Open letter to Elon Musk, NASA, ESA and all the saints of the space industry - why people should push themselves into space.

At the end of August 2022, the Artemis I mission was to start with the launch of the SLS rocket with the Orion space vehicle on top. Due to revealed faults, the launch of the engines was postponed several times, finally the mentioned set was launched on November 16, 2022, and the capsule itself returned to Earth less than a month later – December 11. The goal of the entire, extremely expensive program is to send people to the Moon - and, in fact, return them almost immediately. In the first stage, no one flew into space, in the Artemis II mission, currently planned for April 2026, the crew will only look down at the Moon, orbiting it several times. Only in the Artemis III mission, if everything goes smoothly, will several people land on the Moon and spend some time there.

And that is basically all when it comes to the loudly announced return of man to the Moon. Return? Let's be serious, this is not a comeback, but a jump at best. Not a little more sense can be seen in the next planned stage of the so-called conquest of space, which will be a permanent base orbiting over the Moon. Only this will differ from the currently operated ISS station in that it will be much further, which means more expensive transport of people and means ensuring their survival. Only in a permanent base operating on the lunar surface can any sense be found, as long as it leads to the implementation of the project that I would like to present later in this letter.

Excitement was evident in the statements of many prominent people involved in the Artemis program, and journalists commented on all events surrounding the launch in a similar tone: "The unmanned Artemis 1 mission is the world's largest rocket - the Space Launch System (SLS) - together with the modern Orion spacecraft...". We experienced a similar sensation several decades earlier, although the circumstances were different then. The most important of them was the arms race between two powers: the Soviet Union and the USA, the pseudo-peaceful emanation of which was their competition in conquering space. In just ten years, incredible organizational and technological progress has been made in this area, culminating in the landing of a man on the Moon. Therefore, bold visions emerged that by the end of the 20th century, orbital flights would become an everyday occurrence for space tourists, humanity would begin to colonize the Moon, and the first manned missions to Mars would be carried out.

Unfortunately, the dreams of fantasies, mostly lovers of SF literature and films, collided with hard economic realities, or even ordinary pragmatism. Indeed, from a business point of view, the development of the technology of unmanned devices carried into Earth orbit, from the lowest to geostationary, turned out to be sensible - that is, profitable. However, it is extremely doubtful in this respect to send people even to the closest space to us. Manned space flights can - so far - be justified by treating them only as scientific research. And the point is not that people on orbital stations are irreplaceable for carrying out some kind of research, because 99.9% of experiments can be carried out using remotely controlled or autonomously operating stations. In fact, it all comes down to research on people themselves, i.e. determining the impact of the conditions prevailing in space (overload during take-off or landing, long-term weightlessness, radiation) on the physical and mental condition of the personnel delegated to space.

Let's be honest and brutal: this is the only effect of decades of sending humans into space, most of the time being very down-to-earth – for what is the paltry distance of four hundred kilometers to interplanetary distances, which in turn are negligibly small compared to interstellar abysses. Extraterrestrial travelers have already gathered a small crowd, nearly five hundred people, of which 96% survived the expedition (eighteen people died). People on Earth also died during preparations, training and flight tests - here there were almost a hundred fatal cases (unless such or other events were classified or assigned to other accident categories). Incredible money was spent at the same time.

And what has all this done to our earthly civilization? Did any of the people sent into space make any extraordinary discovery? Or maybe he created a unique invention that could never be conceived here on the face of the Earth? I am not aware of such cases. All these arguments showing how many amazing

technologies were created in the development of space programs are obvious, but they were developed (and carefully checked as far as possible) **before** sending more teams into Earth's orbit or the Moon, so basically these people might not have gone anywhere anymore. And if you really had to test some technological innovations in real space conditions, you could send monkeys or pigs there instead of humans.

OK, even a monkey (let alone a pig) would not answer the simple question "How was it?" So we send people into space with whom you can constantly talk to, both before, during and after the flight. They can also be carefully examined, both before the trip and after its end (at the orbital station itself, the scope of diagnostic tests is temporarily very limited).

Of all the cosmic factors adversely affecting the physical and mental health of people, we cannot generate only one on the surface of the Earth: a long-term state of weightlessness. The entire galaxy of other tortures can be perfectly recreated or simulated, and at an incomparably lower cost. If only volunteers are found, they can be joyfully irradiated, subjected to overload and vibration, noise or, on the contrary - sensory deprivation, or you can lock a few people in a cramped cubicle for six months or a year and see if they finally want to kill each other. So until we manage to generate a "decent" state of weightlessness in Earth laboratories (otherwise there are already the first promising results - already more than twenty years ago a certain frog levitated in a strong magnetic field), only this state remains the only excuse, with scientific undertones, to organize further manned space flight.

There has been a lot of talk (and writing) lately about space tourism. Tourism is, in some respects, like "real" science: someone who spends money on basic research should not expect to obtain results that yield tangible, financial results, at least not for the foreseeable future. Similarly, a tourist who buys a two-week holiday in an exotic corner of the world should also not expect that he will be able to recover any of this amount. He's just supposed to spend money, play and relax. Its organizers make money from tourism.

In that case, space tourism is the hope that the "passenger branch" of this industry has a business future, which will ultimately translate into an accelerated pace of expansion of the human species into closer and more distant space. However, not everyone likes this possibly bright future for passenger spaceflight. At present, considering the means of transport used, sky-high tourism (as opposed to sky-high tourism) is extremely anti-ecological. An orbital traveler uses as much resources as a thousand passengers on a long-haul flight or a million cyclists taking a weekend bike ride.

So far, there is no way out of a no-win situation. For the next decades, we are doomed to use archaic, in principle, chemical rocket propulsion, invented at least 800 years ago. Even the most modern, currently built rockets are no different - in terms of the basic principle of operation - of those with which the Chinese tried to offend the Mongols in the besieged city of Kaifeng in 1232. In the case of carrying charges into an orbit around the Earth, the main problem is not the source (or carrier) of energy used, but the very idea of the jet propulsion, in which the vehicle pushes itself away from itself. Give me a fulcrum and I will make space flights 100 times more energy efficient!

I admit at this point that I am a fan of SF literature and films myself, I dreamed of extraterrestrial journeys as a kid, so I was also very disappointed at one point when I came to all these gloomy statements that I made in the above introduction. I am even a little surprised, but at the same time I am glad that there are institutions in the world (with a sufficiently high level of social consent to finance them), one of the goals of which is to organize manned flights into space. There is also a man - Elon Musk, whom I support at least in some endeavors. His business activities are widely controversial (and the recent political one – even greater), but I like the fact that he intends (at least according to what he has been declaring for a long time) to spend a large part of the accumulated wealth on an economically absurd project, i.e. the colonization of Mars.

However, it seems to me that it is decades too early to achieve this goal, and it is only partly economic. He may, of course, even spend all his fortune to someday die on Mars, and not necessarily (as

he himself said) upon landing on its surface, but it is a much more important undertaking in space closer to us, Earthlings, much more urgent - and really needed by all mankind. I hope that the arguments I will present in a moment will reach him someday and will eventually change the priorities he has set for himself. I also address the same arguments to all space agencies, and in spite of what I have written about manned flights so far, the project I mean is worth organizing manned space flights, and the technologies used to develop it in such a way to make space travel safer, cheaper and more common.

The concept is not new, it was invented at least in the 1960s. Imagine that the first manned base was built on the lunar surface, then the second. They are separated by a distance of several dozen kilometers in a straight line. Some economical, fast and safe transport between them could be used, so an electric railroad was designed and built with the carriages suspended by a magnetic cushion. Due to the lack of friction and perfect vacuum, the railway is actually very economical, at the beginning it is enough to accelerate the carriages to a considerable speed, which will be maintained for as long as possible without additional energy expenditure. At the end of the journey, only the carriages need to be braked, preferably by recovering kinetic energy (charging batteries at the same time).

There is no friction, we will place the magnetic track in a perfect straight line, so at first glance you do not see the speed limits that this type of transport can reach. 360 km/h, or 100 m/s? No problem, with the right electric drive it could as well be a kilometer, five or ten kilometers per second. However, it is worth noting right away that for the Moon the first cosmic velocity is only 1.68 km/s, so after accelerating to this speed, railway passengers will be in a state of weightlessness, in fact orbiting just above its surface. It takes little more to just jump off the track and actually enter some sort of orbit around the Moon, making only slight adjustments to the jet flight along the way.

The second cosmic velocity for the Moon, i.e. one that allows it to fly away from it at any distance, is a little more: 2.38 km / s. Thus, by building an electric railway on the Moon, a space launcher will be created on the occasion, which will allow you to return to Earth or fly to other planets in the solar system in an economical way. And the Moon will become the fulcrum I am looking for, which will make flights into interplanetary space a hundred times more energy efficient than comparable tonnage expeditions using rocket (jet) engines at the beginning of their journey. We just need to add a small correction: the track of the railway will not be a straight line, but a segment of a circle roughly in line with the lunar equator (and possibly close to it).

Let's try to find some good name for this installation. The first obvious (SLS-related) idea is the Lunar Launch System, or LLS for short. However, given that it is a big **EL**ecromagnet **ON** the Moon, it may be abbreviated as “ELON the Moon”.

One name or another is a secondary matter, the important thing is that it is a really economical way compared to rocket (jet) propulsion, especially in a situation where we want to achieve high speeds. Attention - now the real ride is about to begin!

After noticeably exceeding the speed of 1.68 km/s, weightlessness will turn into gravity, but directed opposite to the Moon's gravity. Passengers will have the impression that the Moon is above their heads. They will be able to walk inside the carriages on their ceiling, which will become the floor. As speed increases, this apparent gravity will increase faster and faster, more or less proportional to the square of the speed.

Let us assume that we do not want to exceed three times the acceleration of gravity, such an overload will be able to withstand any moderately healthy person, who is half-lying on an appropriate armchair. We will achieve them for the speed of the carriages equal to 7.35 km/s. This is quite a good result, with such a speed you can reasonably arrange manned trips to Mars. If we tried to do the same in one jump from the surface of the Earth, we would spend incomparably more energy, not to mention polluting the atmosphere with huge amounts of rocket fuel burned up.

The use of anti-g suits allows you to withstand much more, let it be 10 g. We will achieve them at the speed of the carriages equal to 13.16 km/s. It is almost twice as much as before, but it is worth enduring a few minutes of discomfort at the beginning of the road to shorten the time to cover it twice.

When we consider transporting goods or sending unmanned vehicles, there is no rigid limit on the overload withstand, it remains a matter of the technologies used and the selected design solutions. By allowing an overload of 53 g, we are able to launch, using the lunar electric railroad, loads at a speed of 30 km/s. This is already a huge speed, far from the Earth's gravitational well, and practically impossible to achieve using classical chemical drives. Only an ion propulsion, assisted by nuclear power, will someday allow such speeds to be exceeded, but it would require many months of time to laboriously accelerate the vehicle.

But let's get back to our railway, where there will surely be problems with its construction: the drive system and the contactless suspension of the wagon. Maybe not necessarily a wagon, but some kind of a moving base platform, permanently connected to the track and containing components of the propulsion system and the generation of a magnetic cushion. These components are constantly needed in the moment of acceleration of the ejected cargo - and they are also completely unnecessary in this space. Therefore, let only what is necessary fly into space.

Meanwhile, what does not fly, i.e. the run-up platform, must work contactless, transferring enormous forces. Suppose its mass is 1000 kg. With the same additional load accelerated to 30 km/s, it will break out of the track with a force of one million newtons. Writing in human terms, a two-ton weight will be as heavy as a hundred-ton on Earth. So that the acceleration path is not absurdly long, the horizontal acceleration should also be sufficiently large.

Exactly, how long should the railroad track be? Starting with the shortest possible, allowing for a minimum travel speed of 2.5 km/s and a horizontal acceleration of 3 g, this gives us a distance of 106 km. To this distance it is necessary to add - let's say - an additional 14 km of track, on which the platform, when emptied of cargo, will slow down, with more or less eight times greater overload than during the acceleration of the load (23 g against 3 g).

Building a railway on Earth, even a fast and magnetic one, with a track length of 120 kilometers, does not seem to be an overly difficult or expensive undertaking, but in the conditions of the Moon, with zero technical infrastructure at the beginning of the cosmic adventure of mankind, it is currently beyond the reach of anyone and any possibilities . The only real course of action is in the next small steps. At the beginning, a small lunar base should be created, gradually equipped in such a way that more and more things can be done and built using the resources available on the spot. At some point, such a level will be reached that almost everything will be created locally - buildings, machines, devices. Only microprocessors, antibiotics and seeds will be transported from Earth to the Moon - and also temporarily. And people, of course.

And we already have a vision of space exploration for the next several dozen years. First, there should be this lunar base - or a few bases that should become almost completely self-sufficient in the first place and capable of unlimited development, based on locally mined resources. In the next phase, the construction of a space-magnetic-electric railway will begin, with a successively extended track. Already 20 km long, it will allow for the maneuverable transport of cargo - from the Moon's surface to the Earth's orbit or to its surface. After reaching 120 km, it will be possible to transport people relatively comfortably and economically - from the Moon to the Earth (the other way round will be uneconomical for a long time). Speed close to 7.5 km/s (the limit for average people due to the emerging centripetal acceleration) requires a track with a length of over 1000 km. It should be noted, however, that in this particular case we deal with a vertical centripetal acceleration equal to 3 g (at the end of acceleration) and a horizontal acceleration (constant from the beginning of the path), which in total will give an unacceptable 4.2 g (at the end of acceleration). Reducing the horizontal congestion, and the overall congestion, requires the length of the road - up to, say, 1,500 km.

The use of anti-g suits and reaching 13 km/s translates into a track with a length of 4 – 5 thousand kilometers. And this is already half the length of the lunar equator, extending the track until it is finally closed into a circle will be the finale of the project. From now on, the limits on horizontal acceleration will disappear (you will not have to strain with the drive to reach a certain speed), in addition, the cargo can be released at any point in the circular route, which in turn will allow it to be expedited at any time and in any direction of the solar system. The track under construction, i.e. still open, will initially be directed towards the Earth, and other directions will be available only in certain configurations of the Earth and the Moon (a given direction will open for some time approximately once a month).

The closure of the railway track in the equatorial circle will additionally increase the functionality of the entire installation. Namely, it will reduce the cost of landing on the Moon (or increase the mass of transported cargo) of spacecraft, whether sent from Earth or returning from other planets in the solar system. Such a vehicle only needs to enter the Moon's orbit and slowly lower it to meet the accelerated - to a speed of 1.68 km / s - platform. After locking the handles, the braking stage will take place, with the recovery of the kinetic energy of the moored vehicle. The whole process of deorbitation does not appear to be an overly difficult maneuver, and the most important gain is that the rocket fuel necessary for a conventional landing need not be consumed.

It would be much more difficult to "catch" vehicles traveling to the Moon at higher speeds by rail. Theoretically speaking, it may be even (for unmanned objects) 30 km/s, but in such a situation exceptional precision and synchronization of the trajectory of the vehicle and the speeding train platform should be achieved. In the event of an unsuccessful landing maneuver (we only have one approach!), such a vehicle will pass the Moon and fly away into space, in unfavorable conditions it will leave the Solar System forever (unless it is equipped with an additional, efficient jet system). And when people want to land on the Moon in a similar way, with a cruising speed of 5 - 8 km/s, the re-landing approach will be possible in many months and will require the use of an additional, classic jet propulsion.

It is very possible that after the construction of the first circular track (or even earlier), a second - or maybe a third - track will begin to emerge, using technologies developed in the meantime to increase the load-bearing capacity and efficiency of the installation. Although one of the successively built ones should be definitely oblique to the other equatorial ones (possibly crossing the poles), which will allow the vehicles to travel into space beyond the ecliptic plane.

Meanwhile, it is not worth looking so far into the future, let there be at least one lunar railway line, in the most modest version. And even in the most modest version, it must be supplied somehow, and the electrical energy converted into the kinetic of an accelerated platform with a load. Let's assume that the mere suspension on a magnetic cushion is not overly energy-consuming (superconducting magnets do not use energy, it is only needed to cool them), while acceleration requires quite a lot. Suppose we want to launch a manned vehicle with a total mass of 5 tons towards the Earth, with a horizontal acceleration of 3 g. The power needed to accelerate such a vehicle will increase proportionally as it accelerates. If we want to reach 2.5 km/s, this power will be 375 MW at the end of the in-run. That's quite a lot, that's what a small power plant produces. Can anyone imagine the weight of the most efficient and light electric motors with a capacity of nearly 400 MW at present? I am afraid that these are dozens of tons, while we want to disperse the modest five. It should also be noted that even assuming an excellent efficiency of 98%, 8 megawatts of heat will be generated during this acceleration, which must be absorbed and dispersed somewhere.

So it is clear that the active drive itself must be placed in the rail track, and the run-up platform will only be a passive set of superconducting magnets. The next electromagnets in the track will be active in a negligibly short time, when this platform moves within their range of operation, so they will be able to deliver great power in pulses, and will not have time to heat up excessively (the heat of the losses will dissipate along the long track). Then it makes no sense to build one or even several power plants sparse along the track, perhaps you just have to install solar panels and battery packs in parallel next to it. If these

components are sufficiently durable (there is still some time to develop appropriate technologies), the final result will be a self-powered installation, i.e. almost free in the course of further operation.

Just to supplement these calculations, I will add that accelerating a similar 5-ton wagon, also with an acceleration of 3 g, but to a speed of 30 km/s, will ultimately require nearly 5,000 MW, or 5 GW. For comparison, the largest nuclear power plant on Earth, which operates in Japan, generates little more - 7.9 GW. Hydroelectric power plants are stronger, but there is unlikely to be a construction of such on the Moon. One can think of nuclear power plants, but these solar panels with batteries, installed together with the railway line that are gradually extended, seem to be an equally good or even better solution.

Once the track is enclosed in a circle around the equator, batteries can be dispensed with. After all, half of the Moon is illuminated by the Sun all the time. In such a situation, a solid energy bus would be needed running alongside the installation to transfer these gigawatts of energy from the bright side to the shadow side of the Moon. However, I mentioned that after closing the track in a circle, there is no need to rush too much to accelerate. If we reduce the acceleration by a factor of ten, the power requirement decreases by a factor of ten. Acceleration to 30 km/s will take about two hours instead of 17 minutes, but what do these hours mean in relation to the remaining travel time counted in months or years?

For now, let's stay with the most modest, 20-kilometer railway, capable of sending goods to the Earth at a speed of 2.5 km / s. What can these goods be?

At this point, it is worth taking a break from the patterns of obtaining and processing raw materials, patterns shaped on Earth, in definitely different than lunar conditions. If we scrape some soil on a shovel almost anywhere on the Earth or the Moon, what elements will be found on it in the first place? It will be oxygen, silicon, calcium, aluminum, magnesium and iron in various proportions, often other elements will also be found. On Earth, it's worth digging a little and finding places rich in specific minerals, but on the Moon it's probably not worth it. When building and extending the railways, you have to take what is "at hand" and use appropriate technologies to obtain specific elements. The most important are three: oxygen, silicon and aluminum. We will obtain excellent insulators from them: quartz glass (SiO_2) or sapphire glass (Al_2O_3), and an excellent conductor - aluminum (on Earth it is not so perfect, mainly due to the presence of the atmosphere and oxidation and the formation of non-conductive layers at the contacts between separate pieces of wires). Aluminum with appropriate additives is also a great construction material.

These few materials, sent from the Moon into an excessively high orbit of the Earth, will constitute 98% of the mass of successively constructed orbital stations - spacious and comfortable, for example in the shape of a slowly spinning large ring (spinning generates artificial gravity). The basic skeleton of the station and most of the structures, components and mechanisms that make up its equipment will be made of aluminum, glazing and thermal insulation will be made of opaque ceramics and transparent ceramics.

Over the next decades, many such stations may be created, with a total mass of even tens of thousands or millions of tons. Only with the use of a seemingly distant but very practical lunar electric-cosmic railway and the minerals available in its vicinity will it become a viable undertaking. Lugging the same amounts of simple materials from the Earth's surface, a nominally a thousand times shorter distance (400 km compared to 380,000 km), would be thousands of times more expensive in terms of energy, it could also ruin the Earth's atmosphere. After all, it is not expected to develop, in the next fifty years, propulsion systems better than classic and chemical rockets. The only thing that can be done is to force the use of hydrogen as rocket fuel, not liquid or gaseous hydrocarbons. We can hear critical voices of people complaining about the enormous costs of building and operating SLS rockets (in the Artemis program) and the permanent problems that plague them, largely related to the collection, transport and pumping of liquid hydrogen, but cheaper technologies based on liquid or liquefied hydrocarbons (methane, kerosene) are acceptable only as a temporary solution when only one or two expeditions a year depart from Earth into space.

But let's go back to our economic and clean Lunar Launch System (LLS). Not only will the construction of around-the-earth orbital stations become much easier, so will the colonization of Mars. You can prepare all the necessary (on this other planet) and highly flaky infrastructure on the Moon and cheaply transport it to Mars, and then send hundreds or thousands of colonists to it (perhaps most of them will already be born on the Moon, transporting people from Earth to the Moon it will always be very expensive.) You can also send a lot of space probes (even massively produced) on the Moon to all parts of the Solar System. Only with the lunar railway will it be possible to actually conquer the space closest to us.

The terrestrial civilization is extremely lucky that there is an exact object near its home planet - not too big, not too small, with a perfect vacuum on its surface. Low gravity and, above all, no atmosphere are key factors in building a real space transfer station. You can imagine building a similar installation directly on Earth, but here you have to reach speeds of at least 8 km / s, which is unrealistic in a dense ocean of the atmosphere. Let even acceleration be carried out in a vacuum tube several thousand kilometers long, but in the end you have to jump out of this tube - and at this point you will have a collision with a dense atmosphere, in which a hundred-tons vehicle will burn and/or evaporate in a dozen or so seconds (fortunately, any the passengers of the vehicle will not see it, and in the first fraction of a second after meeting the atmosphere, they will be crushed by the overload of 500 g). Then why don't we get the end of the pipe high where the atmosphere is very thin? Ok, you have to go up at least 20 kilometers, gradually ascending the pipe over a distance of hundreds of kilometers. For now it is unrealistic, people have not even exceeded a silly kilometer in point objects. Perhaps in five hundred years some gigantic installation of this type will be built, for now let's do something more modest, on the Moon.

There is another factor that I have not mentioned, which is why we urgently start work on building this lunar railway. It will become the most important shield protecting the Earth from the fall of an asteroid of significant size. Suppose it has a mass of one billion tons - if we send a series of charges in its direction and cause a collision with a total mass of one thousand tons and a relative speed of 30 km/s, it will change its trajectory enough that the collision with the Earth will not occur. All you need to do is do this maneuver at least a few years before the asteroid's fall date is set.

Such large facilities are usually monitored long enough, so we will rather have time to react in time. The problem is the smaller objects, which also pose a (in proportion) smaller threat, but are discovered almost at the last moment. However, the same thousand tons fired very late may turn out to be quite effective, because they will act on a much smaller mass (also changing its trajectory sufficiently).

If all these considerations do not affect the imagination of "cosmic decision makers", I will present a final argument that (at least I hope so) will induce the relevant government factors of the richest countries to invest in the installation presented above. The lunar space rail could be used as a powerful weapon. A few tons of properly shaped metal shot from the Moon at a speed of 2.5 km/s will fall to the Earth, reaching over 11 km/s, obtaining almost 20 times more kinetic energy "for free" (here the initial momentum of the bullet will be strengthened by Earth's gravity). Perhaps most of it will burn in a dense atmosphere, but the rest will act like a large, classic bomb, even if it explodes high in the atmosphere, but still causes a devastating shockwave. In turn, a thousand tons accelerated on the Moon up to 30 km/s, supported by the Earth's gravity, will act on it like a small atomic bomb (detonated in the atmosphere). Such missiles falling from space cannot be shot down with anything, even with a nuclear charge exploding in their vicinity, because these are not classic, delicate in design devices (for example rockets with precise control), but a "primitive", accelerated, large and inert mass. In addition, no place on Earth will be safe, at most, the vicinity of the poles will be a little less accessible for missiles fired from the Moon (the missiles will fly there diagonally into the atmosphere, which will translate into a longer initial braking distance).

Dear Generals from the Pentagon! Wouldn't you feel at least a little worried if China was the first country in the world to start building its LLS installation? Americans – you probably won't let yourself be overtaken in this new arms race, will you? Europe, which includes economically and technologically developed countries, could also make a little effort and organize a fundraising campaign that goes far

beyond standard ESA sponsorship. Formally speaking, the sum of the economies of the leading European countries exceeds the potential of the American or Chinese economies, but rich Europeans seem lazy with the current peace and quiet in their immediate surroundings and are rather reluctant to agree to spending more than a fraction of a percent of their current income on something that is not will bring them noticeable benefits in the coming decades. In such situations, dictatorships have the advantage, in which the leader is ready to starve a frightened and docile society just to have his expensive military toys. Fortunately, it usually happens that in the scientific and technological race, totalitarian-ruled countries lag behind the rest of the democratic world. The only exception is China, mentioned at the beginning of the paragraph, which may indeed be a cause for concern in the near future.

Incidentally, the lunar electric-cosmic railway would be a graceful topic in many SF books or films. I can already imagine the various stories that take place during the construction of the installation or after its completion, some space disasters in the background, a failed interception of the returning crew, an alien invasion repelled by missiles thrown by railroads, an attack by terrorists trying to take control of the railway and then take control of the whole world. I have not noticed any such stories yet, but I do not want to convince anyone that I have read all the SF books and watched all the movies. But fairy tales and stories with stories, but the organization that will have the described installation (someone finally has to take care of it), will really have a portal connecting the Earth with human colonies located in the nearest cosmos: on Mars, and larger asteroids along the way to Jupiter, perhaps on a few of its moons and the moons of Saturn (launchers can also be created here). Much further it gets really cold...

Dear Mr. Elon Musk! You are probably the only person on Earth who can join the possible competition between China and the rest of the world in the construction of LLS (or to use another abbreviation: ELON the Moon). If only because even an extremely despotic dictatorship is not able to devote most of its resources to this project - but you can. So, please rethink your long-term strategy for space conquest. Is it really worth going straight to Mars, without building an exceptionally solid support along the way, such as lunar bases and an electric space railway? From the point of view of a human being on both the Moon and Mars there is no atmosphere either, a torn suit here and there will end up dying by suffocation. Gravity on both celestial bodies is smaller than on Earth, although this will ultimately not be a problem (you can build a kind of "oblique" house centrifuge, spanning a circle of large diameter, spinning in such a way as to increase local gravity - and it is best to do is on the magnetic track so as not to use too much energy to keep the centrifuge running). Whether on the Moon or on Mars, civilization will eventually have to be developed as self-sustaining, without regard to the resources, components or labor supplied from Earth.

However, the colonization of the Moon is easier than the colonization of Mars, and in the initial phase it is much safer for its participants. In the event of health problems, a relatively quick - within a few days - the return of a sick person from the Moon to Earth seems realistic, and it will also be possible to drop something urgently needed from Earth to the Moon at a similar time. In the case of Mars, similar actions are unrealistic. In the contacts of the Earthlings with the colonists of the Moon, an imaginable and sensible exchange of services is possible - the use of the electric-space railway in exchange for unique trinkets made or existing on Earth, in the case of Mars, it remains to count on the good will of Earthlings. What could the latter get from Mars in exchange for the aforementioned microprocessors, antibiotics or seeds? Some rocks for research? It's not enough in the long run.

Mr. Elon Musk, I have drawn attention to a venture called The Boring Company, seeking to develop underground high-speed transportation. I thought to myself that you are preparing the technologies necessary to launch the lunar railroad (magnetic suspension, contactless propulsion, travel in a vacuum), but I found no later any mention of just a proper continuation of expansion into closer and farther space. I also do not suppose that you are making any secret plans in the scope similar to what I have written about so far, besides, it would be difficult to hide a similar intention in the long run. In that case, please move The Boring Company to the Moon and you will sign up with golden letters in the Civilization Book of

Progress. Who knows if you won't save humanity in this way from extinction, if it happens by chance that the lunar railway can be launched at the last moment before the discovery of a great cosmic rock on a collision course with Earth.

I also appeal to all space agencies to support this great project or, if necessary, to assume - by the most interested and the most energetic - organizational leadership and to allocate serious resources for the detailed development of the project, assigning it to smaller tasks and their gradual implementation. Certainly, in the initial phase of the construction of the lunar railway, people with the appropriate equipment will be needed, so it is necessary to organize a manned space expedition, the sense of which I raised my reservations at the beginning, but now I cancel them in full. I suppose that in the next several dozen years robots will be created so skillful and independent that they will be able to continue this great work without human participation, but in my opinion it is not worth waiting so long with the expansion of humanity into space, since here on Earth it is sooner or later we will see a really serious, global catastrophe. After all, clearseers have been predicting it for hundreds of years.

Sławomir Drażba

Warsaw, March 2025.