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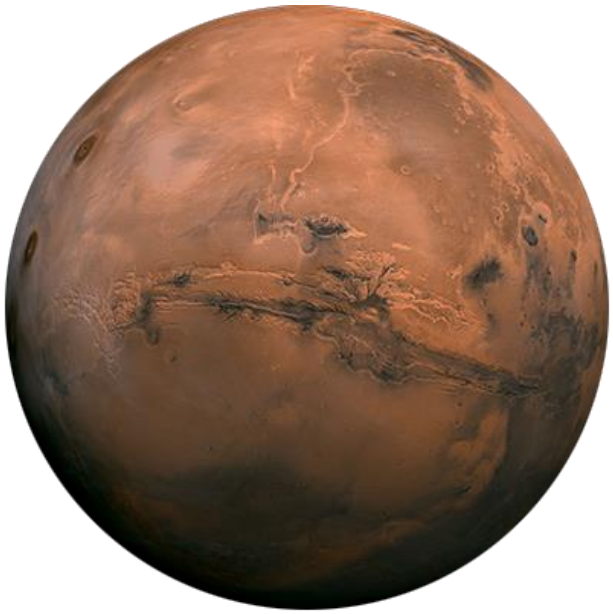
Astra News Magazine
may 2022

Hello everyone!

Welcome to the twelfth issue of Astra News!

The cover for this issue marks the end of the school year and the birthday of this magazine, May 22. Astra News is now one-year-old.

Max and I hope that this school year was very prolific for you and that you learned and worked beyond! To celebrate your achievements, please, turn on the music[1] when looking at the cover (Note: the music plays when your cursor is hovering above Mars)[2]:



We wish you a fantastic summer break, to replenish your energy and to meet the next school year with goals even greater than you had for this outgoing year!

To the stars!

Yours,
Max and Leonid

The cover is by Leonid Vishnevskiy. For the background, a NASA image of the sky around the galaxy NGC 1052-DF4 was used.

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[1] "Sunrise", the opening section of Op. 30, "Thus Spoke Zarathustra" (1896) by Richard Strauss; the theme song from "2001: A Space Odyssey" (1968, Stanley Kubrick).

[2] If this doesn't work in your browser, then please use this direct LINK.


SPACEX

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

ROM The Republic of Mars

About ROM

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

Please, see the beginning of this project in issues No. 1, 3, 6, 8, 9, 10, and 11.

In this issue

As you probably know, Curiosity, who is exploring Mars, sent us a riveting image recently. However, it's not a simple task to trick scientists. They were quick to debunk the myth of a door on Mars. But Curiosity is just an 11-year-old teen, although the size of an SUV. He feels lonely on Mars waiting for us to come.

Together with Max, we are sending Curiosity our collage as a reply to his picture, which you can see on the left.

But that's not all. How could we be so sure that it's not a door? After you read the article about dark matter and dark energy, you may not be so sure.

Scientists have to go by what they can examine in the laboratory, but in that, they have been unsuccessful yet with neither dark matter nor dark energy.

It may be a door, but not in a sense that we are aware of yet. Curiosity might have sent us a clue.

The collage on the left contains the riveting image taken by the Curiosity rover on May 7, 2022.
By Leonid Vishnevskiy

Dark Matter and Dark Energy

By Leonid Vishnevskiy

Part I. Dark Matter

What is Dark Matter?

First, this is a hypothesis. We should not forget that physics never stops to amaze us, and even a hypothesis as strong as dark matter could be rejected in the future. Dark matter is composed of particles, whose nature is yet to be found. They react poorly or not at all with the particles that we know ("normal" matter), with electromagnetic waves, and also react poorly with themselves.

How then did we discover dark matter? Mainly because there is a lot of it.

The Discovery of Dark Matter

Originally identified as the "missing mass," dark matter's presence was first suggested by Swiss American astronomer Fritz Zwicky in the early 1930s. While studying Hubble's observations of the Coma Cluster of galaxies, he noticed that under the measure of visible mass, single galaxies were moving too fast for the cluster to remain bound.

Since galaxy clusters are the largest gravitationally bound objects in the universe, they need large amounts of gravity to hold them together. Gravity is determined by the mass of a substance. So, for there to be high gravity, there has to be a high mass. And here Fritz Zwicky had run into a problem that led to the discovery.

Knowing the properties of all the visible objects/substances in the Coma Cluster and that their high velocities should, but don't, allow them to escape the cluster, he determined they do not have enough mass for such a large gravitational force that would hold them inside the cluster. So, there must be an unseen matter in the cluster; and a lot of it. The matter that would be required for such a force we now call "dark matter", discovered by Fritz Zwicky. In 1933, he presented his conclusions in the journal of the Swiss Physical Society. However, it was not understood clearly that we came across a new matter, and partially this turned into a reason for dark matter to be neglected for roughly forty years.

The renaissance of dark matter took place in the 1970s. On a smaller scale (this time it was a galaxy, not a cluster of galaxies), American astronomer Vera Rubin came to the same conclusion as Fritz Zwicky had previously. By studying the galaxies' rotation/velocity curve, she came upon the discrepancy between the forecast and observed motion of galaxies, which could again be explained by "dark matter". This time dark matter drew a lot of attention, and studies of it began.

By the way, dark matter is not black. Unlike black holes that have such intense gravity that not even light cannot escape them (and so they are black), dark matter is not gathered as tightly to provide gravity that strong. Here "dark" means a mysterious matter.

Of course, after we accepted dark matter, we improved the definitions of "galaxy" and "galaxy clusters".

Galaxy clusters are the largest gravitationally bound objects in the universe and they have three major components:

1. Hundreds of galaxies containing stars, gas and dust;
2. Vast clouds of hot gas that is invisible to optical telescopes; AND
3. Dark matter.

A galaxy is a gravitationally bound system of stars, stellar remnants, interstellar gas, dust AND dark matter.

A microscopic part of dark matter in the Coma Galaxy Cluster

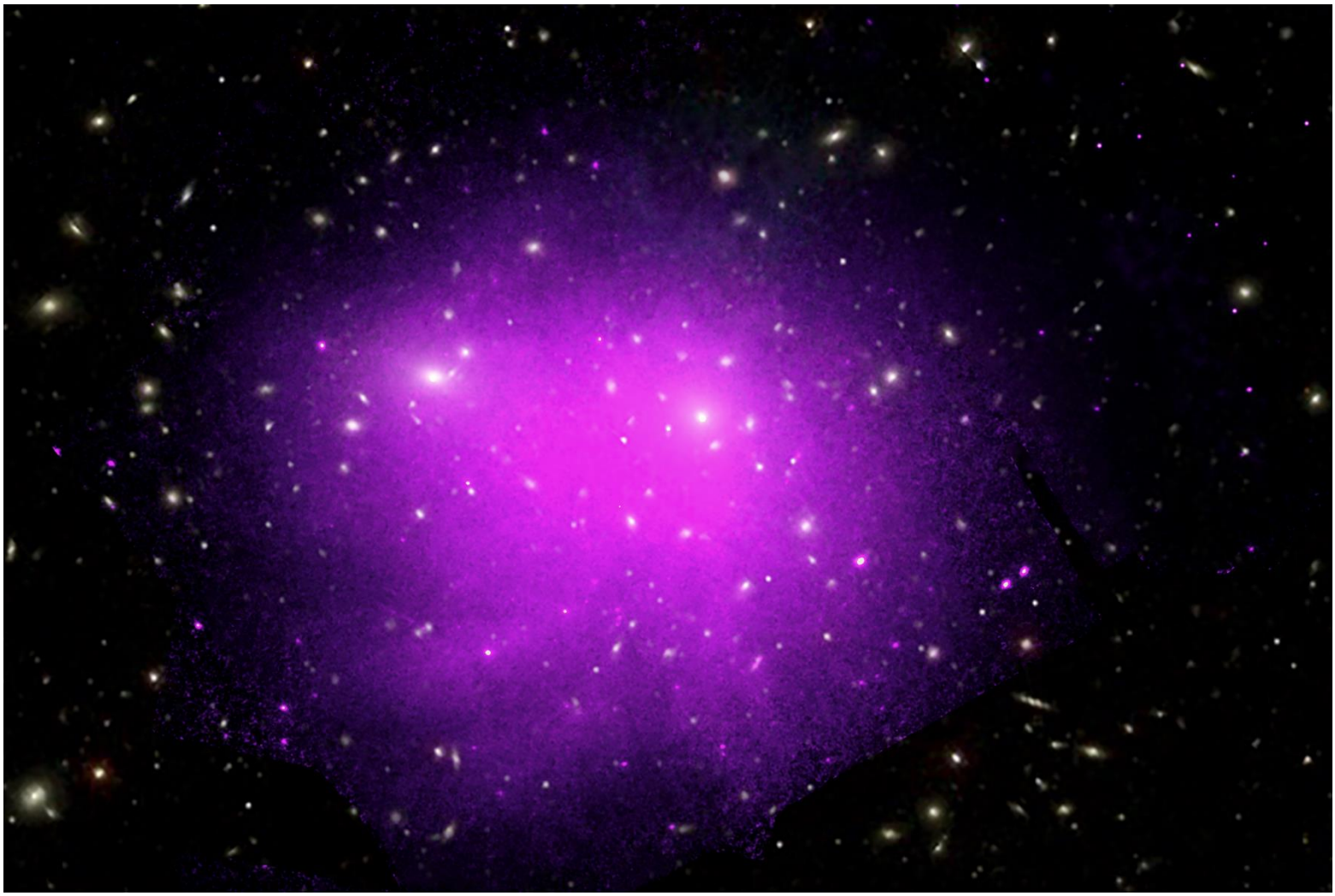


Image of the Coma Galaxy Cluster, consisting of almost 90% dark matter, but it is not visible.
Image credit: X-ray: NASA/CXC/Univ. of Chicago, I. Zhuravleva et al, Optical: SDSS

A Bit About Gravity

There are four fundamental forces that we know (from strongest to weakest):

- the strong nuclear force
- the electromagnetic force
- the weak nuclear force
- gravity

It's interesting that while we have traced the electromagnetic force and the nuclear forces to their origins in quantum particles, gravity remains a mystery. And although the nuclear and the electromagnetic forces act over different ranges, and between very different particles, they have strengths that are comparable to each other. Gravity has a completely different strength. One justification for this is string theory. According to it, gravity is so weak because it leaks in and out of extra dimensions.

In everyday life, we are more familiar with gravity than with the other forces: every child knows why apples fall, and not every adult remembers the definition of the electromagnetic force. Though keep in mind that in science, the real challenge starts with seeking to understand gravity.

Galaxy Girls at the Gravity Feast[1]

Young ladies illustrate how galaxies remain together in clusters thanks to gravity as a result of dark matter. White dresses symbolize the delight of staying together. No one and nothing wishes to fade into the universe, forsaking family and friends.

Image from the public domain.

[1] Keep it secret from your history teacher.

The Dark Side of Gravity

Not everyone agrees that dark matter exists.

In one particular instance, it's based on elegant reasoning, but I agree with most that this assumption lacks sufficient ground. It suggests that instead of adding new matter to our picture of the universe, we should revise or expand our knowledge of gravity. The beauty of revealing what lies in front of our minds and yet unnoticed.

However, only the idea is simple. The hypothesis itself is challenging to crack. But isn't it always so? Simplicity can be a gate to a whole new world. Here it's called "Modified Newtonian Dynamics" (MOND).

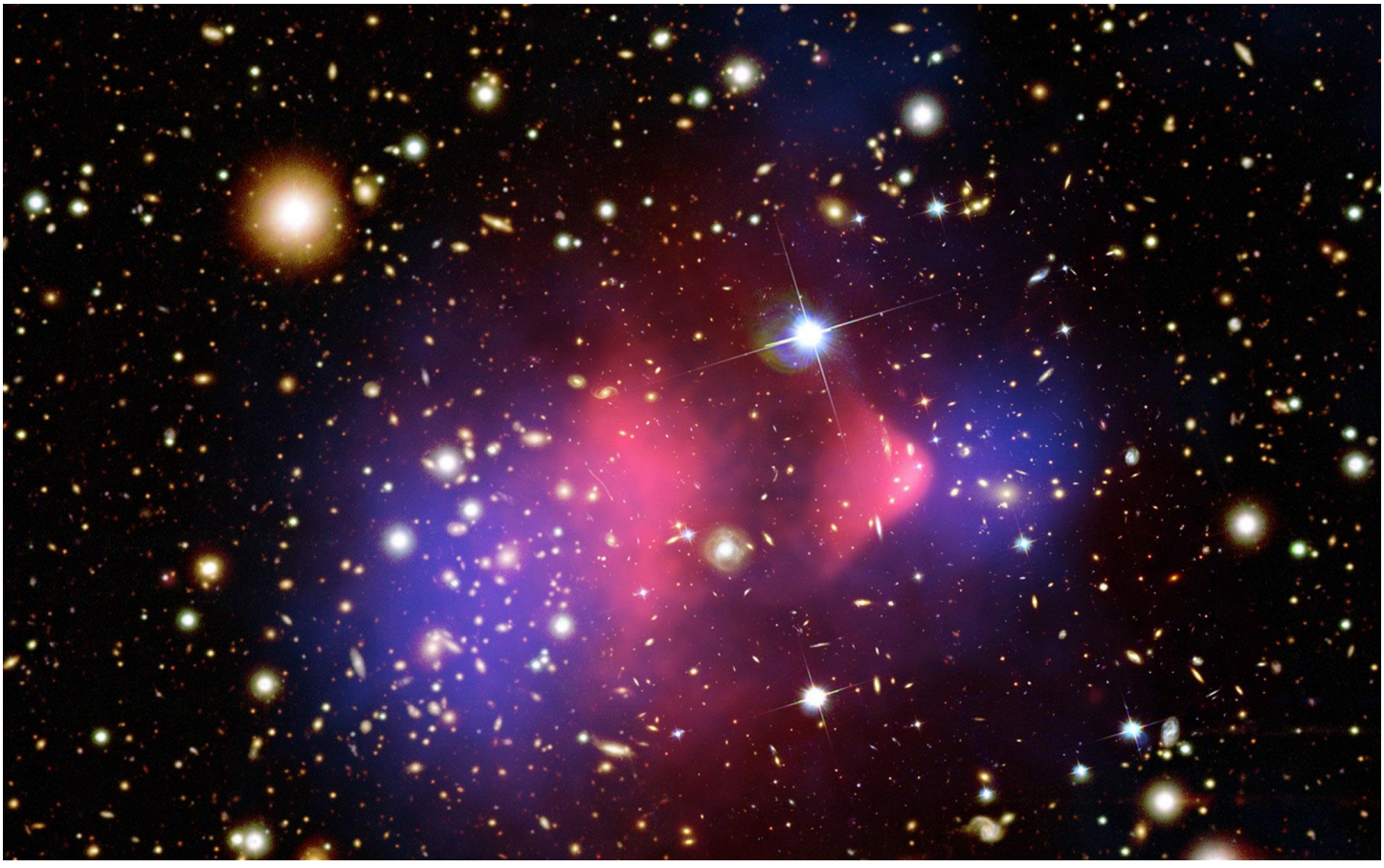
To uncover more, one way to go is to start here and then experience the full force of entropic gravity.

MOND was developed in 1983 by Mordehai Milgrom. In 2007, Erik Verlinde developed the Entropic Gravity theory, which describes gravity as an entropic force.

There has been some proof that there are differences in orbital speeds of distant stars, which cannot be explained by dark matter, but can be explained by MOND. However, the Bullet Cluster is our strongest evidence for the existence of dark matter, and MOND cannot explain the cluster's effects yet.

The Matter of the Bullet Cluster

Please, read more about it here. It contains a short accurate explanation and links to learn further.

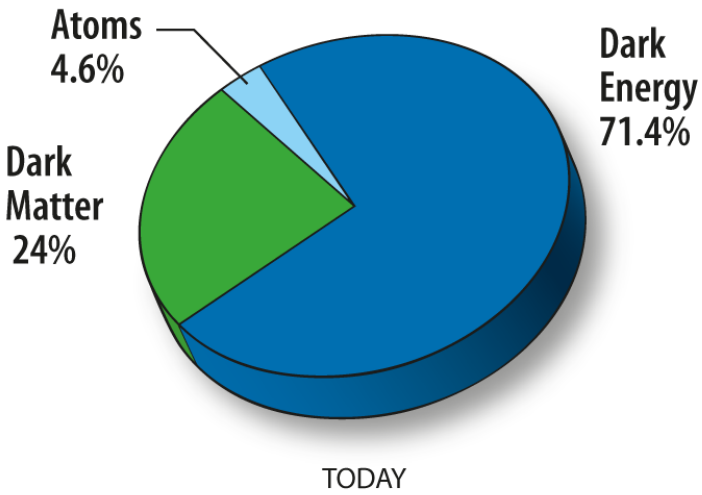


Part of the image, Image Credit: X-ray: NASA/CXC/CfA/ M. Markevitch et al.

What Makes the Universe? Dark Energy

Before I was telling you that there is a lot of dark matter out there, that dark matter is obscure. So, what should I tell you now when we start to review dark energy? Look at the diagram below. Now let me tell you that we know more about dark matter than about dark energy.

I suspect younger students might get confused by looking at this diagram. Is energy matter? And if not, then why is it included as part of the universe? This follows from what we agreed to define as "the universe". The universe contains all the matter and energy there is. The universe contains absolutely everything. Earth's diagram would look different, of course.



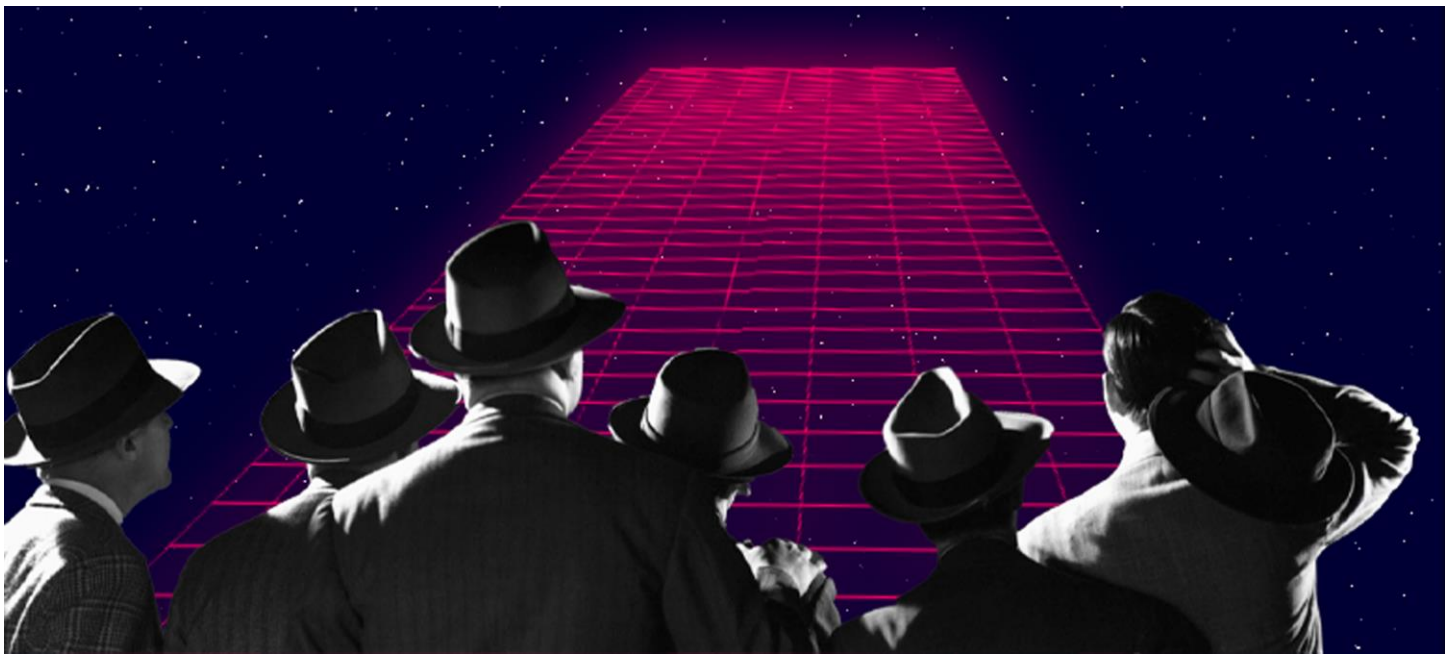
Did you already notice "today" in capital letters written under the diagram? That's important.

This diagram was quite different right after the Big Bang. The first drastic change took place around 380,000 years after the Big Bang. Gradually, it became what you see in the diagram, and it continues to change. Why does this process never stop?

Because, as you know, the universe continues to expand, and it affects all of its components: atoms, dark matter, and... dark energy, that mysteriously speeds up the expansion of the universe.

Image source

What I admire about this diagram is that it also defines how little we know about the universe. And even if we learn that dark matter and dark energy were something that lay in front of our eyes and mind and yet remained unnoticed, in this sense the diagram will still continue to be true.



Collage by Leonid Vishnevskiy

Part II. Dark Energy

What Is Dark Energy? The Expanding Universe

> Dark energy is the name given to the unknown force that's creating the rate of expansion of our universe, and it speeds up over time, rather than slowing down. That's opposed to what we expected from the universe that began in the Big Bang.

We think that dark matter is everywhere. It is in your room right now, as it is in deep space. That is not the same with dark energy. We observe it only at major scales and in space. Another key difference is that dark matter (being a matter) is able to unevenly arrange its particles in the universe, while dark energy is present evenly. However, being distributed evenly doesn't mean that the strength is ever guaranteed to remain the same.

The accelerated expansion of the universe was discovered in 1997–1999 by two independent projects, the Supernova Cosmology Project and The High-Z Supernova Search Team, according to the results of an observation of a type la supernovae. The expansion of the universe has been accelerating for the last 6–7 billion years, so the acceleration was not always present. And this discovery wasn't a complete surprise. Back in 1917, Albert Einstein added the parameter Λ to his equations of General Relativity (1915) when he realized that his theory implies a dynamic universe. Before the common view of the universe was that it is static, but Einstein suggested that gravity would cause it to either contract or expand.

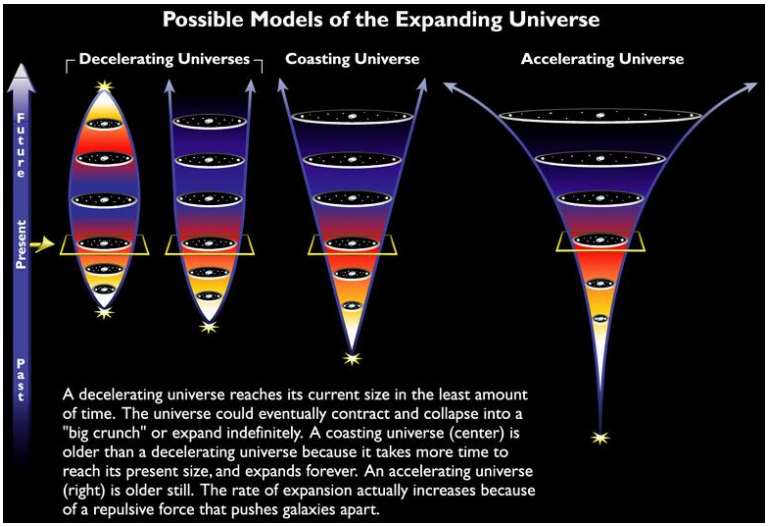


Image source

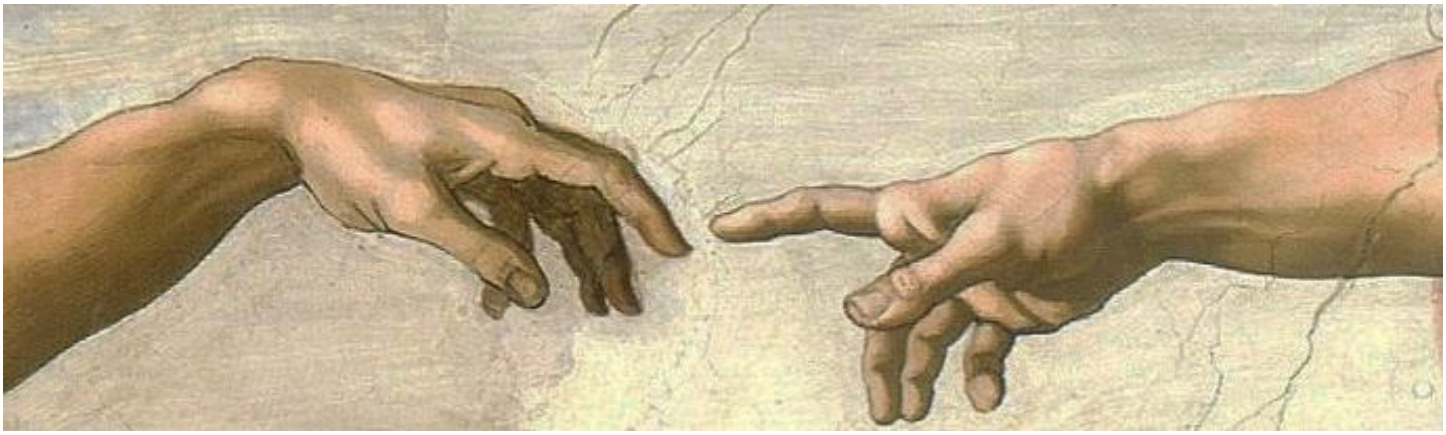
Even the very short introduction to dark energy would not be complete without mentioning the Jewish Russian scientist Alexander Friedmann. His solutions to Einstein's equations provided early evidence of an expanding universe. Can one equation describe the history of the universe?

In Conclusion

From what we learned so far, we presume that dark matter holds the universe together while dark energy drives the universe's ever-accelerating expansion. The future of the universe depends on the evolution of dark energy.

Part III. Good News

As the universe expands and galaxies get further and further from each other, gravity and other forces still hold the galaxies and what is within them together.



Part of the painting "The Creation of Adam" by Michelangelo from The Sistine Chapel Ceiling, virtual tours Musei Vaticani

FICTION

This is a free land without boundaries. Become a pioneer. Come and build your world! That's what defines fiction within *Astra News*.

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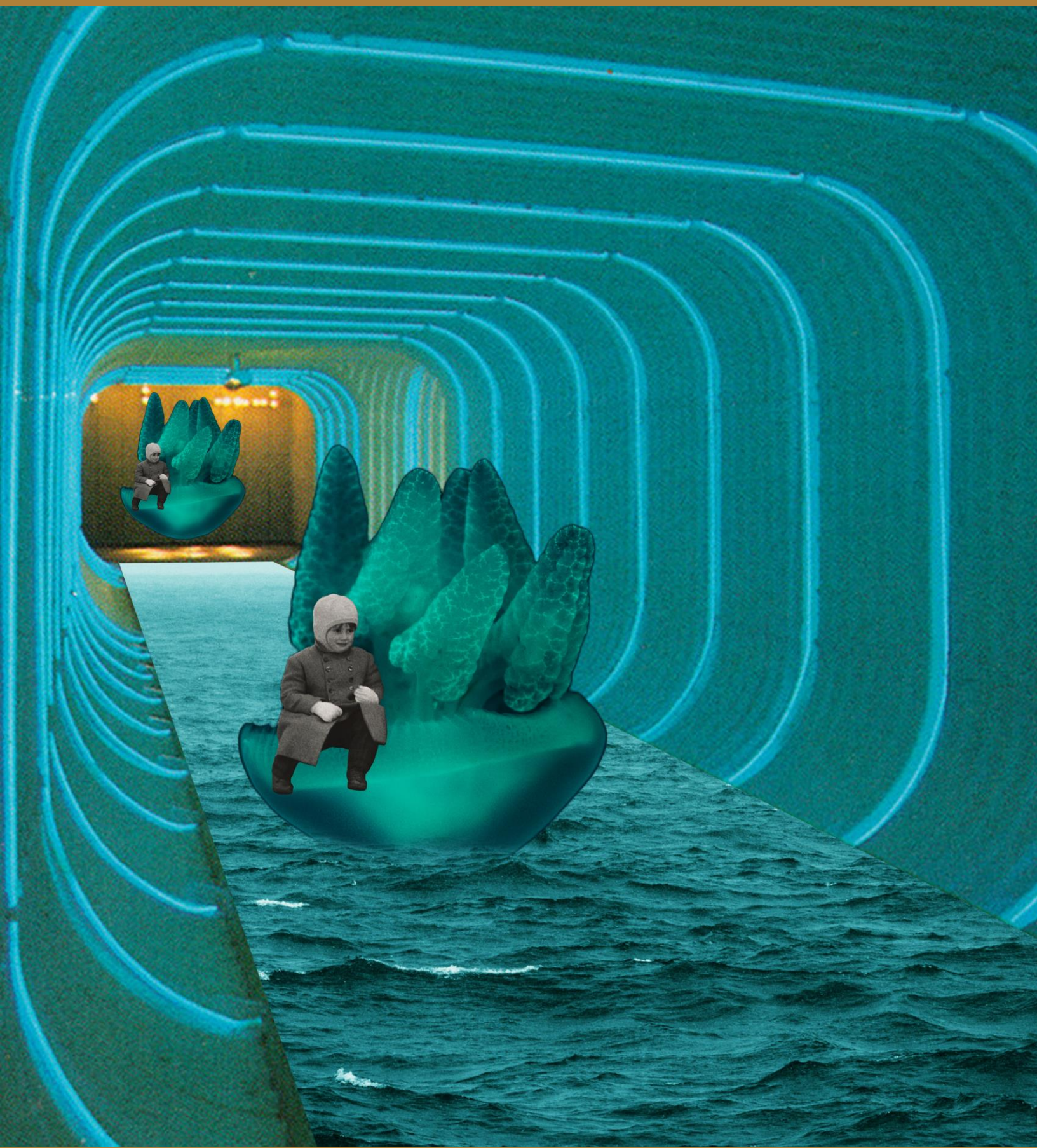


Introduction to Pumpkin and His Enemy

Story and accompanying collage by Leonid Vishnevskiy

I wrote this story for the 11th issue. When I gave it to read, I learned that there is a well-known classical story for kids with a similar plot[1]. I had never heard of it, though. As a hypothetical situation, I described all this to my friends at school and asked whether a person should still publish the story and received two different answers. In the 11th issue, I followed the answer of "no" and started the series Adventures of a Magic Boy. In this issue, I followed the answer of "yes", and accompany my story with the collage to your left.

Pumpkin and His Enemy

I lift my hand. He lifts his hand.

I lift my leg. He lifts his leg.

I turn my head, and he turns his head. Everything that I do, he does, too.

Right now, he is on the other side of the room, looking right at me. I turn away from him and notice that he also turns away from me. I've had it up to here with his tricks!

"Who are you?" I ask sharply.

While I am asking him this, he mocks me by moving his lips mutely. Then he just stands and watches me, waiting for me to burst out.

"Answer!" I demand, almost to the point of yelling.

He mocks me again and stays silent.

"All right. What do you want?" I think I'm becoming scared. "I'm tired of your jokes! Answer me now!" Silence and the mute moving of lips. I clench my fists with fear and direct myself straight at him, but hear quick steps behind me and a voice that I would recognize from thousands.

"Pumpkin, be care-"

"Mom! There's a wicked man there! Drive, drive him away, please!"

She gets closer and looks. Now, there are two scary people there. And one looks exactly like my mom! I need to rescue her! I run head-first into the scary people, but feel myself in the air and appear in my mom's hands.

She smiles. The second person smiles too and stops being scary.

I smile too.

The collage on the left contains images from the public domain, including an image from Unsplash by Johan Mouchet.

[1] The Thing in the Pool. By Lilian Moore. You can borrow a digital copy of the book for free from the link.


ЯДЯМОЦИЯ

Adventures of a Magic Boy

Second Adventure

Story and accompanying collage by Leonid Vishnevskiy

While we are preparing to get on the train, a person in a wrinkled grey shirt comes to us and worriedly says: “In the city, a big train rode out of a building! Don’t go there.” Having said this, the man keeps approaching other people on the platform. “Nonsense”, my parents say synchronously as we are entering the passenger car of the train. I notice they are slightly worried, but ignore that. I have long been waiting for this weekend and am ready to enjoy every bit of it.

Today we are going to watch a movie! None of us yet know what that means, though. Recently, it was my birthday and my uncle gave us all tickets to go watch one. But because we live in the suburbs, we first have to take a train to the city where it is being shown.

Riding on trains is always fascinating for me! I love to sit and look through the window, as the little houses run away and the forest comes; then the forest runs away and other little houses become big.

“Here it is,” I say when we arrive and see a sign that reads “Movie Theater”. We walk over, come inside, and see that the movie theater does indeed look like a real theater, only without a stage. A few minutes pass by and someone announces: “The movie is starting!” It becomes dark.

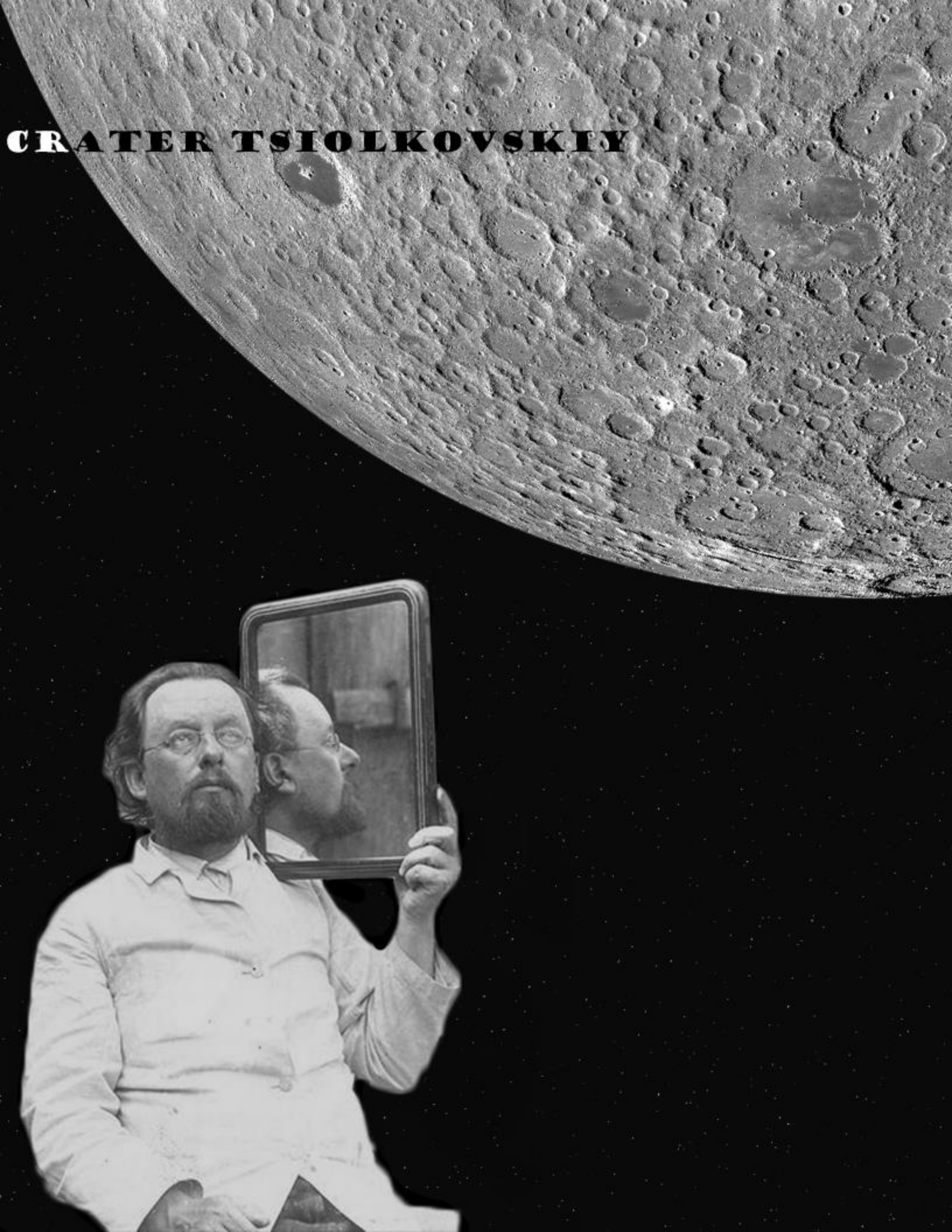
It was at this moment that I notice, in front of us by about ten of my steps, a large white rectangle hanging on the wall. Or perhaps I didn’t pay attention to it before. Now a beam of light is shining on it, and a flickering grey color appeared there. Is that all there is to see? No! There is a railway station full of people now. Where did they come from? Suddenly, we see a train approaching. It’s going straight at us!

Big chaos ensues, and I am on the streets with everyone else.

My parents decide to not delay and hurry us back home. We first go back to the platform. A train arrives, people unload from it and we are telling them about the big train. “Nonsense”, they reply.

P.S. This short story is a tribute to the Lumière brothers. For the collage, I used an image of Comet ISON from the NASA Hubble site.

I also used images from the public domain, including from Unsplash by Erik Torres and Kendrew Schexnider.


CRATER TSIOLKOVSKIY

The Vitruvian Man

About the Vitruvian Man series

Stories about people who took their part in exploring space.

In this issue

Konstantin Tsiolkovsky (1857–1935).

In the previous issue, there was an article about the classical rocket equation, also called the Tsiolkovsky formula. With this formula, we can figure out how much fuel we need to propel our rocket into space and navigate there.

We will continue to introduce you to Tsiolkovsky. Besides being the father of rocketry and cosmonautics, he was a philosopher. Not only was he solving the technical questions of how to get people into space, he was discussing philosophical questions associated with space exploration.

In this issue we will cover mostly his biography, and in the next issue we will start rocketry and the philosophical part.

On your left is a collage on which you can see Konstantin Tsiolkovskiy and the Tsiolkovskiy Crater on the far side of the Moon. In 1959, this crater was discovered by photographs from the spacecraft Luna 3.

Here is the Tsiolkovskiy Crater on a map from the International Astronomical Union (IAU) and the Working Group for Planetary System Nomenclature (WGPSN).

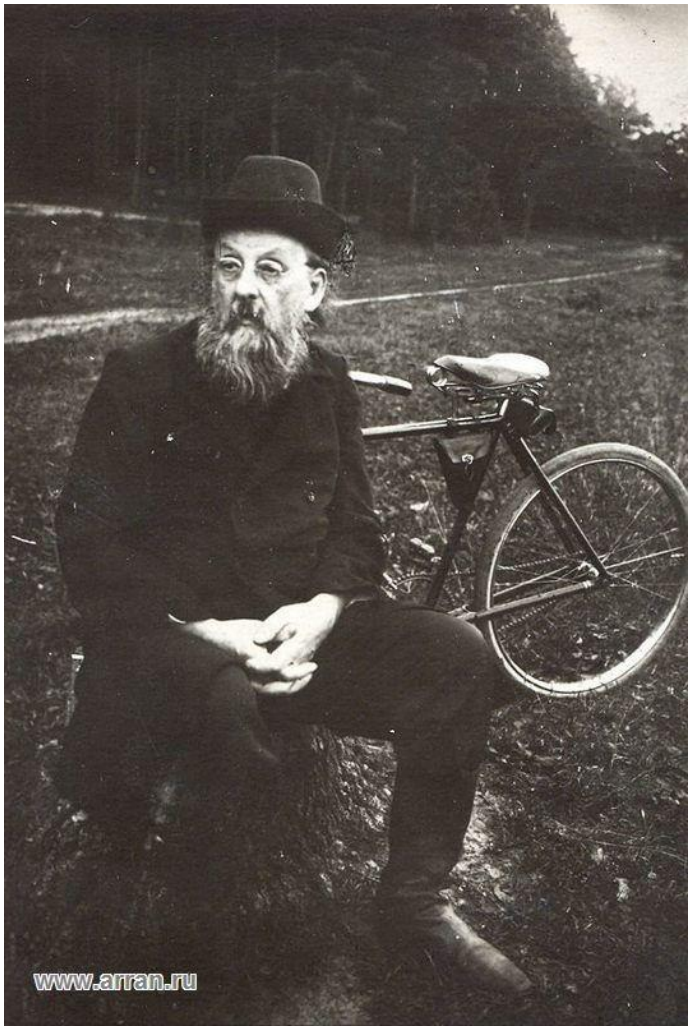
Collage by Leonid Vishnevskiy
For the collage, an image of Tsiolkovskiy taken in 1902 (credits) and an image of the far side on the Moon (credits NASA/GSFC/Arizona State University) were used.

Konstantin Tsiolkovsky

The Father of Rocketry and Cosmonautics
Part I. Biography

By Leonid Vishnevskiy

Konstantin Eduardovich Tsiolkovsky[1] was a Russian/Soviet scientist. When I think of him, what first comes to my mind is the German composer Ludwig van Beethoven. It's not always about the launches and rockets. You see, he was almost deaf. At the age of ten, when he was riding a sled, he caught scarlet fever, survived it, but hardly heard anything for the rest of his life. However, great things lie within ourselves.



Sometime he is regarded as the only father of rocketry. But although Tsiolkovsky was a step ahead[2], "the Romanian Oberth and the American Goddard conducted similar research and arrived at comparable conclusions, (and) there is no evidence that each knew details of the other's work. Therefore, all three scientists share the title of Father of Rocketry."[3]

Tsiolkovsky is also known as a philosopher, he believed in anthropocosmism. It is a concept based on ideas about the harmonic unity of man and society with the universe.

Tsiolkovsky lived through two eras: the Russian Empire and the Soviet Union. Soviet propaganda liked to say that under the tsar, Tsiolkovsky was not recognized. I find that to be partly true, but it has little to do with the regime from Tsiolkovsky's own words. Most likely because of the unfortunate circumstances at the time and the knowledge that that he was self-taught, he was not being taken seriously.

Take for example the case with the equation. After some rejections, Tsiolkovsky was able to publish it in the "Scientific review" (Nauchnoe Obozrenie) magazine in 1903. However, it had a very small circulation and the magazine had become more political than scientific by then.

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[1] Sometimes I write his last name not with "y", but with "iy" at the end. Both variants are correct. The crater is officially named Tsiolkovskiy Crater, but other than that, in English the most common usage is the shorter version of "y".

[2] Tsiolkovsky Begins Modern Spaceflight Theory

[3] nasa.gov Konstantin E. Tsiolkovsky

“Tsiolkovsky's manuscript reached Nauchnoe Obozrenie at a bad time, just after its publisher had died and the magazine was about to fold. Only a few copies of the magazine were distributed before the press run was confiscated, according to Galina Sergeeva, deputy director for scientific research at the State Museum of Cosmonautics, located near Tsiolkovsky’s house in Kaluga. "Until the 1960s, it was believed that this work had never made it outside Russia, when, with the help of American researchers, a copy of Nauchnoe Obozrenie containing Tsiolkovky’s article was discovered in the Library of Congress," Sergeeva said.”[4]

Here are additional parts to the story, from the memories of Alexander Leonidovich Chizhevsky (1897-1964). Unfortunately, you can only read it using Google Translate.

I am using Russian and English sources, prioritizing Russian sources, as more material is available in his native language. My main source was Tsiolkovsky’s archive. It contains 31680 sheets, and it is located in the Russian Academy of Sciences (RAS). This archive was digitalized and is accessible to the public, though it is only available in the form of images (scans). Tsiolkovsky’s archive is divided into 5 categories, I have given the links to each category with a short description.

(1) This mainly contains scientific articles, notes, reviews, etc.

(1a) This mainly contains sketches

(2) This mainly contains autobiographical records, private letters, private notes, photos, articles, etc.

(3) This mainly contains letters related to his scientific and social activities

(4) This mainly contains letters related to his scientific and social activities, but also with more specific labels of the recipients

With this article I am not aiming to retell all that I have learned about Tsiolkosvky. I rather want to share the name of this great man with you, and with that get you interested to learn more.

I found this particular biography to be the most thorough and critical, and it’s written in English. Earlier, I cited this material as citation 4. I suggest for you to start your journey with this: http://www.russianspaceweb.com/tsiolkovsky.html

However, the most important part starts here. In section (2) of Tsiolkovsky’s archive, there is an autobiography that I translated into English for *Astra News*. Tsiolkovsky was 67 years old when he wrote it, the year was 1924. I think it is the right thing to do before giving tribune to anyone else to let Tsiolkovsky speak for himself. The autobiography[5] (with its Russian version included) is on the next two pages.

All photos and scans that I used in the article are from the archives of RAS.
Stay tuned for the next issue to continue reading about Konstantin Tsiolkovsky!

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[4] russianspaceweb.com/tsiolkovsky
[5] He lived through devastating personal losses, and when he writes about “weak strengths”, I think that is a big part of it.

K. Tsiolkovsky

Autobiography

I was born in the ‘50s of the previous century in one of the central guberniya of European Russia. My parents were poor. On my 10th year or life, I became deaf from scarlet fever and my hearing recovered badly afterwards.

With my peers in society, since my hearing was bad, I was often put into messy situations, where I would look ridiculous. This distanced me from people and forced me to read and concentrate. But there were very few books, especially for me. So, I had to think more for myself, and often I took the wrong path. Quite commonly I would invent or discover what was already known long ago. In return, I became accustomed to thinking and taking everything critically. However, I believe that originality was in my nature. Deafness and unwilling distancing from society only widened my originality. The lack of books and teachers led to the same result.

Deafness and other difficult circumstances completely kept me away from school; however, eventually, I had to take exams and get my diploma. I was a teacher of physics and mathematics for nearly 40 years. Yet I had few teachers and books of doubtful quality. So, you can consider me genuinely self-taught.

I was so used to working independently, that when reading textbooks, I realized that I found it easier to prove the theorem myself than to search through textbooks. Only sometimes this was not successful.

In the ’20s, due to poor health, I had to retire

from teaching. Although in the lectures I had to speak more than listen, and while the exams were exhausting for me, it did not stop me from loving to teach. Only the work of teaching would take away all my weak strengths, and leave me not much to learn new things and to independently study. I would write and calculate almost always only on the holidays and breaks.

Difficulty hearing from my childhood of course influenced my limited understanding of life and lack of connections. Maybe this was the reason why at 67 years of life I had no social status or serious success.

Now in retirement, I was given the opportunity to apply to a higher education facility to teach physics and math. But I did not have the strength left for such an activity.

Some autobiographical records you can find in the introduction to my book “A simple study of the airship”.

All my life consisted of thinking, calculating, practical works, and experiments. Homemade laboratory/workshop I always took with myself.

From another introduction to my book “Outside the Earth”, you can see this activity.

It’s boring to talk about myself and practicalities when there are so many questions left unanswered, and so many uncompleted, unpublished works. The most important is still not written down. Will I have enough strength, will I be able to finish these hypothesized works?

K. Tsiolkovsky.

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VIII/12

5

К. ЦИОЛКОВСКИЙ.

АВТОБИОГРАФИЯ.

Родился в пятидесятых годах прошедшего столетия в одной из средних губерний Европейской России. Родители были бедны. На десятом году я оглох от скарлатины и слух мой плохо восстановился.

Со сверстниками в обществе, со своей тугоухостью, я часто попадался в просак и конечно был смешон. Это удаляло меня от людей и заставляло читать и сосредоточиваться. Но книг было, вообще, мало, а у меня в особенности. Поэтому приходилось больше мыслить самостоятельно и часто итти по ложному пути. Нередко я изобретал и открывал давно известное. Зато я привык мыслить и относиться ко всему критически. Впрочем, самобытность, я думаю, была в моей природе. Глухота и невольное удаление от общества только расширяли мою самодеятельность. Немногие книг и учителей делали то-же.

Глухота и другие тяжелые условия совершенно лишали меня школы, хотя мне пришлось потом сдавать экзамены и получать права. Я был учителем физики и математики чуть не 40 лет. Все же учителей, кроме ограниченного количества и сомнительного качества книг, у меня не было. Так что можете считать меня самоучкой чистой крови.

Я так привык к самостоятельной работе, что, читая учебники, считал более для себя доказательство теоремы без книги, чем вычитывать из нее доказательство. Дать не всегда это удавалось.

В 20-х годах по слабости здоровья, я должен был оставить

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учительский труд. Хотя на лекциях мне приходилось больше говорить, чем слушать, хотя меня очень мучили экзамены, но это мне не мешало любить мне мою учительскую профессию. Только она отнимала все мои слабые силы и оставляла немного для пополнения знаний и самостоятельных трудов. Писал я вычисления я почти всегда на праздниках и каникулах.

Тугой слух с детства, разумеется сказался в полном незнании жизни и отсутствии связей. Может быть это послужило и причиной того, что даже к 67 годам моей жизни я не выдвинулся и не имел серьезного успеха.

Уже в отставке, мне предлагали подать прошение в одно из высших учебных заведений для поступления туда преподавателем физики или математики. Но у меня уже не оставалось сил для такого рода деятельности.

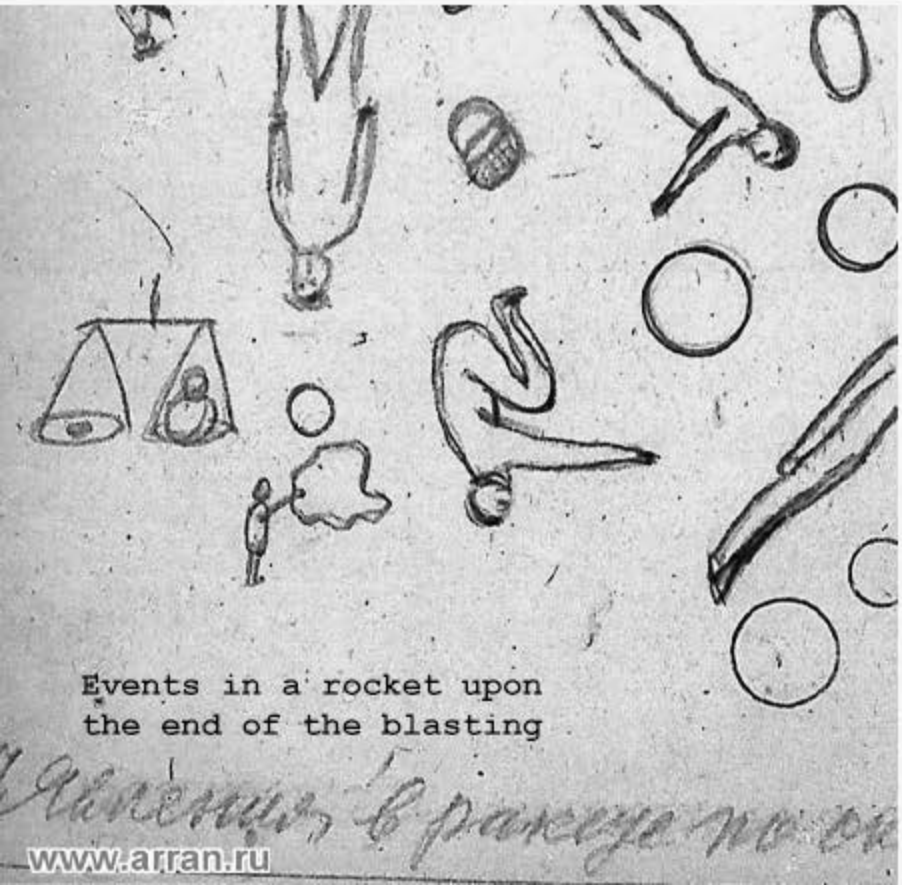
Некоторые автобиографические черты вы можете видеть из предисловия к моему "Простому учению о воздушном корабле".

Вся моя жизнь состояла из размышлений, вычислений, практических работ и опытов. Меня всегда сопровождала домашняя мастерская.

Эта деятельность вытекает из другого предисловия к моей книге "Вне земли".

Скучно говорить о себе и мелочах жизни, когда так много осталось еще неразрешенных вопросов, не законченных мною изданных трудов. Самое главное даже еще не записано. Хватит ли сил успеть их осуществить эти задуманные работы!

К.ЦИОЛКОВСКИЙ.-



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