Project “Sphere”

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Introduction

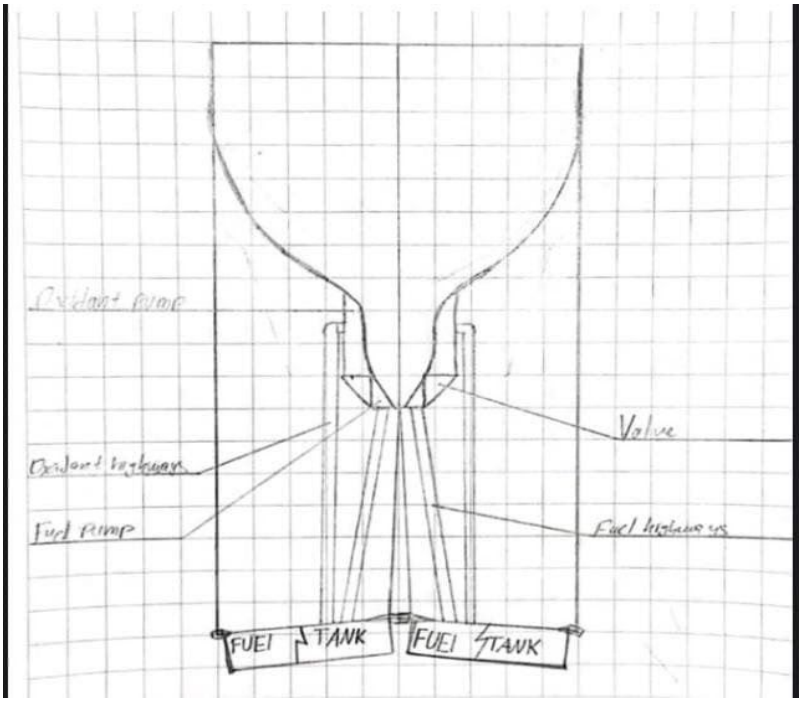
It was on Friday, May 26, 2051. My name is Gulyamov Oybek, and at the same hour, I flew on my first expedition to the ‘Sphere’ station. My watch was supposed to last 1.5 years, during which time I, as a bio-security specialist, had to monitor the condition of the Shield Panels and to change them in special circumstances. Thankfully, there was enough accumulated material. Some of my colleagues (or rather all) called them Shit Panels, but it is worth remembering that there is a grain of truth in every joke.

Circuit description

For now, let me introduce you to the structure of the station itself. This station was designed to test equipment, ideas and concepts for adapting the station for a comfortable stay of humans and other living creatures in interplanetary space. The first versions of the station were in orbit between Earth and Mars, as this location was the most optimal for the delivery of non-renewable food during the periods of open windows and direct communication between the Earth and the

colony on Mars.
The station itself is a geodesic sphere, consisting of many triangular segments. The structure is quite strong and does not require additional reinforcing beams from the inside, which is an undoubted advantage since the internal volume is freed. It is worth remembering that this is also the maximum internal volume and the minimum surface area.
One segment consisted of three hollow titanium tubes, which were connected using an adapter with graduations that connect every 60 degrees. Also, the divisions of the adapter were turned back slightly so that the geosphere could be assembled. To simplify assembly, the adapters could be split into two parts if necessary and fastened with 6 bolts. The dimensions of pipes and adapters were determined depending on the size of the terminal station. This kind of scheme provided both simple launches into orbit and easy assembly already in space.

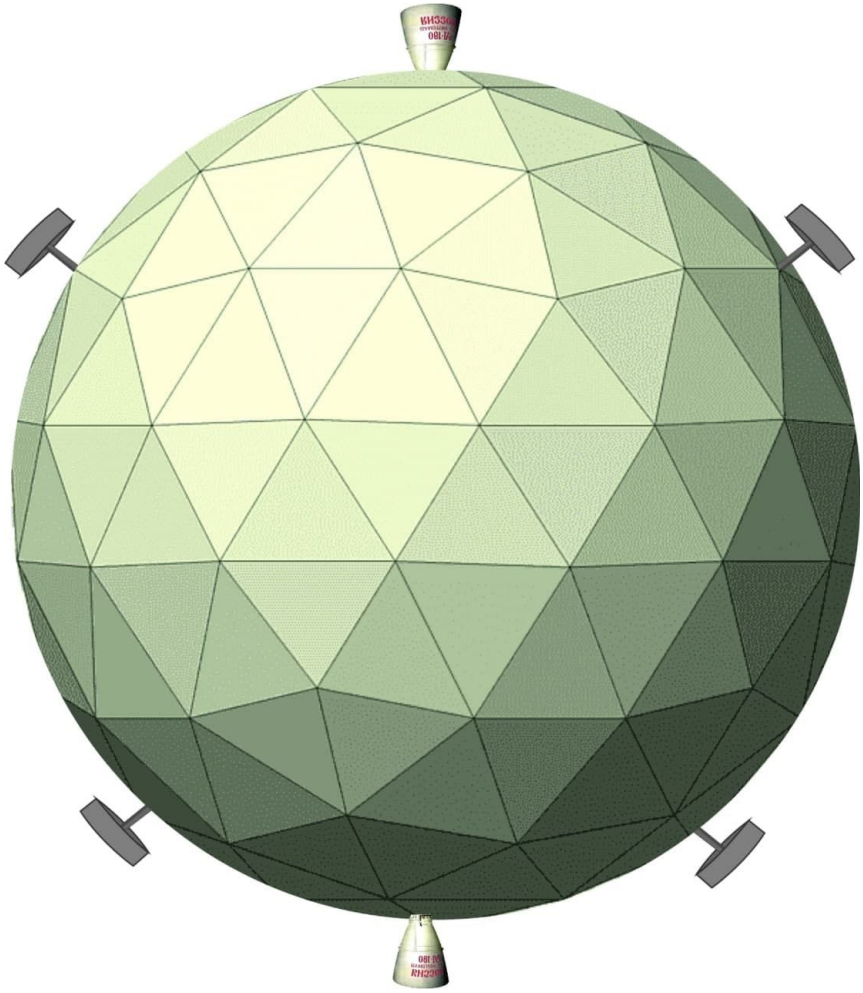
The space between the tubes of the segment could be used to store solar panels, an external airlock, or a receiver for resupply or crew.
Solar panels were located on every segment, except for those on which the airlock was installed, a principle that allowed the full potential of the geodetic sphere concept to be exploited with tremendous benefits.
There were only two engines for correcting the orbit. They were located opposite each other, each in its own hemisphere. They were attached to adapters and nearby beams and fuel was taken from all segments of the station. To perform a manoeuvre, the station interrupted its rotation and set the desired direction, while the engine gave a short impulse The crew and all equipment were to be secured during the planned adjustment.



1.Orbit correction engine appearance

The orientation system consisted of 6 control moment gyroscopes mounted on long beams, each weighing 600-900 kg, depending on the size of the final sphere. Despite the huge mass of the flywheels and the reinforcing beams for them, it was significantly more profitable than the use of engines in the long run
To protect the crew against radiation, a shield panel was attached to each segment from the inside, which consisted of carefully dried, high-pressure

compacted scraps and non-recyclable waste packed in polyethene human faeces. Urine was also stored in polyethene and was part of a shield panel. The thickness was 5.5 centimetres. Together with the rest of the segment, this helped to reduce the level of lethal radiation to minimum levels.



2.Approximate appearance of the station

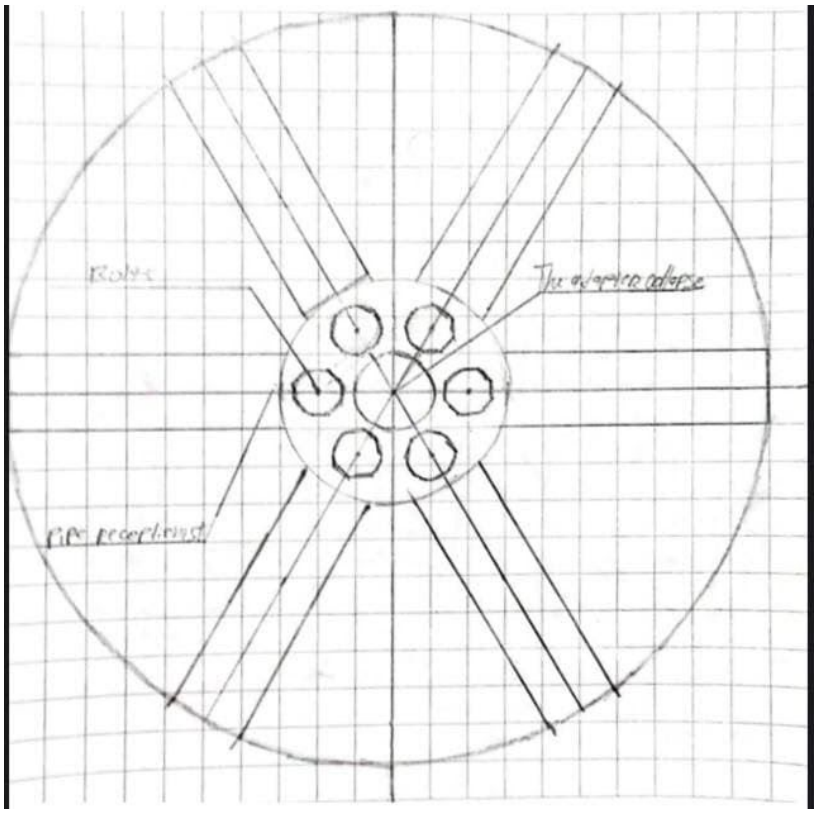
It was up to me and my assistant to make the shield panel. First, you need to collect all the solid waste and sort it into shapes. Then there is a 12-hour drying and the process of compression all into a single, thin, triangular shape to reduce the thickness of the product. Finally, I wrapped everything in a film and pumped out the leftover air. With urine and other dirty liquids, things were easier. I just had to fill it with the same film and make sure that not a single drop of air got there. After that, we combined them into one whole and transferred them to the inner airlock.

To fix the shield panel on the segment, we had to go out into the inner volume of the sphere, pull it out and push it to the right place. After that, we fixed it on three clips. If one such panel was damaged, we simply put a new one on top of it.
The outer airlock was designed for loading food and crew, and it was also required for a spacewalk in the event of an external breakdown, it was installed last, while the inner airlock was located inside the sphere and was designed to install new segment panels.
The segment's elements were connected together and, with the help of special clips, attached to each beam from three sides, and this was called a full-fledged segment.
Also, transparent segments with 30 cm lead glass were delivered to the station. The station module had to be attached to the glass of its windows so that at least something could be seen through the glass. There were four of them, two per hemisphere. Such transparent segments were needed rather for that so that the crew did not feel as if they were in a tin can and could look at space during breaks. Also, cameras were installed with a view in all directions. Yes, the aliens we cut off the ability to quietly sneak up and eat all of us.

Station assembly

Now the question arises: how can all this be delivered to orbit and assembled? Everything is extremely simple. Before the start of the construction of the space station, my team and I had to prefabricate shield panels on Earth. Then the carrier rocket put all pipes and adapters into low reference orbit.
The rocket also carried, depending on the dimensions of the final geosphere, from 2 to 4 humanoid robots, which would assemble the base of the station. They possessed innovative and compact batteries with a capacity of more than 3000 MWh, which is enough for all our needs. The parts were placed on a special platform together with robots with a diameter of 6 meters. To start assembly, they climbed over to the backside of the platform and transferred some of the parts there to start the process.
The first part was an adapter firmly attached to the platform for convenience. Then there are pipes, we attach six more adapters to them and so on until the

end of the assembly. The pipe and adapter were fastened with a special glue that dissolves metal, like for plastic models. In order not to use motors during construction, robots could move through pipes to different parts of the structure as our ancestors did on trees. To simplify assembly, the adapters were divided into two parts and fastened with the same glue.



3.View of adapter

After the construction of the first half of the hemisphere, the androids filled its segments with elements, which were delivered by the same carrier rocket that delivered pipes and adapters. After that, a heavier-class rocket in several passes took out all the station modules, fuel, equipment and food supplies. Each module had its own compact and simple control system, which allowed him to "park" himself to his place. The modules were fixed to the sphere on 6 beams 2 meters long from each vertex of the sphere into the adapter.

From that moment on, when building the hull of one segment on top of the modules, it will be immediately filled with the “stuffing” that had been stored on the back of the platform since the second launch. At the end of the assembly, a gateway was installed in the final segment and the platform from which it all began was disconnected. The process of assembly of an entire station of medium size took about a week. After settling and checking all the systems of the station, it was necessary to accelerate to the second space speed with the help of the booster block delivered by the carrier rocket together with the crew. The assembly of my station No. 3 with a diameter of 42 meters was completed 4 years ago and lasted 7 days, the crew consisted of 36 people. During all this time, nothing serious happened to her, except for one case.

Incident

On May 24, 2051, an asteroid of presumably 0,1 meter in diameter and at a speed relative to our station
of about 100 meters per second crashed into the station. It had not been noticed anywhere. Usually, such asteroids are detected long before the alleged collision, but this time the system, for some reason, gave failure. Thankfully, the blow passed tangentially, and in addition to 8 badly damaged segments and 1 completely torn off, a sealed module with waste was touched. The only advantage of this event is that a new constellation "Feces" appeared in the sky.
Because of the damaged module, it was necessary to spend time assembling a heavier rocket and loading there the necessary tools, material for restoring the station and, of course, specialists.
At that time, the station was at the closest possible distance from the Earth equal to 980,000 km, this distance we covered in 10 days. By the time of our arrival, the crew left the station through the docked rescue module and returned to Earth. We had to correct the damage ourselves. You may ask: “Why don't you send the same robots there that assembled the station?” The fact is that repair is a much more complicated and delicate process than assembling. It requires some kind of flexibility of thought that the program did not have then.
Takeoff went well, we went to LEO, accelerated and headed straight for the station. The crew consisted of five people: me, my partner Ryan McDonald, engineers Lewis Aaron and Hans Meyer and Nikolai Demikhov who participated in the design of the "Sphere".

Debating over problems

Every day before our arrival, we diligently thought through a plan to rescue the station. It was decided not to restore but to dismantle all the damaged segments and patch the hole with new ones. But to detach the pipes from the adapters, it was necessary to heat the contact points to 440 degrees Celsius. The mixture of dissolved and solidified metal melted and you could safely remove the old one and put in a new pipe. This was a temporary solution since we only had adapters with tubes, a supply of faeces and urine and a lot of glue that dissolves the metal. Very soon, the glue will become a decisive factor in this whole story.
We decided to push the module out through the hole from the meteorite. To replace it, a month after we arrived at the station, an inflatable module arrived, which was pushed through two airlocks and installed inside.
By the way, the station was in rotation. This was done to distribute heat evenly over the entire surface. Before the crew left the station for undocking, they stopped rotation. It's a pity as we could have filmed another ‘Interstellar’.

Being in space

Well, it's time to talk about life and work at such a station. Before flying to the station, the crew had to spend all their leisure time together. These were board games, sports, hobbies, and sincere conversations. Thanks to all of the above, the crew at the end of the training became a big family, where every quarrel or resentment was forgotten quickly but even if one individual did not like the other, he could calmly say so and he would be moved away from him. The rest of the time they underwent technical training.
During the first settlement, the crew had to make the station comfortable. The crew member's personal cabin was initially worked out to his taste, the member could hang a hypoallergenic carpet on the wall or decorate it with air-purifying flowers, whatever (within the normal range). The rest of the lounges were designed in a minimalist style. This is both convenient and adds lightness to the soul, therefore the crew no longer felt cramped. Also, huge TV screens will be installed on the walls, transmitting images from external cameras with incredible naturalness and clarity. In general, there were seven types of modules: an individual module, a common room, a gym, a cinema, a canteen, laboratories and other workplaces, as well as a workshop.

The individual module was a cylinder 3 meters long and 2 meters wide. It had a bed, a shelf for personal belongings, a temperature and humidity control panel, a personal computer with access to the Internet at certain times and an interactive whiteboard where various schedules, menus or daily schedules could be located. Three of these cabins were attached to each other and formed a triangle and between them, there was a vertical corridor to the common hall. There were 3 such triangles and they were located on top of each other.

The common room was a place where the inhabitants of those triangles could spend time playing games, reading literature, or discussing future experiments. It was rectangular in shape 8 by 5 meters and was divided into several zones for a certain type of recreation. The lighting was varied over time to maintain a sleep schedule. It was extremely handy.

If the station's crew was more than 64 people, between the common hall and, for example, the workplace there was another room where the inhabitants of one half met. There they did things that could not be done in a small group. This arrangement was called "emotional levels." This helped to smoothly move from proud loneliness to a large group of friends and it was very practical, although I did not have a chance to live and work normally at Sphere.

The gym was a small hemisphere repeating the contours of the dome. It was about 18 meters in diameter. In space, all rooms seem to be larger than they really are. There were simulators, a sports bar with all sorts of oxygen drinks and motivational posters. The crew also included 2 physical trainers who controlled all our actions. And yes, cleaning robots were stored and charged under the floor of the gym and they left this niche themselves.

After training, I was supposed to go to the shower. It was something. First, you fly into the capsule completely naked. Then you cover yourself with various gels, shampoo and soap. You put on your glasses, plug your nose and ears, stretch your arms and legs, and press the countdown. And after 5 seconds, powerful jets of water fly into you from all sides and wash away absolutely everything from you within 4-6 seconds. To pump out all the water, the capsule spins up a little and you need to hold on to the handrail. Then the hatch opens and you quickly get out and the system pumps out everything after you. After that, you are clean from head to toe. It remains only to wipe yourself with a towel with ducklings.

The toilet was in the same room as the shower room and represented a pipe in which negative pressure was created; the toilet seat was tightly pressed against the astronaut's body, bending around the buttocks and genitals so that it was possible. After the end of the process, air seeped into the pipe through the valve and this flow carried the future shield panel to the storage module. And in order to drink fresh water the next day, the astronaut was asked to do his job in a hose.

Of course, the first time the crew drank water from the Earth, while urine was accumulating to become part of the shield panel. Then, filters and mineral stations turned 99.9% of urine into clear water.
The cinema was twice as small as the gym, but this did not prevent it from accommodating almost the entire crew at the end of each day, intrigued by the trailer for a new documentary about the plight of laboratory rats. The film was played using an over-compact IMAX projector for which the last person to fly into the hall was responsible.
In the dining room, we ate in groups in turn. You fly up to the sideboard, take canned food to taste and fly back to your table. But don't be alarmed, there were also freeze-dried foods and even dry mix cakes for the holidays! They weren't very good, but it's a sin to complain, we were in space. Each table had a special coil-shaped heater. You just had to insert your food into the spiral and cover with a foil lid and you're done, Bon appetite! There were 4 such tables for 4 people.
Now about the laboratory. Various experiments were carried out there, mainly genetics. They tried to create plants that grow on average 6 times faster and 4 times more fruitful than on the Earth. They grew up in nutrient solutions. By the way, thanks to these experiments, a good botanical garden was formed in the laboratory (in fact, some of the crew often rested in the laboratory).
They also bred a species of bacteria producing, due to their vital activity, both oxygen and electricity. After so many years, I can say that they did well because one small battery powered by bacteria could not only charge your laptop overnight but also saturate a small room with oxygen no worse than plants!
For this, they needed only darkness and a supply of rotten food. Thanks to this, this place has overgrown with various legends and horror stories. For example, Stockman: a humanoid creature with grey skin, moving on 4 long limbs, with a half-dead face and going around the station at night. It appeared as a result of a terrible mistake of one geneticist. And now it wanders around the station every night in search of a half-asleep astronaut on the way to the toilet.
By other workplaces, I meant small rooms in which communications specialists sat, 7 security officers were monitoring various parameters and half a dozen programmers watching the functioning of their new neural network taking over the work of those same officers.
Now about my workplace: the workshop. It housed a whole workshop for the production of shield panels! This 6 by 6 room accommodated a faeces supply point, a drying room, a pressing and packing machine, as well as an air pump. I had to go there only when necessary or when I was cleaning the shop from dirt. The rest of the time I could help in the laboratory, take over on duty, or be in outer space. There I had to inspect the panels for damage. If I found a hole or

crack, I would report it to Houston and patch the panel with a special kit.

Arrival

Even thousands of kilometres away, I could see the glitter of the Sphere panels. 3 hours before docking, we started checking the gateway, equipment, suits, and so on. Having finished, we sat down in our seats and began to wait for a closer approach. Although I managed to complete the full training course, and experienced astronauts flew with me, the feeling of intense excitement was still present. We didn't have much time to fix it: 2 days if we were in protective suits all the time.

Having flown up to a distance of about 30 meters, we observed a rather large hole in the shape of a cigar, and from it flaunted a fermented module with waste. Having estimated the amount of work, we went to the gateway, which stood at the very top of the geosphere. We docked without any problems, but the station airlock hatch desperately did not want to open and we had to apply our old-fashioned methods. Taking a hammer and a screwdriver, I began to inflict pinpoint blows on one jammed lock and the hatch opened after 6 powerful blows

Having flown inside, we felt the intense heat as if on a clear summer day. It turned out that the temperature at the station was 38 degrees! Although the station was launched remotely and then stopped before our arrival, the air conditioning system was turned off and heat penetrated through the transparent segments and through the reinforcing beams. In addition, in order to cool the station to an acceptable temperature in such a short time, it was necessary to turn off almost everything and direct all the power to the cooling system. It was necessary to urgently start repair work, spin up the station again and turn on the air conditioner to full.

Aaron and Meyer flew to the duty room, I went to the workshop and Nikolai and MacDonald to inspect the station and prepare building material. It is worth noting that there was a complete mess inside, the collision and turmoil afterwards did not contribute to the cleanliness. Having flown into the workshop, I quickly connected the tank we had brought to the waste supply system. With a loud hum, the mass began to flow into the dryer. At a time, she took the material on 3 panels and dried it for up to 12 hours. I flew into the duty

room and there I was told if we did not spin it up within 8 hours, the temperature would rise by 10 degrees. If I had stood on the ground then my legs would have buckled, but I had to control myself and not panic. I flew to the outer airlock and helped to get all the pipes and adapters and most importantly the heating element.

MacDonald and I took off our protective suits and changed into spacesuits. Then we disconnected the ship from the station and smoothly moved away. Having checked all the parameters again, we began the process of going into outer space. Having opened the airlock, it became unusually quiet, as if in this world there was only me and nothing else, only emptiness. But suddenly Ryan's voice hit my ears, telling me to get out of my stupor and start pulling out the material. So I did.

At this time, Nikolai coordinated our actions from the station. The first step was to securely attach the pipes and adapters to one of the station segments with clips for convenience. Then we flew up to the damaged segment and began to heat up the coupling point, it took about 5 minutes. Without removing the heater, we carefully pulled out the pipe, wrapping it with a cloth so that drops of the mixture would not fall on the equipment. Then we inserted a new one there, all the same without removing the heater. There was only one problem: some pipes just bent and we had to cut them into pieces for about 20 minutes to pull them out, and there were 6 such pipes. The rest were torn into 2 parts. So, after 2 hours we managed to change only 7 out of 15 pipes. It is worth remembering that all actions in space are slower than expected.

Having used up the supply of pipes, we began to return to the ship to restore our supplies and to rest. Already in the ship, looking at the station, I noticed progress and began to believe that we would finish before we had to spin the station again. During the second run, we managed to dismantle only 3 pipes and insert only 2, when suddenly Aaron said that they were no longer able to work in such conditions and urgent action was needed.

After some deliberation, we decided to turn the station around with the unheated side and move Aaron, Meyer and Nikolai to the ship while the temperature dropped. This did not solve the problem in the long run, but it did save time while the other side warmed up. In this case, we would have to work in the dark, which is not convenient even with flashlights. But we had to. Meyer was responsible for the manoeuvre. He requested permission to manoeuvre from the system, and then from Houston, and put one of the flywheels into the rotation.

The System

It can be seen from your eyes that you are interested in what kind of system it is, well, I will tell you. In total, it consisted of 20 subsystems, headed by the NASA control centre. Each subsystem was responsible for controlling its parameters, the more complex they are, the more complex and powerful the subsystem that controls it. Security officers, if necessary, gave a request to the system for some action and, after taking into account all the parameters, it permitted or refused our request with a detailed explanation. For example, if the speed of rotation was sufficient, and the attendant gave a request to increase it, the system would refuse, because if the speed was high, the modules inside the sphere could breakaway and crash against the walls of the “Sphere”. But if, for example, it was necessary, the attendant gave a request to Houston, which was superior to the System.

Continuation of work

Turning 90 degrees, the sphere began to slow down and after describing a half turn, it calmly stopped. We quickly rounded the Sphere, docked and let red, deep breathing and very sweaty colleagues inside. There, we waited until the station inside cooled down to 28 degrees. At the same time, our panels were ready.

While Nikolai, Meyer, and Aaron were back-running all the systems and simultaneously discussing how to make working in the dark more productive, McDonald and I flew to the workshop. If you dry the manure outdoors for a few days, it will stop smelling of its natural aroma. It's the same with our faeces. To keep them in shape, it is necessary to coat the loose shield panel with a special paste. Next, we take out a triangular baking sheet with a workpiece from the dryer and put it under a hydraulic press with a pump. The pump is needed to sum up the force of pressure from the outside to the force of the press. Before pressing, the thickness of the workpiece was 11 centimetres, at the end of

process 4. After that, we wait until the paste dries for about 5 minutes and lift the press plate. Done! It remains to pack it in polyethene in a special machine, pump out all the air and drag it to the internal airlock. And yet, this time we decided not to make panels with urine since 80 percent of protection was already provided by panels from faeces. We did this 2 more times and put 3 new portions in advance for drying. And yet, this time we decided not to make panels with urine since 80 percent of protection was already provided by panels from faeces. Having moved all 3 panels to the internal airlock, we began preparations for entering the inner volume of the sphere. Spacesuits for this were light since radiation practically did not penetrate, but in our case, we had to put on full-fledged spacesuits for outer space. Having put them on, we sealed the airlock module and began to release the pressure. After opening the airlock, We turned on some of the interior lighting and began to pull out the shield panel. To begin, one of us had to get out, and the other had to push the panel forward from the inside. The first person took it and unfolded so that the second one could get out too. Then we began to push the panel to the place of fastening in almost pitch darkness with flashlights on our foreheads and with the hope that we would reach the illuminated area, we turned on only a part so that the rest of the team could start all the station systems. Upon arrival, we discovered that the clips were not suitable for attaching panels. We took defective pipes with a diameter of 0.2 mm with us, which was enough so that the polyethene-pipe clips could not properly attach to the segment!
Later we were told that the new alloy of which the pipes were composed behaved unpredictably relative to tests carried out on Earth and shrank too much in volume. And the clips were designed for the exact dimensions of the pipes, so the problem required a comprehensive solution.

Just screws

Then we were notably desperate, threw the panels in the same place and went back to the station. Having already taken off our spacesuits, we were discussing the option of returning to Earth, when suddenly I decided to involuntarily put my hand into one of the pockets of my pants. Sensing some objects in them, I pulled it out and at the same moment shouted the word “EUREKA!” To the

entire station, to the entire space. Guess what was in my pocket? Screws! Yes! I had the idea to pierce the polyethene with six screws, two on each side with the head up, and attach it to the pipe with the sharp end using the same glue. Why are you looking at me like that? The polyethene was pretty strong and there was a lot of glue. In general, we went back, and with all the foolishness flew to the place of repair. And after a minute I was poking the panels all over with screws, and MacDonald glued them to the pipes.
The rest of the time we waited for the panels to dry, sometimes we turned the station with the cold side to the Sun and then went outside to finish the restoration work. When NASA found out about everything, they almost went crazy with the simultaneous joy and anger. After 52 hours, the station was almost completely ready for subsequent operation. Then we, in a voluntary-compulsory form, started cleaning the station and then counted all the stocks on it.

Epilogue

We returned home as heroes, people who managed to restore the most complex station with the simplest method. Even 65 years after that event, my colleagues and I are still recognised and asked for an autograph, mostly by little kids, of course.
Even now they use such a sphere, only for flights to other stars. It is the same geosphere only from outside, while from the inside, this is a completely different layout of the modules, it has a much greater comfort achieved thanks to experiments carried out at those stations to which I flew! They also thought of attaching two "Spheres" to each other, the one with people, in the other with a thermonuclear reactor! I think in 50 years such a structure will not yet exhaust its potential.
You know, I heard that it all started in the head of one very talented Uzbek, probably an inveterate dreamer. This was a man to leave something behind, and it seems to me that he did it.

P.S.

2000 years later …

(The conversation of two genetically modified potatoes playing chess)

-Mashed potatoes! You put a checkmate again!

- You know, it's not even luck, it's a special talent. My own test tube, you know, was special.

-Shut up! You are the same root vegetable as I am, so don't play it out.

-For your information 2000 years ago you would have been devoured at McDonald's, and for my beauty, they would have put me in a museum.

-You are right, you would be put in a botanical museum as a unique freak. Now stop flattering yourself and start a new game, otherwise, I have to change a few damaged segments of the neighbouring Sphere soon.