned in the Impressions rubric of this issue (with the movie "2001: A Space Odyssey" by Stanley Kubrick).

Image from "2001: A Space Odyssey"

Why a Spacewalk?

As Sergei Korolev was saying:

"A sailor on the deck of the ship should know how to swim in the ocean; a cosmonaut on board a spaceship or station should know how to "swim" in outer space."

"The spacewalk is associated with a number of operations that may be required when meeting ships if it is necessary to conduct special observations in space. And, finally, in those cases when it will be necessary to fix something on the ship. For example, we are seriously thinking about the fact that an astronaut who went into space should be able to perform all the necessary repair and production work, up to the point of doing the necessary welding, etc. This is not a fantasy; it is a necessity. The more people fly in space, the more this need will manifest itself."

Main Differences Between Voskhod 1 and Voskhod 2

As previously stated in the 14th issue, the three-person Voskhod 1 was not a completely new spacecraft, but rather a modification of the single-person spacecraft Vostok, which carried the first human into space. Similarly, Voskhod 2 was a spacewalk modification of the Vostok spacecraft. It should be noted that Voskhod 2 was thought of and designed concurrently with Voskhod 1.

Unlike the three-person Voskhod 1, Voskhod 2 was designed to carry two cosmonauts: a commander pilot and a co-pilot, both of whom were highly skilled military pilots. For the first flight, the purpose was to perform a multi-person flight, for the second – a spacewalk.

Korolev and Belyaev, on March 18, 1965

While the astronauts on Voskhod 1 flew without spacesuits, the crew on Voskhod 2 was provided with spacesuits. However, the Voskhod ship's cabin was not fully designed for long-term operation in a depressurized state, so a spacewalk required the use of an airlock. Because it was unknown how the spacecraft's equipment would respond in a vacuum, the Soviet engineers deemed it risky to have depressurization of the spacecraft cabin for an extended period. Despite this, it was still possible to depressurize the Voskhod 2 descent module, but the instructions stated that it should only be used in an emergency and that the airlock was a safer option.

Three months later the first United States performed its first spacewalk with astronaut Ed White. The spacecraft was Gemini and depressurization of the cabin was used for a prolonged period in it. It turned out it could be safe. This is how little by little we were gaining the understanding of being in open space outside a spaceship.

Chief Designer Sergei Korolev and pilot in command Pavel Belyaev on March 18, 1965 shortly before Voskhod 2's launch

March 1965. Alexei Leonov saying goodbye to his family

March 18, 1965. From left to right: The first cosmonaut Yuri Gagarin and the crew of Voskhod 2

The Airlock Volga

A space airlock is an airtight chamber with two entrances that allows an astronaut to go on a spacewalk without letting air out of the spacecraft.

The airlock designed for Voskhod 2 was named after the longest river in Europe, situated in Russia, Volga. Because there was no room on the descent module for an airlock, it was inflatable. Just as we couldn't send the James Webb Telescope into space assembled nowadays, back then the airlock Volga had to be assembled/inflated in space too, in orbit in this case. A design for a foldable airlock with a soft inflatable shell that expands in orbit allowed the ship's existing structures and the launch vehicle's fairing to be used with only minor modifications.

It should be noted that at the time inflatable designs for space modules were used out of necessity. However, once it was successfully tested in open space, it also began being a promising alternative to carrying large compartments into space.

Volga consisted of an upper rigid part with a hatch for space access (opened inside the airlock) and a lower mounting ring docked with the ship above the EVA hatch (opened inside the descent module). They were connected with the middle inflatable part, made of two sealed shells, divided into inflatable elements. For reliability, the inflatable elements were divided into three independent sections.

On the upper, outer part of the airlock, a movie camera was installed to film the spacewalk. Two more 16 mm film cameras were installed inside the airlock to film the cosmonaut's entry and exit from the airlock. Before returning to the spaceship, Leonov had to dismantle those movie cameras and put them inside the ship. Additionally, Leonov himself had one more camera. The cameras were sending images to Earth and to the descent module for the commander pilot Belyaev to monitor the spacewalk and be ready to help if needed.

Also, a lighting system, control panel, and other systems were installed inside the airlock. Cylinders with a supply of air to pressurize the lock chamber, and cylinders with an emergency supply of oxygen were installed outside.

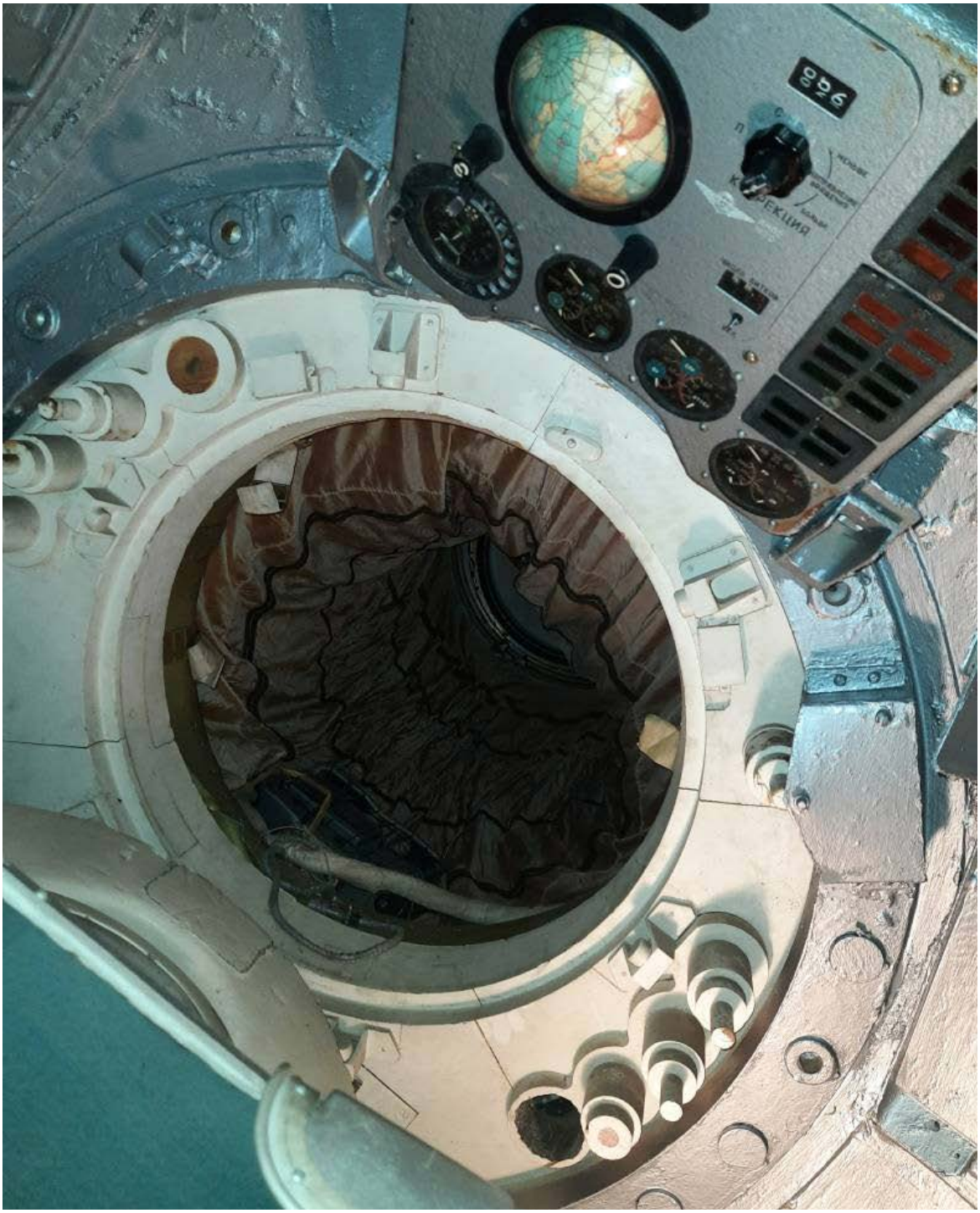
After the spacewalk, the airlock was meant to be fired off of the descent module. That is why, while you can see an original Voskhod 2 in the museum of RKK Energia, the airlock attached to it is not the original used for the spacewalk. Nevertheless, since Volga was made not only for direct flight into space but also for testing, those samples of Volga can be seen in museums. From 1964 to 1965, seven sets of airlocks were made, some were used in space, both for mission and for testing, some for testing on Earth, and some were kept as spares.

To get an idea of the capacity of the airlock, I will give its dimensions. By the way, Leonov's height was 6'2" in a spacesuit , and the spacesuit's width at the shoulders was 27 inches.

Voskhod 2 in the RKK Energia museum. Image credit: The Museum of RKK Energia

Volga Airlock Dimensions

Outer diameter - appr. 3.4 feet (1.2 meters exact)
Internal diameter - appr. 3.3 feet (1 meter exact)
EVA hatch diameter - appr. 3.3 feet (1 meter exact)
Airlock in the folded position- appr. 2.3 feet (700 millimeters exact)
Airlock fully extended – appr. 8.2 feet (2.5 meters exact)
Weight - appr. 551 pounds (250 kilos)



Entrance to the airlock Volga from the descent module.
Image credit: Internet resources

The Spacesuit Berkut (translated as the Golden Eagle, Aquila Chrysaetos)

So, the spacesuit is what protects us from non-Earth-like environments. By 1965, we already had the experience of a man being in open space inside a spaceship. Now it was necessary to experience a man's presence in a spacesuit's open space. What should it be? No one knew exactly. On Earth, it is unachievable to simultaneously replicate all the factors of space flight. Although weightlessness was imitated on an airplane (lasting around 20 seconds), it's impossible to do the same with a space (absolute) vacuum. But during spaceflight, these two factors (not even mentiong all the others) all come together. And adding to this, in any case providing the same level of protection as within a spaceship is impossible. In March of 1965, the spacesuit for a spacewalk was only a best guess.

Alexei Leonov in a spacesuit in an aircraft during weightlessness training in preparation for the flight on Voskhod-2, 1965

The spacesuit of the commander pilot Pavel Belyaev had the same design as Alexei Leonov's spacesuit. Belyaev, if necessary, could depressurize the cabin of the ship, open the hatch and assist Leonov. The total weight of the spacesuit was almost 42 kg (appr. 93 pounds), which caused inconvenience during training on Earth, but did not play a significant role in weightlessness. However, there was another

matter to pay attention to.

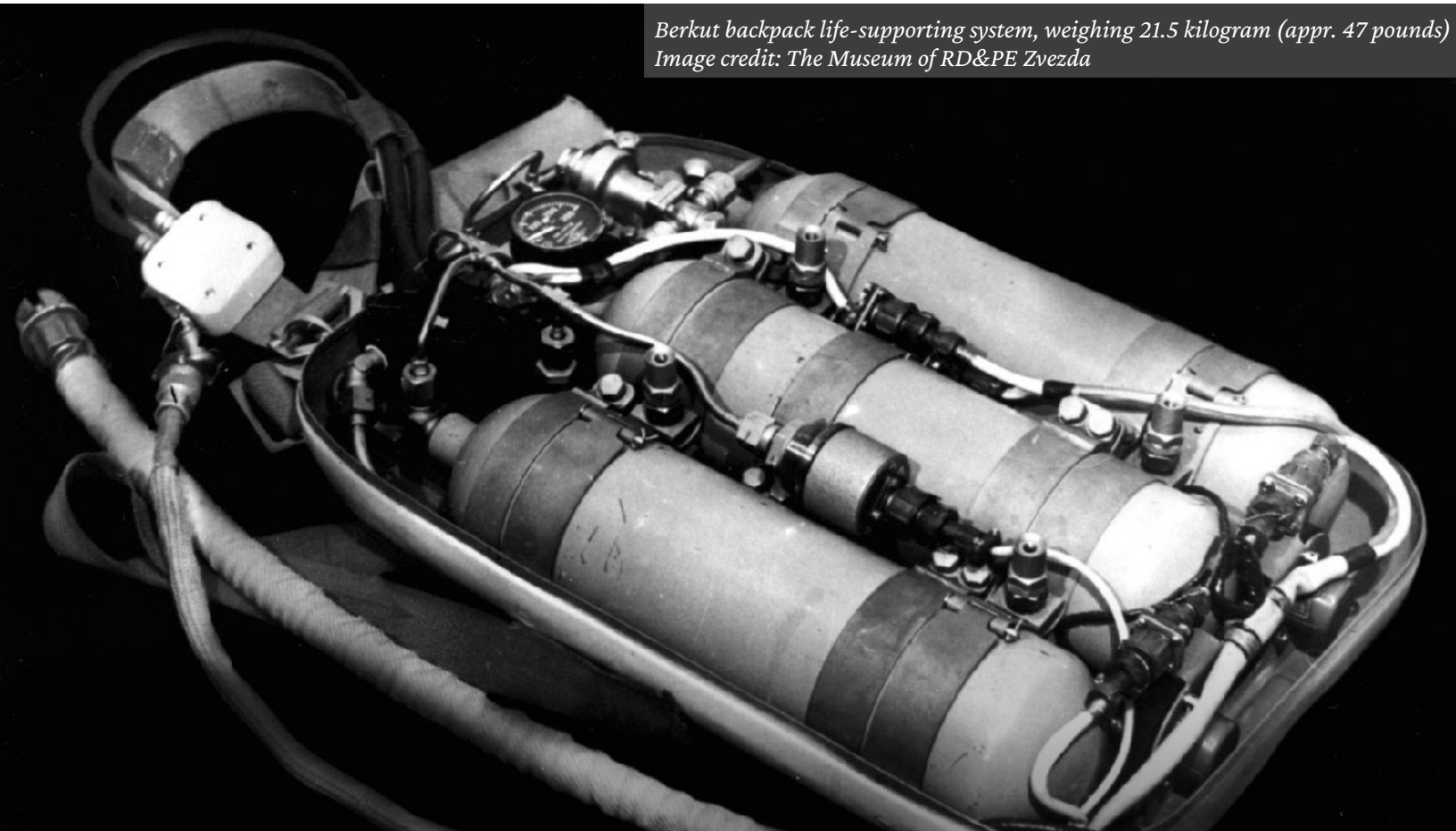
The spacesuit had a double hermetic shell that allowed it to keep excess pressure inside the spacesuit, necessary when entering an almost absolute vacuum with no pressure, which is what open space is, and it made the spacesuit somewhat stiff. If necessary, the pressure in the suit could be reduced to improve mobility (this is what saved Leonov, which we will discuss later in this article).

The spacesuit had a special coating to protect it from the thermal effects of sunlight and possible mechanical damage to the sealed part of it.

The suits had a ventilation system and an oxygen supply. When entering the airlock, oxygen was supplied from the cylinders located there. When entering open space, the cosmonaut was disconnected from the adapter hose in the airlock, and oxygen was supplied from a backpack life-supporting system consisting of pressurized oxygen cylinders, which were attached to the suit with a suspension system.

The cosmonaut turned on the oxygen supply by himself using a remote control. Oxygen use was calculated to ensure pressurization of the suit, oxygen supply to the cosmonaut, and removal of CO2 for 45 minutes. As a reminder, Alexei Leonov's spacewalk lasted 12 minutes 9 seconds, and he spent a total of about 23 minutes in a vacuum/open space.

The cosmonaut's safety in outer space was ensured by a special 5.35-meter tether, which included an anti-vibration device, steel cable, emergency oxygen supply hose, and electric wires, which transmitted medical and technical measurements to the spacecraft, and allowed the cosmonaut to have telephone communication with the ship's commander.



Berkut backpack life-supporting system, weighing 21.5 kilogram (appr. 47 pounds)
Image credit: The Museum of RD&PE Zvezda

Spacesuit “Berkut”, soft design with a removable hard helmet and an open-loop ventilation system. It was intended to provide access to space and to rescue the crew members of the Voskhod-2 spacecraft in the event of an emergency depressurization of the descent module. The weight of the suit is 20 kg. The mass of the backpack is 21.5 kg.

Image credit: The Museum of Cosmonautics

Kosmos 57 and Kosmos 59

Each Voskhod flight was preceded by unmanned flights called Kosmos.

The Voskhod 2 flight was preceded by a flight of the unmanned spacecraft Kosmos 57, which was equipped with an airlock and a Berkut simulator suit. Its planned flight program included a full simulation of the airlock system in orbit, as well as the pressurization of the spacesuit by remote control from Earth. A few days before the flight, during inspections, it was discovered that in the absence of a pressure difference, the exit hatch of the airlock might not fully close and thus the hatch would fail to open due to a glitch. To double-check that the hatch would be closed, it was decided to send an additional command from Earth to close it. However, these simultaneous commands caused another glitch in the spacecraft instead. The aircraft recieved a command to land, however it self-destructed as it was above non-Soviet territory. Although the flight was not fully carried out, most of the operations of the airlock and the suit performed normally, which served as a validation of the equipment.

To further check the airlock operation, which was not done during the flight of Kosmos 57, the flight of Kosmos 59 was performed. After this, the Voskhod 2 mission was authorized. On 18 March 1965, Pavel Belyaev and Alexei Leonov were taken to the launch pad.

Mannequin in the Berkut simulator spacesuit, loading onto a Kosmos spacecraft

Spacewalk

To catch the primary spacewalk window, the crew had to begin preparations as soon as they arrived to orbit.

The airlock was controlled by Pavel Belyaev from the descend module. If necessary, the control of the main locking operations could be carried out by Alexei Leonov from the panel installed in the airlock. Belyaev filled the airlock with air and opened the EVA hatch connecting the descent module with the airlock. Leonov floated into the airlock, the hatch behind him was closed and depressurization of the airlock began.

At the beginning of the second orbit, the airlock was completely depressurized, the hatch for space access opened, and Alexei Leonov stepped into outer space.

Painting by Alexei Leonov

Leonov began to carry out the planned observations and experiments. He made five movements to and from the airlock, with the very first one made at the minimum distance of one meter for orientation in new conditions, and the rest for the full length of the tether. The spacesuit was maintained at a comfortable temperature. Belyaev monitored the work of the co-pilot in space and was ready, if necessary, to provide assistance to him.

After performing a series of experiments, Leonov was given the command to return. The timing was tight, as he had oxygen left for only 20 more minutes. Being on the sunny side for 12 minutes made him sweat, but soon the ship would enter the shadow of Earth, where low temperatures could complicate all his actions and lead to death. Also, in total darkness, he would not have been able to gather the tether together and entrer the airlock.


CCCP

Return to the Airlock and the Descent Module

The timing was tight, and Leonov already knew that he was experiencing an emergency situation. Being outside of the airlock for a total of 12 minutes, at the eighth minute he felt that his hands slipped out of his gloves, his feet came out of his boots.

The problem that arose is explained by the fact that the procedure for entry into the airlock was not possible to fully test in ground conditions on Earth, as mentioned earlier. Due to the difference in pressure, the suit swelled up, lost its flexibility, and Leonov could not squeeze into the airlock hatch. Although it was predicted that such a thing may occur, few people had any idea that it would be so strong. There was no time to consult Earth because Leonov was not only under extreme physical stress but he also had a limited supply of oxygen and would soon be in Earth's shadow.

That's when the spacesuit's ability to reduce its internal pressure came in handy. Leonov depressurized the spacesuit to emergency pressure (to 0.27 atmospheres from 0.4 atmospheres) to facilitate his entrance into the airlock.

Because blood literally begins to boil at low pressure, and Leonov reduced the pressure, it is important to clarify the following. Leonov's body was saturated with oxygen before entering space, since he had been breathing pure oxygen for about an hour up until then, which meant that a great amount of nitrogen must have left his blood. Otherwise, his blood would have started to boil/the nitrogen in the blood would start to bubble, which risks instant death. That's why he took that risk, and that would be the same advice he would be getting from Earth anyway. In other words, this situation was not anticipated on Earth during spacewalk preperation, but still the necessary precautions for it were added to the design of the spacesuit Berkut. Leonov acted as it was expected from a man that went through a highly selective process of becoming a cosmonaut. In a short time, under a lot of physical stress he made the right decision, saving his own life and the mission.

All this time when Leonov already knew about the situation he was in, he interrupted his communication with Earth, not wanting the whole world to learn about the predicament he is in, and also to save time.

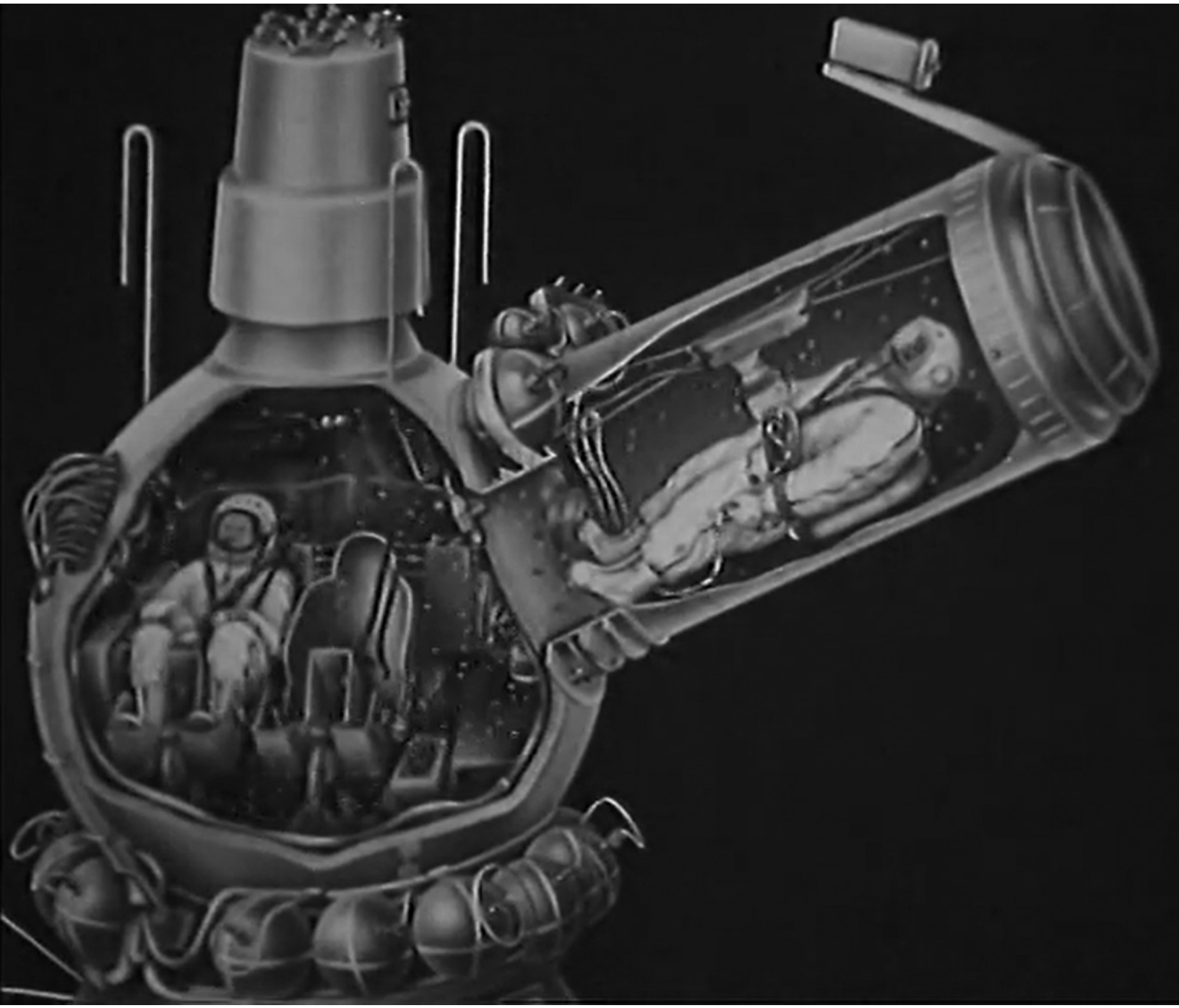
However, was it enough to just lower the pressure? No. Leonov gained some more flexibility, but not enough to further proceed by instructions, because he still couldn't just float into the airlock, he had to pull himself in. The instructions stated that he should enter the airlock and subsequently the descent module feet first, but he could only fit inside the airlock now by entering head first.

Why did Leonov have to go in feet first? While it was technically possible to enter the airlock head first, it was still imperative to enter the descent module feet first and carefully float into the seat, because the hatch that opened

Painting by Alexei Leonov

inwards into the descent module took up 30% of its volume, and also if the EVA hatch would not close automatically, he would have to perform this manually. Additionally, there was the other pilot, Belyaev, inside the module and the control buttons and all that made it impossible to enter the descent module head-first safely.

Thankfully, because the airlock was made of a soft inflatable material, Leonov was able to roll around inside it while attempting to enter the descent module. It was exceedingly challenging to reverse directions since the airlock's internal diameter was one meter and the suit's shoulder breadth was, as was previously stated, 68 centimeters/27 inches. Leonov succeeded in accomplishing this, enabling him to board the ship feet first as planned.



An image from a Soviet popular science film showing the instructed exit and re-entry procedure

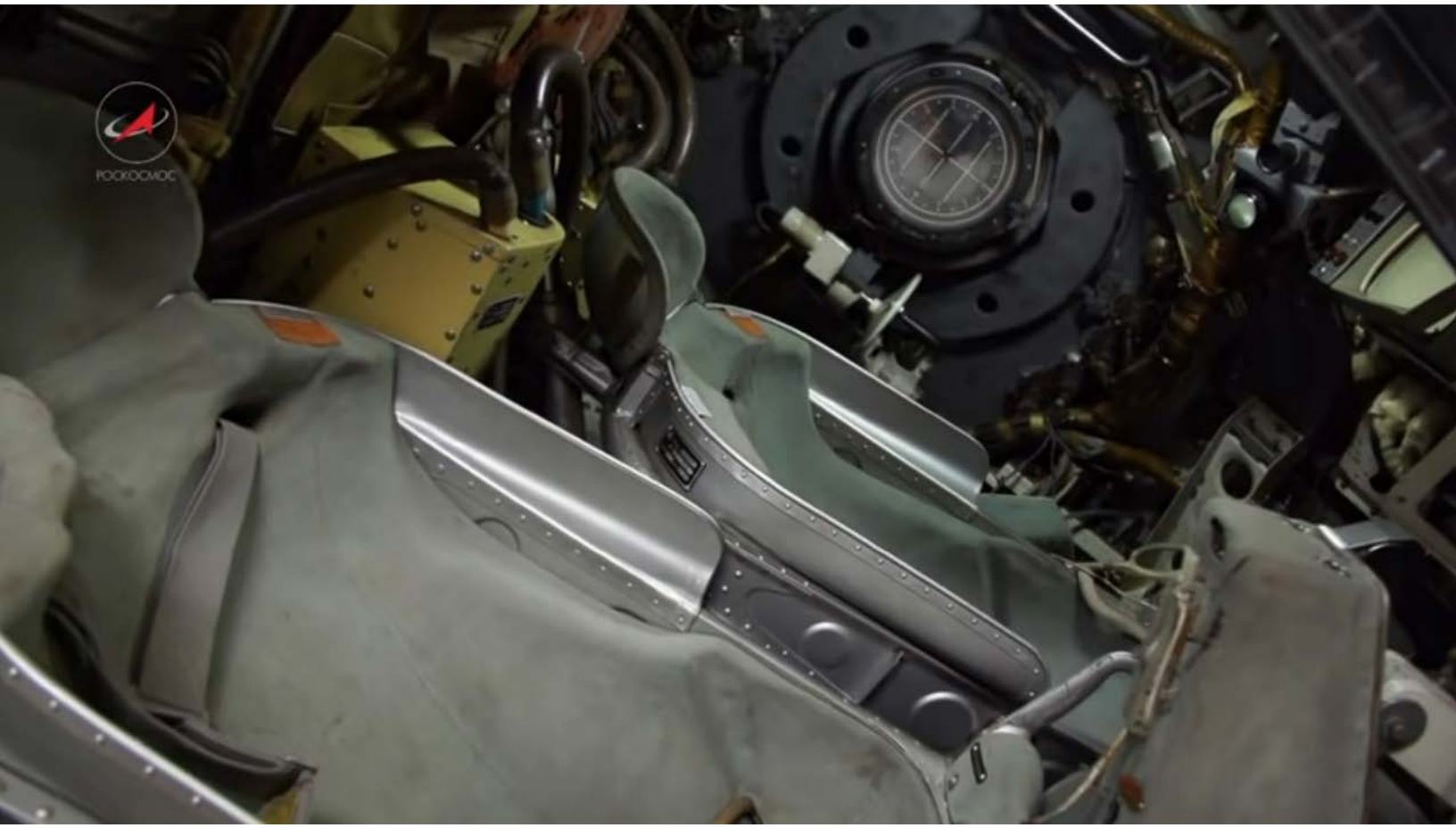
Return to Earth

During the Voskhod 2 flight, seven emergencies occurred, each of which was safely resolved. This experience was useful for subsequent manned space flights. We have just told you about one of these situations, and we will briefly mention another one.

The ship was supposed to start its return to Earth after the 17th orbit, but the respective system did not work in automatic mode. As it turned out later after the airlock was fired off, the surface of the solar sensor, which participated in the automatic mode, became sooty from the airlock's release, and this was the reason for the failure of the system.

For the first time in the history of space flight, the spacecraft had to be landed manually. Since no one expected to land in manual mode, the cosmonaut's chairs were turned 90 degrees relative to the Vzor viewer sight, through which the astronauts could determine the position of the spacecraft. It was like driving at a high speed on the highway, and at the same time having to constantly look to the left. It was not easy to align the spacecraft, but they managed to do so.

They started landing after the 18th orbit. Everything went well. The parachute system worked normally, and Voskhod 2 landed in the taiga in the Perm region. Although the time of year was March, the taiga was still in an intense winter. The astronauts were found fairly quickly, and the next morning they were dropped warm clothes and food from helicopters, lowered a group with a doctor to help, but due to the fact that it was a remote taiga, where



An image from a documentray film with Alexei Leonov showing the interior of Voskhod 2's descent module

Belyaev and Leonov inside Voskhod during training on Earth - this is how tight it was inside. Image source: internet resources

there were no roads and a very dense forest, they had to spend almost three days there.

During this time, a landing site was cleared for a helicopter. However, Belyaev and Korolev then still had to get there on skis. And all this after an extremely difficult space flight.

On March 21, the cosmonauts were rescued from the taiga, taken to an airfield in Perm, and from there to the Baikonur cosmodrome, where they were met by Sergei Korolev and others. Korolev did not yet know about the emergency situation during the spacewalk. He agreed that Alexei Leonov did the right thing by taking responsibility for himself without consulting Earth.

This is how Voskhod 2 went.

Pavel Belyaev died young only five years later due to an infection that resulted from a surgery. Alexei Leonov lived a long life, surviving an assassination attempt that was made upon The General Secretary Brezhnev in 1969, when bullets struck a government limousine many times while Leonov was in the front seat of it, though none of them reached him (Leonov and other cosmonauts were seated into the car in which Brezhnev usually traveled). Leonov died in 2019.

March 21, 1965

March 21, 1965

Footprints in Space

In open space, we have nothing to use as support for our physical movement, for our body, but we can still rely on our dreams, knowledge, and faith.

Sometimes open space is called cold and lifeless. But is it?

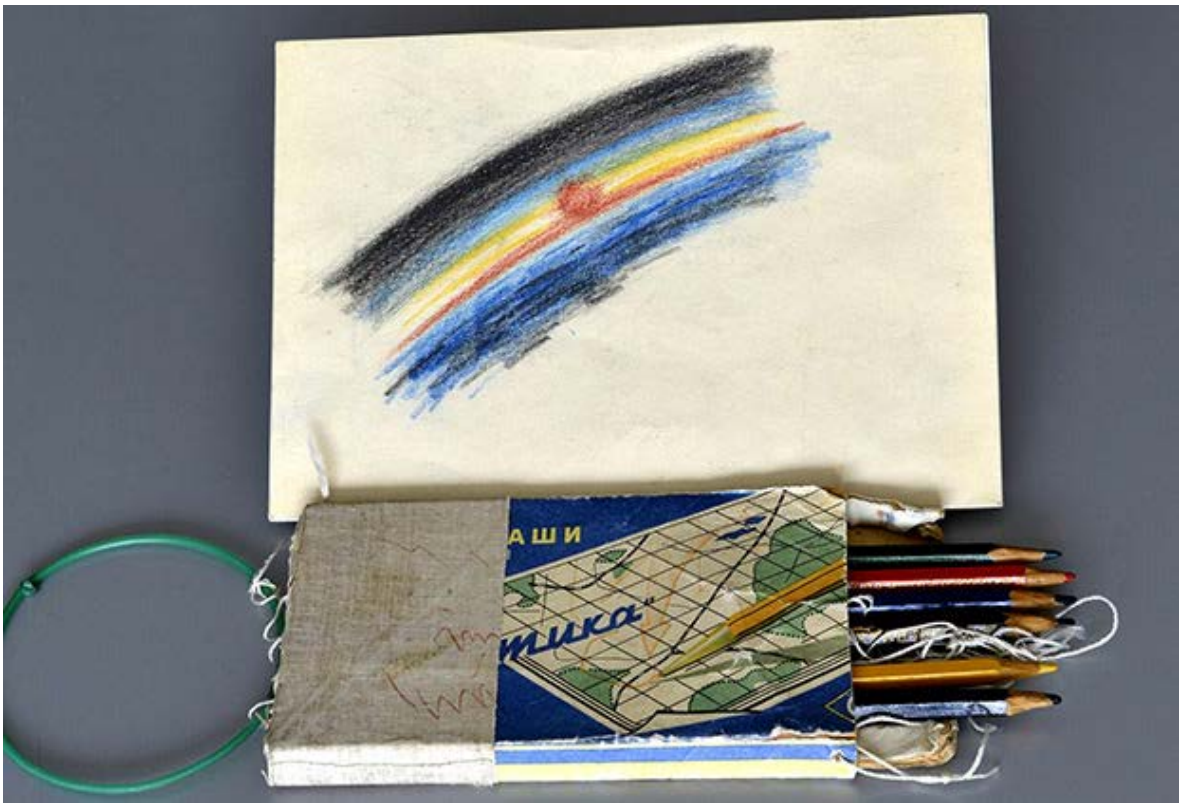
Read what the first person to be in the vacuum of space, Alexei Leonov, said about open space.

"The cold camera lens cannot convey the beauty of the cosmos and its colors. The sky is unusually black, a black that we never see on Earth, and the Sun and stars are brighter than we have ever seen. There are so many stars there that you feel like a grain of sand in space among them, and yet part of it all."

Before becoming a pilot, Leonov was admitted to an art school but did not get to study there because of his financial situation. And here he decided to follow his other dream, to become a pilot. However, he did not give up drawing and continued to do so all his life. In his paintings, he tried to convey what he saw and felt in space.

Our first drawing in space was created in zero gravity while wearing a spacesuit. On it, Alexei Leonov attempted to depict the voskhod/sunrise as seen from Earth's orbit. The pencils were modified for use in space, with each one attached to the table where Leonov drew with a string and rubber bands. The flight was very tense, and yet he believed it was important to share what he saw and felt, even though the cameras were working.

We do have something to lean on in open space, and our footprints in space are an act of creativity.



March 18, 1965, drawn on board of Voskhod 2. Sunrise/voskhod by Alexei Leonov. Image credit: GCTC

SpaceX Starship, image from Official SpaceX Photos on Flickr