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Stone from the Stars

FIVE HUNDRED YEARS AGO a meteorite fell not far from the German town of Enzisheim on the Upper Rhine. The townsfolk chained it to the wall of their church so that the gift of heaven might not be withdrawn, and on it they engraved the inscription: "Many know much about this stone, everyone knows something, but no one knows quite enough."

Often as I think of the history of the Pamir meteorite I recall this old inscription. Yes, I know a great deal about it, more perhaps than anyone else, but by no means all. Yet the main facts about this remarkable phenomenon stand out all too clearly in my memory.

It was six months ago that the first news of the meteorite appeared in the papers—a brief item to the effect that a large meteorite had fallen in the Pamirs. My curiosity was aroused at once.

One would think that the falling of a meteorite would hardly be of interest to a biochemist. We biochemists, however, eagerly watch for every report of meteorites, for these fragments of "heavenly stones" can tell us a great deal about the origin of life on Earth. In short, we study the hydrocarbons found in meteorites.

The next newspaper report about the Pamir meteorite announced that an expedition had located it and had brought it down by helicopter from an altitude of 4,000 metres. It was a huge chunk of stone about three metres long and weighing over four tons.

I had just finished reading the item, making a mental note to call up Nikonov about it in the morning, when the telephone rang. It was Nikonov.

Before I go any further let me say that Yevgeny Nikonov, whom I had known from my school days, was a man of extraordinary self-possession and restraint. I never remember seeing him rattled or upset. But now, as soon as he began speaking, I could tell that something out of the ordinary had happened. His voice was hoarse, his speech so incoherent that it took me some time to understand what he was saying.

All I could make out was that I must come at once, instantly and without delay, to the Institute of Astrophysics.

I called a car and in a few minutes was speeding through the quiet and deserted streets. A fine drizzle was falling and the coloured lights of neon advertisements and signs were mirrored in the wet pavements. As I drove through the sleeping city I thought of all those who were not sleeping at this late hour, of those who at their microscopes, test-tubes and notebooks filled with long rows of formulas, were intently searching for new knowledge. I thought of all the discoveries that were being made, changing the pattern of life and opening new vistas to the wondering gaze of man.

The tall building of the Institute of Astrophysics was ablaze with lights. It occurred to me that perhaps the Pamir meteorite might have something to do with all this activity, but I dismissed the thought. What could there be so unusual about a meteorite to cause such a flurry?

The institute hummed like a hornets' nest. People were rushing up and down the corridors with an air of suppressed excitement. Animated voices could be heard issuing from half-open doors.

I went straight to Nikonov's office. He met me in the doorway. I must admit that until that moment I had not attached much importance to this night summons. After all, we scientists are apt to exaggerate our successes and failures. I myself have often wanted to shout from the housetops when, after endless experiments, I have at last achieved some long-awaited result.

But Nikonov. . . . One had to know the man as well as I did to realize how shaken he was.

He shook my hand in silence and with that quick, nervous, wordless handshake some of his excitement was communicated to me.

"The Pamir meteorite?" I asked.

"Yes," he replied.

He pulled out a heap of photographs and spread them out in front of me. They were photos of the meteorite. I examined them carefully, hardly knowing what to expect, although by now I was prepared for something extraordinary.

However, the meteorite looked exactly like dozens of others I had seen both in life and on photos: a spindle-shaped chunk of what appeared to be porous stone, with fused edges.

I handed the photos back to Nikonov. He shook his head and said in a strange, muffled voice:

"This is not a meteorite. Under the stone covering is a metal cylinder. There is a living creature inside that cylinder."

Looking back at the events of that memorable night I am surprised that it took me so long to grasp the meaning of Nikonov's words. Yet it was simple enough, although the very simplicity of it made the whole thing seem so unreal, so fantastic.

The meteorite turned out to be a space ship. The outer stone envelope, which was only about seven centimetres thick, served as a shield for a cylinder made of some heavy dark metal. Nikonov presumed (as was later confirmed) that the stone shield was designed to serve as protection against meteorites and to prevent overheating. What I had mistaken for porousness of the stone were indentations made by meteorites. Judging by the vast number of them the space ship must have been many years on the way.

"If the cylinder were solid metal," said Nikonov, "it would weigh no less than twenty tons. As it is, it weighs a little more than two. There are some fine wires attached to it in three places. They are broken, which suggests that some apparatus outside the cylinder was torn off during the fall. A galvanometer connected to the broken ends of the wires registered weak electrical impulses."

"But why are you so certain that there is a living being inside the cylinder?" I objected. "Most likely it is some automatic device."

"No, it is alive," he answered quickly. "It knocks."

"Knocks?" I echoed puzzled.

"Yes," Nikonov's voice was trembling. "When you approach the cylinder whoever is inside starts knocking. It seems to be able to see in some way. . . ."

The phone rang. Nikonov snatched up the receiver. I saw his face change.

"The cylinder has been subjected to ultrasonic tests," he said, laying the receiver down slowly. "The metal is less than twenty millimetres thick. There is no metal inside. . . ."

It struck me that there was something faulty in Nikonov's reasoning.

"Surely," I objected, "a cylinder less than three metres long and about 60 centimetres in diameter is hardly large enough to accommodate a living creature, let alone the water, food and diverse air conditioning apparatus required."

"Wait," said Nikonov. "In about fifteen minutes we shall go and see for ourselves. I am waiting for someone else. The cylinder is being installed in a sealed chamber."

"But you must admit your assumption is a bit fantastic," I persisted. "There can't be any human beings inside."

"What exactly do you mean by human beings?"

"Well, thinking creatures."

"With arms and legs?" For the first time Nikonov smiled.

"Well, yes," I replied.

"No, of course, there are no beings like that in the space ship," he said. "But there are thinking beings nevertheless. What they look like is hard to say."

I could not agree. I reminded him how Europeans, prior to the epoch of the great geographical discoveries, had imagined the inhabitants of unknown lands. They had pictured men with six arms, men with dogs' heads, dwarfs, giants. And they found that in Australia and in America and in New Zealand people were made exactly as in Europe. The same conditions of life and laws of development lead to identical results.

"Precisely," Nikonov said. "But what makes you think we are dealing here with conditions of life similar to ours?"

I explained that the existence and development of the higher forms of proteins is possible only within narrow margins of temperature, pressure and radiation. Hence the evolution of the organic world may be said to follow similar patterns everywhere.

"My dear friend," said Nikonov. "You are a leading biochemist, the biggest authority on biochemical synthesis," he made a mock bow, his calm, whimsical self again. "As far as the synthesis of proteins is concerned, I agree with you entirely. But you will forgive me if I say that one may know a great deal about making bricks without knowing much about architecture."

I did not take offense. Frankly speaking, I had never given much thought to the evolution of organic matter on other planets. After all, it was not my field.

"The medieval conception of man with dogs' heads living at the other end of the world did turn out to be nonsense," Nikonov went on. "But with the exception of climate, conditions on our Earth are everywhere more or less the same. And where they do differ, man differs as well. In the Peruvian Andes, at a height of three and a half kilometres, there lives a tribe of undersized Indians whose average weight is no more than fifty kilograms, but whose chest and lung expansion is one and a half times that of the average European. The process of adaptation to life in a rarified mountain atmosphere has gradually changed the physical characteristics of the organism. Now just imagine how different from conditions on our Earth life on other planets may be. There is the force of gravity, to begin with. You seem to have forgotten about that. On Mercury, for example, the force of gravity is one-fourth that on Earth. If people existed on Mercury they would hardly need highly-developed lower limbs. And on Jupiter the force of gravity is much greater than on Earth. For all we know under those conditions the evolution of vertebrates might not have led to a vertical posture of the body at all."

I saw an obvious flaw in that argument and I seized my opportunity.

"My dear friend," I said. "You are a prominent astrophysicist, the greatest living authority on spectral analysis of stellar atmospheres. So long as you stick to the planets I agree with you entirely. But one may know all about making bricks. . . . What I meant to say is that you have forgotten about hands—without hands there can be no labour and it is labour that created man, when it comes to that. But if the body is in a horizontal position all four limbs would be needed for support."

"Yes, but why should four be the limit?"

"Men with six arms?"

"Perhaps. On planets where the force of gravity is very great the vertebrates would most likely develop precisely in that direction. But there are other factors. The condition of the planet's surface, for instance. If the Earth had been permanently covered with oceans the evolution of the animal world would have taken an entirely different course."

"Mermaids?" I jokingly suggested.

"Possibly," Nikonov replied imperturbably. "Life in the ocean is constantly developing although much more slowly than on dry land. There are certain things essential to all rational beings, wherever they happen to live: a developed brain, a complex nervous system, and organs enabling them to work and move. But this is hardly enough to give one any real idea of their general appearance."

"But surely," I persisted, unwilling to yield, "it is not altogether unlikely that thinking beings resembling ourselves may live on planets with conditions similar to our own, is it?"

"It is not impossible," he agreed. "But highly improbable. You disregard one very important factor—time. Man's appearance changes. Ten million years ago our ancestors had tails and no foreheads. How do we know what men will look like ten million years hence? It would be absurd to assume that man's appearance will never change. You talk about similar planets. True, there are planets with conditions similar to our own. But it is hardly likely that the evolution of rational beings on these planets would coincide in time as well. In a word, my dear friend, 'There are more things on heaven and earth. . . .' "

I cannot remember all the details of that conversation. There were so many interruptions—the telephone rang constantly, people hurried in and out of the room and Nikonov kept consulting his watch. Yet looking back at it now it seems to me that that conversation was in itself significant. For fantastic as our surmises might have seemed, the reality exceeded our wildest speculations.

It all seems simple enough to me now. If a ship from another planetary system reached us through boundless space, knowledge on that unknown planet had clearly advanced to a degree far beyond our earthly conception. That alone should have warned us not to jump to conclusions.

The arrival of Academician Astakhov, a specialist in astronautical medicine, cut short our conversation.

"What sort of an engine has it?" he demanded from the threshold.

He stood in the doorway, his ear cupped in his hand, waiting for an answer.

I felt annoyed with myself for not having asked that obvious question. The answer would have told us many things—the technical level of the newcomers, the distance they had flown, how much time they had journeyed in space, what rates of acceleration their bodies could endure. . . .

"There is no engine," said Nikonov. "The metallic cylinder underneath the stone envelope is absolutely smooth."

"No engine?" echoed Astakhov. He pondered this in silence for a few minutes, a look of profound amazement on his face. "But in that case. . . . In that case they must have a gravitational engine."

"Yes," nodded Nikonov. "That's the answer, most likely."

"Can you power a ship by gravitation?" I asked.

"Theoretically you can," Nikonov replied. "There is no natural force which man will not eventually be able to understand and subdue. It is only a matter of time. True, so far we know very little about gravitation. We know Newton's law: every body in the Universe attracts every other body with a force that is directly proportional to the product of their masses, and inversely proportional to the square of the distance between their centres. We know, theoretically at least, that the only limit to gravitational acceleration is the speed of light. But that is about all. But the cause, the nature of gravitation—that we don't know."

The phone rang again. Nikonov picked up the receiver, answered briefly and hung up.

"Come," he said to us. "They are waiting for us."

We went out into the corridor.

"Some physicists believe that gravitation is a property of a specific type of particles called gravitons. I am not quite sure of that hypothesis. But if it is true, then the gravitons ought to be as much smaller than atomic nuclei as the atomic nuclei are smaller than ordinary bodies. The concentration of energy must be immeasurably greater in such minute dimensions than in the atomic nucleus."

We hurried down the steep winding staircase leading to the basement and along a narrow corridor. A group of institute personnel were waiting for us outside a massive metal door. Someone pressed a button and the door moved slowly aside.

There was the space ship: a cylinder of some dark and very smooth metal, resting on two supports. The stone outer covering, cracked in several places, had been removed. Three fine wires hung from the base of the cylinder.

Nikonov who stood closer than the others to the cylinder took a step toward it and at once a muffled knocking sounded from within. It was not the rhythmic mechanical beat of a machine. It suggested the presence of some living creature. It occurred to me that it might be some animal—after all, had we not sent monkeys, dogs and rabbits up in our own space rockets?

Nikonov moved away and the knocking ceased. In the ensuing silence someone's hoarse breathing could be distinctly heard.

Strangely enough, no thought of the new epoch that had dawned for science entered my mind at that moment. It was only afterwards in recalling the scene that I found every detail of it stamped on my memory: the low-ceilinged room flooded with electric light, and in the middle —the dark, gleaming cylinder, and the tense, excited faces of the men gathered around it.

We set to work at once. It was the engineers' task to determine who was inside the cylinder; Astakhov's and mine, to provide two-way biological protection—to protect the living creatures within from our earthly bacteria, and ourselves from any bacteria the space ship might contain.

I do not know exactly how the engineers tackled their part of the job. I had no time to see what they were doing. I only remember that they subjected the cylinder to ultrasound and gamma radiation. Astakhov and I went to work on the biological end. After some discussion (Astakhov's being hard of hearing delayed things somewhat), it was decided to open the cylinder with manipulators operated from the distance. The sealed chamber in which the space ship stood was to be treated with ultra-violet rays.

We worked at top speed, conscious of the living creature nearby awaiting our assistance. We did everything that was humanly possible to do.

The manipulators using a hydrogen burner carefully cut through the metal covering in which the space ship's apparatus was encased. Through slit-windows in the concrete wall of the room we watched the remarkable accuracy and precision with which the huge mechanical hands worked. Slowly, centimetre by centimetre, the flame of the burner cut through the strange, highly refractory metal, until at last the base of the cylinder could be removed.

What lay inside was living matter if not a living creature—a giant brain throbbing with life.

I use the word "brain" solely for want of any other word to describe what I saw. For a moment it looked to me like an exact replica, if magnified, of the human brain. On closer examination however I saw where I had been mistaken. It was only part of a brain. What was missing, we discovered later, were all those departments, all those centres that govern the emotions and instincts. Moreover, it had only a few of the innumerable "thinking" centres of the human brain, though these were enormously magnified.

To be more exact, it was a neutron computing machine with artificial brain matter in place of the usual electronic diodes and triodes. I surmised this at once from a great number of minor indications, but my supposition later proved to be correct.

Somewhere, on some unknown planet, science had advanced far beyond our own. We on Earth have only begun to synthesize the simplest protein molecules. *They* had succeeded in synthesizing the highest forms of organic matter. We biochemists too are working toward that end, but we are still very far from our goal.

I must admit that the contents of the space ship were a great surprise to all of us. All except Astakhov. He was the first to recover the power of speech.

"There you are!" he exclaimed. "Exactly what I predicted! You may remember what I wrote two years ago. . . . Inter-stellar distances are too great for man. Only space ships that operate completely automatically can undertake journeys from one island universe to another. Automatically! Electronic machines, perhaps? No, too complicated. Out of the question. What is needed is the most perfect of all mechanisms—the brain. Two years ago I wrote about this. But some biochemists did not agree with me. I said that for inter-stellar travel we must have bio-automatons, capable of cellular regeneration. . . ."

Astakhov had indeed published an article two years before advancing this idea. I confess it had sounded utterly fantastic to me. Yet he had been right after all. He had foreseen the possibility of synthesizing the highest form of matter—brain tissue—this anticipating scientific progress by many centuries.

It must be admitted that we scientists who work in narrow fields show little imagination in predicting the future. We are far too engrossed in what we are doing in the present to foresee the shape of things to come. There are automobiles today, and in a hundred years there will be automobiles too, only with far greater speeds. Similarly we cannot imagine that the airplane of the future will differ greatly from the present except in the matter of speed. But, alas, that only shows how limited our vision is. And that is why the shape of the Future is often more clearly envisioned by non-specialists.

Sometimes that Future seems altogether incredible, altogether fantastic and unattainable. Nevertheless it comes to pass! Heinrich Hertz, who was the first to study electromagnetic vibrations, rejected the idea of wireless communication. Yet a few years later Alexander Popov invented the radio.

Yes, I had not believed in Astakhov's idea. In order to produce bio-automatons some extremely complex problems would have to be solved. We would have to synthesize the highest forms of proteins, learn to control bio-electronic processes, induce living and non-living matter to work together. All this seemed to me to belong to the realm of sheer fantasy. Yet here right before our eyes was that distant Future. True, it was the fruit of the endeavours of men from another planet than ours, but nonetheless tangible confirmation of the great truth that there can be no limits to scientific knowledge, no idea too bold to be realized.

We did not know anything about the atmoshere inside the cylinder and how our own atmosphere would affect the artificial brain. Therefore compressor units and gas containers were held in readiness to adjust the atmosphere inside the sealed chamber to that in the cylinder. When the cylinder was opened the atmosphere inside it was found to consist of one-fifth oxygen and four-fifths helium at a pressure one-tenth greater than that on Earth. The brain continued to pulsate, though perhaps a little faster than before.

There was a whining sound as the compressors went into action to raise the pressure. The first stage of the work was over.

I went upstairs to Nikonov's office. I moved his armchair over to the window and raised the blinds. Outside dusk was settling over the city. Night had come again, the second night since I had been summoned to the institute. Yet it seemed I had been there only a few hours.

So the atmosphere in the space ship was 20 per cent oxygen—the same as in the Earth's atmosphere. Was this fortuitous? No. This was exactly the concentration the human organism needs. Hence, there must be some sort of circulatory system in the space ship. But if one part of the brain should die, circulation would be disrupted and hence the entire brain would perish.

This thought sent me hurrying downstairs again.

Even as I recall our efforts to save the artificial brain I am overwhelmed again by a feeling of impotence and bitterness.

What could we do? Nothing. Nothing but look on helplessly while the brain that had come to us from outer space, the brain created by the inhabitants of another planet, slowly expired.

The lower part dried up and turned black. Only the upper section remained throbbingly alive. When anyone approached it the throbbing became quick and feverish, as if the brain were calling frantically for help.

By now we knew how the brain was supplied with oxygen. As I had presumed, it breathed with the help of a chemical compound resembling haemoglobin. We had also studied the devices that fed the brain, generated oxygen and removed the carbon dioxide from the atmosphere.

Yet we could do nothing to halt the destruction of the brain cells. Somewhere, on an unknown planet, thinking beings had been able to synthesize the most highly organized matter—brain matter. They had created an artificial brain and sent it out into space. There was no doubt that many of the secrets of the Universe were recorded in those brain cells. But we could not fathom them. The brain was dying before our eyes.

We tried everything, from antibiotics to surgery. Nothing helped.

In my capacity as chairman of the Special Commission of the Academy of Sciences I called a conference of my colleagues to ascertain whether there was anything else that could be done.

It was in the early hours before dawn. The scientists sat in the small conference hall in gloomy silence, their faces drawn with fatigue.

Nikonov passed a hand over his face as if to brush away his weariness.

"There is nothing more to be done," he said in a flat voice.

The others confirmed this tragic fact.

Throughout the next six days, while the few remaining cells of the artificial brain still lived, we kept up constant observations. It is hard to enumerate all that we learned in that time. But the most interesting was the discovery of the substance that protected the living tissue from radiation.

The outer shell of the space ship was comparatively thin and could be easily penetrated by cosmic rays. This had prompted us from the very outset to search for some protective substance in the cells of the bio-automaton itself. And we found it. A minute concentration of this substance immunizes the body against the most powerful radiation. This discovery will enable us to simplify the design of our own space ships. It obviates the need for heavy metal shields for the atomic reactor, and this brings the era of space travel in atom-powered ships much closer.

Extremely interesting too was the system for regeneration of oxygen. A colony of seaweed unknown to us and weighing less than a kilogram which absorbed carbon dioxide and exhaled oxygen had provided the ship with adequate "air conditioning" for many years.

But all these are purely biological discoveries. The knowledge gained in the sphere of engineering is perhaps even more important. As Astakhov had surmised, the space ship was powered by a gravitation engine. Engineers have not yet grasped the principle of the mechanism. But it may be safely asserted that our physicists will have substantially to revise their ideas about the nature of gravitation. The epoch of atomic engineering will evidently be followed by an epoch of gravitational engineering, when men will have still greater sources of energy and speed at their disposal.

The outer covering of the space ship consisted of an alloy of titanium and beryllium. As distinct from the usual alloys, the entire casing was made of a single-crystal metal. Our metals consist, roughly speaking, of myriads of crystals. And although each of them is strong enough, they do not cohere too well. The future belongs to the single-crystal metal, which will have properties we still have to discover. Moreover, by governing the systems of crystallization, man will be able to govern its optical properties, durability and heat conductivity at will.

Nevertheless the most important discovery of all, though not as yet deciphered, is connected with the artificial brain.

The three wires attached to the cylinder proved to be connected with the brain through a rather complicated amplifying system. For six days sensitive oscillographs registered the bio-automaton's currents. These currents were nothing like those of the human brain. And this is where the difference between the artificial and the human brain was manifested. After all, the brain of the space ship was essentially nothing more than a cybernetic device, with living cells taking the place of electronic tubes. With all its complex structure this brain was immeasurably simpler and, as it were, more specialized than the human brain. Hence its electrical signals resembled a code more than the extremely complex pattern of biocurrents in the human brain.

Thousands of metres of oscillograms were recorded in those six days. Will it be possible to decipher them? What will they tell us? The story of a voyage through space perhaps?

It is hard to answer these questions. We are continuing to study the space ship and each day brings some new discovery.

So far many know much about this stone, everyone knows something, but nobody knows enough. But the day is not far off when the last secrets of the star stone will be fathomed.

And then space ships powered with gravitational engines will set out from the Earth for the boundless expanses of the Universe. They will be manned not by human beings—for man's life is brief, and the Universe is infinite. The interstellar ships will be manned by bio-automatons. After voyaging thousands of years in space, after reaching distant island universes, the ships will come back to Earth bearing the unfading torch of Knowledge.