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SOVIET INTERPLANETARY ROCKET TO MARS

by V. Gubarev

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SOVIET INTERPLANETARY ROCKET TO MARS

Following is a translation of three serial articles by
Special Correspondent V. Gubarev in the Russian-language
newspaper Komsomol'skaya Pravda (Komsomol Truth), 2, 3
and 4 November 1962

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ROCKET ON THE LAUNCHING PAD -- "COSMIC EARPHONES"

AIMING THE ANTENNAS -- THE "ARTIFICIAL MARVEL"

[Following is a translation of a serial article by Special Correspondent V. Gubarev in the Russian-language newspaper Komsomol'skaya Pravda (Komsomol Truth), 2 November 1962.]

Waiting... the second hand lazily moves around the dial.

Calm. Cautious, tense calm. The antennas throats are pointed skyward, the indicators on the instruments have settled down, but are ready at all times to break away from their positions; the control panel is lit evenly, indifferently...

The tense silence spread around the space center. Looking at the irreversible second hand of their wristwatches, people are waiting. They are waiting at the launching pad and they are waiting here at the space-flight control center.

T minus one and counting!

Forty seconds... 20... 10... 5...

Now... Takeoff!

...A thin flame appeared beneath the rocket. An instant - and a gush of fire rushed earthward. Slowly, very slowly, the shiny rocket body climbed and suddenly, as if having made up its mind, rushed upward. Faster, faster, faster... The gigantic "needle" kept dwindling in size, and soon only a tiny fiery dot is boring through the sky...

The laconic reports are made:

"The last stage has separated..."

"The station has separated..."

The force which a few minutes ago had been retained in the huge body of the space rocket has been imparted to the small automatic "marvel"

which is being sent as a messenger from Earth to Mars.

The spacecraft is on course. The rocket's designers heaved a sigh of relief--their task has been fulfilled. On the launching pad, people embrace one another, are happy and proud, and yet all this is only the beginning.

For a long time, I tried to find a comparison of the antenna for space radio communications with something that each of us is familiar with but I did not succeed. To imagine it in the form of huge bowls connected together overlooks the sensation of the grandiose scales involved. Most truly, the antenna reminds one of a group of large radio telescopes placed closely together and rotating on a common axis. However, not all of my readers have seen a radio telescope and such a comparison is but an empty noise to them.

Instead of seeking comparisons, we will simply make a small trip around the antenna. Yes, don't be surprised: one can make a trip around it!

There are 3 antennas in all at the space center. Perhaps they are not the heart of the center, but they are its hands--busy, calloused hands of a complex organism called the space center.

Quite a bit of time is needed to climb to the top of the antenna. Its highest point is about on a level with a 12 story building! Alongside of this "monster", a man looks like Gulliver in the land of the giants. Eight large mirrors, each of them 16 meters in diameter, form the "working part" of the antenna. The mirrors are mounted in 2 rows of 4 each. Like soldiers in ranks, they are closely arrayed.

The energy collector is located in the center of each mirror. Since the mirror is concave, the signals from outer space fall onto the durable surface, are reflected from each point, and are collected in one location; thence they pass quickly to the amplifiers.

Let us look beneath the mirrors...we find ourselves in a world of electronic devices, engines, various mechanisms, instruments and equipment. Here everything is crammed to the limit.

From the film "Nine Days Out of One Year", we get an idea of the equipment at the disposal of modern physicists. The labyrinth of equipment and of powerful vacuum chambers, generators and annular magnets--all these are surprising to us in their unusualness and fantastic appearance. However, in comparison with the space communications antenna, the "armament" of the physicists no longer seems so complicated.

We can give an idea of how "stuffed" the antenna is with various devices and equipment by citing but one figure--the antenna's weight is > 1000 tons! This is exclusive of the thick foundations which ensure not only the steadiness of this "giant", but keep it from being put askew even by a single millimeter.

Special devices assure the "noiselessness" of the antenna's operation.

Radio technicians are well aware that, depending on temperature, the functioning of the electrical motors etc., all bodies "emit" (if one can use such an expression) radio waves into the ether. Moreover, the frequency and intensity of these radio waves ("noises") differ. One of the problems of the designers who developed the antenna was specifically the difficulty with the noises in the "giant"; these random noises could easily drown out the radio voice arriving from outer space. The designers did a wonderful job of handling this problem too.

"The antenna operates almost silently both in the direct and in the figurative sense of the word" briefly commented the engineer who was describing the installation to us. --But this is merely one of the problems, and to be sure is far from the main one which the large group of specialists who developed the antenna had to solve. Take, for instance, the "movement mechanisms".

Does it move? Really, does this thousand ton complex actually move?

No matter how paradoxical it may sound, the antenna becomes a worthless piece of equipment if it is incapable of turning in two planes.

Radio transmission from outer space, of interest to Earth observers, is conducted with the AIS (Automatic Interplanetary Station), which constantly moves in relation to the Earth. Of course our planet is not still; it "flees" in orbit around the Sun and at the same time turns on its own axis.

The antenna's mirrors must be directed precisely at one sector of space where the artificial little star is shining (of course, only if we look through powerful telescopes!). The Earth turns, the AIS is moving, and the mirrors of the space antenna also turn slowly. The antenna displaces slowly (imperceptibly to the eye) in a horizontal and vertical plane. When the mirrors are adjusted parallel to the Earth, the antenna is reminiscent of a man who has tilted his head upward; if the AIS is located above the horizon, the antenna reminds one of a man looking at the outlines of distant mountains. Thus the antenna operates around the clock. It is just like a living being, carrying out a difficult and responsible duty...

The thousand ton complex rests on huge spheres, providing it with the ability to turn on its own axis. The mirrors themselves are fastened to a tube flexibly coupled with the frame, and rests on huge bearings.

We say: "Huge spheres, gigantic bearings". This by no means signifies that their large size stresses the "coarseness" of the construction. Nothing of the kind! It would be difficult simply to make such a complex and bulky installation, but it is incomparably more difficult to

force it to work with the accuracy of a clock mechanism. Here the precision is even higher! I think that now it is not difficult to imagine how much inventiveness, creativity and inspiration were required to develop a space antenna. Yes, specifically these qualities, because usually we ascribe them only to the creators of the space rockets and of the automatic interplanetary stations. However, we can state with complete certainty that the development of the antenna, receiving and sending signals into space, took just as much effort as was involved in preparing for the launching of the first sputnik. We would be unable to utter a word about space research, even though we were to have powerful rockets at our disposal, but did not have a space center, which can well be dubbed the "loudspeaker" of space. If this center did not exist, the artificial inhabitants of outer space launched from our cosmodromes would be cut off from the Earth by an impenetrable wall of silence.

Can it be that the cosmic "earphones" are radio telescopes, only of very high power? No doubt, there is something in common between these astronomers' aids and the antennas for extremely long range radio communications, but likely the difference is great. This applies above all in relation to the ability to eavesdrop on the universe. With the space antennas, the "hearing" is more sensitive, and they function with incomparably greater accuracy than their "younger brothers". This demanded the development of radically new equipment.

Ticking off the cosmic miles, the AIS is flying to the "Red Planet", namely to Mars. The powerful beam of energy shot out by the antennas, has overtaken the station. At command from this beam, the onboard equipment was switched on. The information on the condition of the spacecraft, the scientific data regarding interplanetary plasma, and many other data accumulated during this time are emitted by the radio transmitter on the AIS. The signal speeds earthward. It is very faint; it is not possible to mount powerful transmitters in the station because they require a lot of power. The energy of the radio signal falls on a large area, and only a trivial part of it falls upon the receiving antennas of the space center.

Now the "witchcraft" begins. The "midget signal" must be amplified so that it can relate what is being done on the AIS. Therefore in the space center the voice of the interplanetary station is magnified, decoded, converted to a generally accessible language understandable to anyone who listens to the TASS communiques.

The antennas have done their work; they have picked up the signal. And what happens next?

HERE THEY ARE WAITING FOR SIGNALS FROM OUTER SPACE:

DESCRIPTION OF AN UNDERGROUND LABORATORY

[Following is a translation of a serial article by Special Correspondent V. Gubarev in the Russian-language newspaper Komsomol'skaya Pravda (Komsomol Truth), November 1962.]

Sorcerers sometimes walk in white cloaks. It could not be otherwise. Complex equipment is affected by each bit of dust. This is easy to understand because the engineers are dealing with such microscopic "experimental objects", i. e. barely perceptible signals, that the slightest disturbance in one of the devices could make the station a "deaf mute". Although all systems are duplicated and are ready to go to the aid of one another at the very first disruption of the established operating rhythm, the struggle to maintain the cleanliness of the installations does not slacken for an instant. The "sanitary state" is not inferior to that in an operating room. Why should it be inferior, since here the radio engineers conduct just as complex operations on the "sick" signal from space, as do the surgeons in the operating room?

The space antennas extend upward, striving to be closer to the stars, but the electronic equipment with whose aid the message from the AIS is reinvigorated and made understandable, tries to "bury" itself in the earth.

We are walking around the rooms of the "underground palace". Here is one of them. Electronic devices are arrayed along the walls.

"These are our amplifiers" explains the engineer who is guiding us. "As you see, they are similar to one another, but each has its distinguishing features. The fact of the matter is that a signal, received from space, passes alternately through each amplifier. As a rock rolling from a mountain gradually picks up speed, the signal is gradually amplified. This bank of amplifiers is quite sensitive. The radio wave, weakened from its prolonged trip through the cosmos, gains power here. The amplifiers restore it to its proper phonation."

In the universe, the stars carry on a "lively conversation" with one another. They fill interplanetary space with radio waves of various frequencies, which mingle with the voice of the automatic station and muffle it. The chaos of radio sounds falls on the receiving antennas. From this gibberish, it is necessary to separate a single voice, i. e. that of the messenger sent from Earth.

The amplifiers handle this task well. Here the background is eliminated, the "chattering" of the stars is segregated, and the amplified voice of the AIS is heard just as it sounded millions of kilometers away.

Our concept of the space center would be far from complete if we did not visit the building where the transmitters are installed.

Before getting a response from the AIS, it is first necessary to interrogate it, switch on the equipment on it, and finally give the command to begin the transmission to Earth. One of the antennas mounted in the space center serves this purpose. This antenna scarcely differs from the receiving ones, but it performs exactly the opposite task; it does not listen, but rather it speaks with the AIS.

Very high frequency waves are needed to send an order to the AIS. Moreover, they must be "rammed" into the scale of frequencies, or as the specialists say, "a very narrow band width in the ether is needed"...

In school, we encountered the concept of the "Doppler effect". The physics teacher told us that if an automobile would move along the street at several thousand miles per second, the red signal light would appear to be green. For the driver, a "displacement of frequencies" would be taking place.

Using the Doppler effect, astronomers determine the distances to stars and establish their motion. It is also an aid to specialists in long-range space radio communication. They have to receive from the station radio waves of strictly fixed frequency, because only then can they decode the "space message", and determine the velocity of the AIS and the distance to it.

To measure the "shift in frequencies", it is necessary for them to be stable on Earth. This stability must be very high.

The radio transmitters at the space center have a power of > 100 kilowatts. Indeed, there are no equals to them on our planet!

The specialist avers: "All this is correct, but how can such transmitters operate along with such sensitive receivers? Really, they will interfere with one another."

I ask your forbearance: I forgot to mention that the transmitters and the receivers mounted in the space center are set up at a great distance from each other. Further, if we consider that they are separated by a thick earth layer, interference is then quite lacking...

We wanted to depart from the engineer who had guided us about the "underground palace", but he suddenly recalled:

"Just one moment! I forget to show you the "gauge of frequencies".

"Gauge of frequencies? I knew of the existence of a gauge for length, weight and finally for time, but "frequency gauge"--just what is that?"

The engineer explained: "It's a simple matter, but quite necessary. The fact is that the frequencies at which the transmission into space is conducted must be rigorously fixed. Hence they must be compared with some standard, just as we compare the setting of our watches with the tolling of the bells in the Spasskaya Bashnya (Tower). Of course, we could use an already existing "time gauge", however in our work, a very high accuracy is needed. So here we have developed our own "frequency standard".

From outside, the room could not be differentiated from the others. A small inconspicuous piece of equipment stood in the corner.

"That is our gauge. Of course, you can't feel it, but this is the most ideal device in the world in regard to precision. There is no other like it. The "accuracy of frequencies" is guarded by special devices which do not allow the frequency to "waver" but hold it in strictly assigned limits.

Many times we took voyages into the future. The pages of books have vicariously taken us into a world, endlessly filled with the most complex machines and devices. But the fantasy created by the writers fades in the light of the reality of the space center, and the most important is that it is all done by the hands of your contemporaries, i.e. people who are around you every day, every hour, every minute.

In the evening when I met one of the directors of the space center, I shared my impressions with him.

"There is no escaping it, the cosmos is calling us" he smiled. "We are going outside the bounds of Earth; you won't get there by boating on the Volga. Come into the control center when we once more are in touch with the "Mars-1". Then you will really realize what is concealed behind the cryptic phrases of the TASS reports:

"The onboard radio transmitters, operating on frequencies of 922.76 megacycles and 184.6 megacycles, are functioning stably. The power of the signal being received matches the computed value. The hookup with the interplanetary station is excellent. The transmitted commands made the passage and were processed distinctly".

FIRST PERIOD OF COSMIC RADIO COMMUNICATION

[Following is a translation of a serial article by Special Correspondent V. Gubarev in the Russian-language newspaper Komsomol'skaya Pravda (Komsomol Truth), 4 November 1962.]

November 1. Six hours ago, the automatic interplanetary station took off for Mars. For 360 minutes, the space center has been preparing for the first period of radio communications.

The final checking is underway. The TV screens are lit in the main control panel. Various installations in the "underground court" are lighting up. The heads of the services announce:

"Everything ready at the second area"...

"The equipment is all in order"...

"We are waiting."

"Well, now everything's in order! We could even call Proxima Centauri!..."

The command point is in a large well-lit installation, reminding one of the electronic brain of the factory of tomorrow. With a twist of a lever, there becomes visible on the TV screen any corner of the space center.

A telegraphic device is chattering. From the coordinating-computer center, data are arriving on the flight of the artificial "marvel" flying towards Mars. Now the points for close communications are tracking the station and are relaying the data about the orbit to the coordination-computer center, where the trajectory is refined and whence the data are sent by telegraph to the space center. The tracking station for long-range radio communications goes into operation only when six hours have elapsed after the launching.

The electronic computers linked with the antennas have already been put into operation. The cosmic "loudspeakers" are turning slowly, aiming precisely at the tiny sector of the sky where the AIS is at that moment...

A young engineer busies himself with some tape recorders. He is singing quietly about the quadruped "cosmonauts" -- Belka and Strelka.

I had not heard this song.

"Some young people wrote it at the cosmodrome two years ago" he explained. "At the time that the dogs were launched. They envied them; indeed at that time, Yuriy Gagarin was still being whirled around in the centrifuge. Listening to the dogs barking from outer space, these boys wrote the song. More exactly, one of the physiologists wrote the verses, and then the music came into being. I don't know the authors, and if you please, it doesn't matter; it has become a "popular space song"...Excuse me, it is starting..."

...No, here the shutters of photo devices were not snapping shut, movie cameras were not clicking, there were none of the attributes of the triumphant state that you get from the movie screen or from the voice of a director. Here work was being done. People were writing a scheduled chapter in the book of space exploration.

A powerful beam of energy rushed from the antennas. Fractions of a second--the station was still close--the beam overtook it and switched on its transmitter. Within a second, the antennas had received a reply and the tape had recorded the voice of the AIS. So far the hookup with the station was accomplished in fractions of a second, but the time would come (the AIS will go far) when minutes and even dozens of minutes will be needed to hear the response from the Mars-1.

The decoding of the "reply" took another instant, and the telegraph was already at work, transmitting the cosmic "message" to the coordination-computer center.

The "conversation" with the AIS will be conducted regularly" explained one of the directors of the space center, when I asked him to relate to our readers the details on the program for launching the AIS toward Mars. The duration of each contact will be an hour and a half. Such a system of "talks with space" is fully justified, and it completely assures the scientific flight program.

Thus, the order has gone to the AIS to begin transmitting. What does the report begin with? First of all, the AIS reports on its "condition". In the station there is installed a special device that keeps track of the airtightness, temperature, humidity etc. All the data are fed into the transmitter, which announces to Earth: "The onboard equipment is functioning normally!".

The second point covered by the space report refers to the so-called "trajectory data". On its basis, we determine the orientation of the station, distance to it, and flight speed.

Finally, the main part of the report from the AIS is the scientific information. In the automatic interplanetary station travelling to Mars there are special devices and instruments which while en route analyse the interplanetary gas, count the number of impacts with meteorites, deal with gravitation and conduct many other scientific experiments in the natural laboratory known as interplanetary space.

We will be in contact with the AIS for seven months.

The TASS report notes that Mars will be photographed. Having such photos at their disposal, scientists can establish whether there is vegetation on Mars. This problem has troubled scientists and fiction writers for many decades. In the debates, both pros and cons are included. The "opinion" of the AIS will no doubt tip the scales in one direction or the other.

Mr. Pickering has not been circumvented by glory. The western press devotes quite a lot of space in its pages to one of the developers of spacecraft and automatic interplanetary stations in the U.S.A. Thus I was able to recognize him easily when I met him at the International Astronautical Congress held in Varna at the end of last September.

V. N. Pickering is a great scientist and without doubt, his opinions about the basic stages of mastering outer space are of interest; hence I asked him to respond to several questions.

"How do you evaluate the achievements in the conquest of outer space? Who is leading--the USSR or the U.S.?"

Pickering replied: "I divide the space achievements into two categories: scientific and technical. By the second category, I connote the thrust of rockets, engines, and the weight of sputniks. Here the Russians are indisputably in the lead. They have attained phenomenal successes! However, we hold first place in respect to the scientific achievements."

"On what do you base your opinion?" I asked.

"Without equipment, the mastery of outer space is unthinkable. The electronic devices must hold the spacecraft on course, must constantly send reports to Earth, must maintain fixed "climatic" conditions on board the spacecraft, and perform dozens of other tasks--ranging from the control of the engines' operation to conducting the most complex scientific experiments in the atmosphere and on the surface of other planets. Frankly, I consider that our equipment is more "sophisticated" and improved than that which has been developed in the Soviet Union" replied Pickering.

"Excuse me, Mr. Pickering but there is a contradiction in your words. Speaking in your language, "technical" advances are impossible without improved equipment."

"This is correct. The tandem flight of Nikolayev and Popovich could never have taken place without complex equipment. Admittedly, in Russia there is the equipment needed to put sputniks into orbit around the Earth and to maintain a radio hookup with spacecraft that do not travel beyond the Moon. It is another matter when we are talking about interplanetary flights..."

Pickering went on: "Let me cite a second example, recently in the U.S. an artificial earth satellite was launched. With its aid, for the first time in history, TV transmission between Europe and America was accomplished. TV programs were sent regularly to Europe. I don't wish to touch upon their content--the quality of the transmission was quite low, however the actual fact was very remarkable in itself."

Pickering concluded: "In my opinion, these examples point out the superiority of the equipment made in America. I feel that the USSR needs several years to overtake the U.S. in this respect..."

At that time, I did not argue with Mr. Pickering, and therefore our chat with the developer of American spacecraft ended with the words that by now are almost traditional: "Time will tell".

Less than a month went by. The years (which according to the deep conviction of the American scientist would be needed by our scientists to develop "interplanetary" equipment) had shrunk to several days. This figure is formal, because it is clear to everyone that it is impossible to develop solar batteries or radio transmitters in just one month.

In the evening at the space center, one of the directors in our radio industry arrived by plane. I related to him my conversation with Mr. Pickering and asked him to comment on it.

He said: "Probably Mr. Pickering puts too much faith in the American press, which is trying with all its might to take "revenge in space" even if only on paper." He went on: "The first 'voice against' the utterance of the American scientist is the launching of the automatic interplanetary station towards Mars. The accomplishment of such a space flight is incomparably more complex than the launching of an AIS towards Venus. The distance and the flight speeds are greater. I think that Mr. Pickering would not deny that quite "sophisticated" gear is needed for accomplishing such an interplanetary flight."

"Pickering has the view that we are not able to establish a radio hookup over cosmic distances amounting to millions of kilometers. In this he is mistaken. The rendezvous of the AIS with Mars will occur at a distance > 250 million kilometers. The data obtained from this flyby will be

Equipment
"The USSR has the
ment for space radio communications!

"The Americans are quite proud of their TV satellite. This is no use
course a great scientific and technical advance. However, there is no TV
in upbraiding us for not having such a sputnik. Why should we send
transmissions for the same distance as is being done by the Americans?
To be sure, this is being done remarkably well by Intersatellite. It is, but
be feasible to conduct TV transmission with the U.S. and vice versa, but
for this it would be necessary to orbit a sputnik at a very great height.
This is an incomparably more difficult problem. In my view, the solution
of a worldwide TV system will proceed specifically in this direction.

"The launching of the automatic interplanetary station to Mars
is an outstanding achievement of Soviet science and technology. It is sep-
arately of science and technology. Because one can never artificially
separate one from the other!" concluded the director.

Right now, moving at tremendous speed from Earth towards Mars, help
the Soviet automatic interplanetary station is on its way. It will help
to solve many problems of outer space. But today it is performing
another, no less important task--the AIS is settling the debate concerning
the superiority of the sciences in the U. S. and the USSR. The space
traveller "Mars-1" is lending its strong voice in favor of the science
and technology in the Land of the Soviets!

Space Center.

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