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PLANET OF ENIGMAS

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PLANET OF ENIGMAS

L. Maksimov, Editorial Board

Mars in the eyepiece! What will the first scout of science tell?

A huge, blindingly-bright, white-hot body cut through the morning sky and at the same instant a deafening roar, to which nothing can be compared, shook the whole surrounding area. For hundreds of kilometers around, as though tossed by a seismic wave, buildings swayed. Window panes noisily shattered and came down in a very fine rain. Books fell from shelves, dishes slid off, chandeliers swayed threateningly. The pendulums of clocks all at once began flapping, breaking their usual measured pace, and soon the clocks died down, sealing with their immobile frozen hands the moment of the extraordinary catastrophe. For tens of kilometers around a mighty wave of air wiped everything living from the face of the earth. And an inconceivably strong explosive roll was heard even for a thousand kilometers from the spot, where the unprecedented flame flared up and the magnificent and terrible column of smoke went sweeping up to the clouds...

Time knows how to keep secrets, mercilessly effacing what is

most valuable, needful, and irreplaceable. Effacing so swiftly that even what eye-witnesses testify to becomes unsteady, doubtful, at times improbable.

Fifty years is a very short moment in the history of mankind. But the fifty which have passed since that August morning in 1908 when the flame of more-than-earthly force blazed up over the Stony Tunguska have blotted much out of human memory, even in the place of the catastrophe itself.

What happened over the taiga? Did a meteorite which had slashed its way into the terrestrial atmosphere fall to pieces? Did a comet whip its blinding tail over the taiga? Or perhaps an interplanetary ship bringing emissaries to the earth from another world suffered fatal damage?

Large expeditions have not given an exact answer to these questions. Scholars still debate the secrets of the Tunguska marvel. But, categorically denying the possibility of space travelers having crashed or unreservedly believing in such a catastrophe, participants in the debates again and again appeal to our neighbor in the universe, majestic and morose Mars, possessor of the most puzzling and burning secrets of our world.

Did not indeed unknown cosmonauts fly from there?

Mars has kept its secrets for a long time. But now there is only a very little time left for us to torture ourselves with guesses. The mysterious veil is falling, revealing to our gaze Mars without secrets, without enigmas, but all the more majestic and magnificent.

A Little Earth

Not one heavenly body has attracted and still attracts such fixed attention, nor has evoked such deep interest as this reddish

little star, on the whole far from being most noticeable in the nocturnal firmament. There are many reasons for this interest and above all, that Mars has proved to a rather close relative of our earth.

In the house of the cosmos the earth and Mars live as neighbors. Mercury of all the planets is nearest the sun. Beyond it is the orbit of Venus. Then follows the earth. And not much farther on is found Mars. This "not much" is small, really, by cosmic standards — at the moments of nearest approach of the earth and Mars (during opposition) the distance between them is found to be less than 60 million kilometers. A ray of light takes less than 4 minutes to cover this path.

The average distance of Mars from the sun is not too great either. It amounts to 227.7 million kilometers. This is only one and a half times the distance between the earth and the sun. Mars must make a longer journey than the earth in its movement about the sun. But it also moves along its celestial course more slowly than the earth. Of course, it takes considerably more time for its journey. The Martian year — the period of one revolution about the sun — lasts about 687 of our days.

Mars, like earth, rotates about its axis. Therefore, on Mars, as on earth, there is an alternation of day and night. The accord between the rotation periods of the two planets is surprising. On earth, days are 23 hours 56 minutes. For lovers of accuracy we can calculate this figure a little further. According to the latest measurements the Martian day is equal to 24 hours, 37 minutes, and 22.669 seconds! It has been measured with an accuracy of three thousandths of a second! We are far from being able to reckon all segments of time on earth with that accuracy.

When it created our planet and Mars, nature was not chary of

coincidences. The French astronomer Camichel, using the beautiful photographs of Mars taken at the Pic du Midi Observatory in the Pyrenees, determined one more important value with great accuracy — the inclination of the equator of Mars to the plane of its orbit.

Behind this long formulation is hidden a principle which determines to a vast degree the climatic conditions on a planet. The earth's equator is inclined to its orbital plane at an angle of 23° 27'. Owing to this very inclination the change of seasons occurs — summer follows spring and gives way to autumn. If this angle were equal to zero an "intermediate season" would set in on earth, something on the order of an endless autumn-spring. It is easy to imagine how substantially that would influence all life on our planet.

In this respect Mars is scarcely different from earth. Its angle of equatorial inclination is 23° 50'.

Nevertheless there does exist a certain difference between the change of seasons on earth and on Mars. On earth the duration of astronomical spring, summer, fall, and winter is almost the same. The shortest of the seasons is winter. It lasts 89 days in the northern hemisphere. Autumn is a bit longer — 90 days. But spring and summer last for 93 days and nights each. As you see, the difference is only four days.

On Mars the situation is a bit different. In one of its hemispheres autumn is the shortest of all: 143 Martian days and nights fall to its share. On the other hand, spring, the favorite season of lovers, is extended to 193 days. If the seasons on Mars are like those on earth, this feature would be extremely pleasant: the flowering spring lasts very much longer than dank and dark autumn.

Mars is different from our native planet in many other respects,

too. First of all, it is considerably smaller. The diameter of Mars equals only 6770 kilometers, that is, almost twice as short as the earth's. The surface area of our neighbor is correspondingly smaller — it is 29% of the area of the earth, i.e., it equals the surface of the terrestrial continents. And its volume is 15% of ours.

Scholars have of late also successfully measured Mars' mass rather exactly. It turns out that it weighs almost 10 times less than the earth. And therefore the force of gravity on Mars is considerably less. If future space travelers take with them a set of weights of one earth kilogram and a spring balance, they will discover that on Mars their weights will show not 1000, but only 383 grams.

That will be very pleasant for earthlings debarking on Mars. Having completed a flight very short by cosmic standards, the traveler weighing 70 kilograms on earth will feel himself rejuvenated on the new scene, surprisingly light on his feet. Of course, here his weight will, you know, **feels** like only 27 kilograms. The body's muscles, used to terrestrial loads, will easily throw him from place to place. The records of a Valeriy Brumel' or of an Igor Ter-Ovanesyan will be broken at the very first attempt.

The phenomenal feats of a Yuriy Vlasov would not remain unsurpassed, either: on Mars any reasonably healthy person would manage a bar weighing 150-200 kilograms on earth.

But all that is, of course, a joke. The federations of light and heavy sports would hardly set Martian records by earth standards. Much more serious and important is the fact that the weakened force of gravity would also lower the take-off velocities from Mars, which are exceptionally important to space travelers. In order to loft an artificial satellite into orbit around Mars, it is necessary to impart

to it a speed of only 3.5 kilometers a second (instead of 7.9 on earth). And for departure from Mars into cosmic space — escape velocity — one must move with a velocity of 5 kilometers a second. This is two times less than on earth, where one must accelerate to 11.2 kilometers a second.

This advantage is hard to overcome. The problem of taking off to return becomes one of the most complicated and important problems, you know, in manned flights to other planets. To start from a big and heavy planet takes huge reserves of fuel which one must, very likely, take along with one from earth. When escape velocity is lessened these reserves are substantially curtailed. Returning from Mars is much easier, for example, than returning from Venus where take-off demands 10.2 kilometers a second. And not to speak of Jupiter, for instance, for which escape velocity is 61 kilometers a second.

So space travelers in the future will probably stop on Mars with pleasure.

Do You Know Areography?

By no means every science can boast of the day, or even of the year of its birth, far from it. And, in fact, the birth of such a "baby" extends as a rule over decades and at times even over centuries. Slowly, grain after grain, isolated data gradually accumulate, slowly adding to the basis of the future branch of science.

In this sense areography is a rare and pleasant exception. Three years ago it celebrated its tricentennial.

Areography is geography, only not of the earth (geo-) but of Mars, which is sometimes called by its Greek name, Ares.

To the only very weakly supported eye our neighbor seems uniformly

yellowish-red. Even through a telescope of average power we can make out curious and significant surface features.

In 1659 Huygens first made a sketch of the surface of Mars which he had seen. These rough outlines were in essence the first map of our neighbor and the year of observation was the birth date of areography.

Through the telescope it is quite clearly visible that approximately 5/6 of Mars' surface has the characteristic reddish-yellow hue. The general reddish-yellow background is broken by darker markings, very intricate in form. Large dark spots on the surface of Mars are called seas. And the principal red-yellow surface bears the name of mainlands or continents.

Hardly anyone has any doubt today that these designations are purely conventional. Over the spacious breadth of the Martian seas surge no mighty waves. Their bays beckon no storm-tattered vessels to the quiet shore. In the depths of the lakes — such are called the individual spots small in size — no golden fishes play.

As a matter of fact, our neighbor has no large basins of water which could be called seas in the terrestrial sense. The continual change in the outlines of the seas and their color change during the year prove this more convincingly than anything else.

But on the other hand the mainlands undoubtedly represent dry land — a broad, slightly undulant, waterless plain, only here and there raised up into isolated, not-too-high peaks.

Deserts on earth are colored in different yellowish-red tones from golden to blood-red. It is true that we have reddish soil — terra rossa — which is not found only in waterless places. Extensive regions of the tropics and subtropics also have a reddish tint. Whoever has been in Georgia in the Chakva region will remember that distinctive color. It is natural to take the orange-yellow spaces of the Martian

mainlands for sandy deserts, too, rich in oxides of iron or some other similar substance with this characteristic color.

The innumerable sandstorms which often cover the surface of Mars with a thick, dark shroud testify convincingly that its mainlands are not luxuriant subtropics, but a dry desert covered with rocks ground into powder.

In distinction to the mainlands the seas of Mars impress observers with a considerable variety of coloring.

During the Martian year they smoothly alter their coloration from light blue in winter to grayish-greenish in spring. By the beginning of summer green tones predominate in the seas. But then at times a brown coloring appears and gray-blue anew. By the time a new winter is in full swing the seas are again light bluish.

The seas on Mars occupy a quite definite position, but still from year to year their outlines change perceptibly. Eight years ago in the northern tropic zone of Mars there appeared, for example, a huge new dark spot with an area of about 600 thousand square kilometers! In other words, a sea has been spilled on the surface of our neighbor one and a half times larger in size than our Black Sea.

At that time, however, in all probability no catastrophes had occurred on Mars: a rather considerable section of the surface (about two percent) simply changed its coloring. There is nothing unusual for Mars in that, because every year areas considerably larger in area near the Martian poles change color regularly and according to a pattern.

In the winter months near the pole a huge white cap spreads at times covering up to 10 million square kilometers. With the advent of spring the white spot begins to decrease; and its borders contract to

the pole, at first slowly and then faster and faster. Having shrunk to its minimum by the end of summer, the polar spot then begins to grow anew, strictly following the change of seasons.

Right now there are practically no doubts that the polar caps of Mars consist of water congealed by the low winter temperatures. The heat of spring warms this wintry covering and the polar cap thaws, contracting before our eyes. The water formed moistens the soil and around the thawing cap is produced a characteristic dark belt.

In step with the thawing of the caps the amount of water increases and it flows farther and farther from the pole along the surface of the planet. But it does not flow in an even, dark cover, but in dark streams, surprising in their regularity, which have received the name of canals.

There are few mysteries in nature which evoke such admiration and astonishment as the Martian canals. A dense net of them is flung over the surface of the planet, not in random labyrinths of streamlets or fissures, but in a rigid network, as of a carefully thought out irrigation system. If we wanted to conduct water on earth by the shortest route from one point to another we would have to dig a canal along an arc of a great circle — a part of a circle with its center at the center of the earth.

However improbable that may be, all the canals on Mars do proceed along arcs of great circles. Not even one canal gets lost in the deserts of the Martian mainlands. They all begin and end in the seas, interconnecting them. Where two canals meet, a dark spot is always formed — junctions, as though the water brought by the canals abundantly wet the soil near their confluence.

The canals are of different length. The shortest of them stretches

for 400-500 kilometers. But some of them extend for five and a half thousand kilometers. The width of the canals is rather great — approximately 100 kilometers. It is quite obvious that even if the canals were actually connected with some hydraulic processes, their apparent breadth is not at all the surface of the water, but only the soil wet by this moisture.

In winter the canals are completely invisible. But as things warm up, as the ice or snow of the polar cap thaws, the net of canals begins to show up, as though appearing on a photographic plate. At first light shadows near the polar cap show through. The shadows coalesce and extend farther and farther, as though fed by a wave of moisture running from the pole. This wave runs rather swiftly, "developing" up to 3-4 kilometers of canal length per hour. The places in the seas, where the dark wave has managed to flow in its course along the canal, also begin to change their color, acquiring more and more sharply pronounced greenish tones.

When autumn sets in, the process unfolds in reverse order. The canals at the equator pale, beginning, as it were, to dry up, and the whole net gradually withdraws to the pole, completely disappearing by the beginning of winter. Together with the canals the seas also begin to fade. The greenish tints grow dim, a yellowishness appears, and then light-bluish-gray tones gradually prevail.

Contemplating the astoundingly regular and "reasonable" (from the point of view of irrigation) net of canals, we are hard put to it not to think that they have been consciously laid out by thinking creatures desirous of watering the parched soil. It is not surprising that from the very moment of their discovery, 85 years ago now, the mystery of the canals has excited everyone who even once in his life has viewed

Owing to the smallness of the force of gravity, pressure and density of the atmosphere on Mars drop considerably less slowly on direct ascent than they do over our planet. At the height of 25 kilometers the pressure of the Martian atmosphere is already equal to our pressure at that level. And at greater heights our neighbor's atmospheric pressure and density exceeds the earth's.

This structural feature of the gaseous envelope of the planet is fraught with many unpleasantnesses for future cosmonauts. We may expect, for example, that meteors falling on Mars will burst into flames at a height of 200-250 kilometers. Meanwhile, in the earth's atmosphere these blazes occur considerably later: only at 120-150 kilometers over the earth's surface.

All these data indubitably have great significance in elucidating the possibility of life on Mars. It would be considerably more important, however, but in addition also much more difficult, to clarify what gases the atmosphere of Mars might consist of.

Answering this question is incredibly complicated. We have up till now managed, you know, to examine the atmosphere of Mars only through the atmosphere of the earth. Put a little lamp behind a thick red glass and ask a comrade to ascertain whether the little lamp itself is painted red. He will turn out to be in a very difficult position. But the problems confronting astronomers are hundreds and thousands of times more complicated.

And nevertheless scholars have overcome them in great part.

Carbon dioxide was discovered before other gases in the atmosphere of Mars. It has turned out that there is approximately twice as much of it as in the terrestrial atmosphere. It constitutes in all, however, only a quarter of one percent of the total volume of gases above the

surface of the planet. On the other hand the lion's share — 98.5% — belongs to nitrogen. On earth there is also much nitrogen; it constitutes more than 78% of the volume of our atmosphere.

Scholars have particularly carefully searched for oxygen and water vapor in the Martian atmosphere. These searches have, however, not been too successful. Today it is hard to affirm categorically that there is no oxygen in the Martian atmosphere. But if there is any, the amount does not exceed 0.15% of that found in our atmosphere. The search for water vapor, moreover, has given no results.

We cannot say that the data make the partisans of life on Mars happy.

Life on Mars

We can nevertheless assume today with a high degree of truth that life exists on Mars!

If we concede that there are not only living but also thinking beings on Mars, the problem of whether life has originated on earth probably excites them.

And really from the point of view of a Martian the natural conditions on earth should be considered extremely unfavorable to life. Indeed, the atmosphere contains a huge amount of moisture hindering the process of respiration. A "colossal" oxygen content, a thousand times greater than the normal Martian content, would lead to a terrible acceleration of the processes of oxidation; a body would just burn right up from the excess oxygen. Finally, the incredible heat — the earth, you know, receives nearly two and a half times as much solar heat as Mars!

But from the point of view of the inhabitants of the earth the

conditions of life on Mars are just as unfavorable. The atmosphere is very rarefied. There is by far not enough water. There is no water vapor in the atmosphere, little oxygen. It is cold; the average yearly temperature on Mars is 23° below zero Centigrade.

And, nevertheless, if we soberly weigh all these circumstances, in no case are we able to assert that they make life on Mars impossible.

Let us begin with the simplest data. The cold. Yes, the climate on Mars is very rigorous. But in the warmest regions of Mars the average yearly temperature is around -10° C. Meanwhile, our temperature in Yakutia, for example, is -11° C. And it never enters anyone's head to say that life is impossible there.

In some regions of Siberia the thermometer goes down to -70° C. And on the Antarctic continent the climate is even more severe than that. Nevertheless in Siberia and on the Antarctic continent live both plants and animals. On Novaya Zemlya, for example, the cruel winters support different plants of more than a hundred sorts. On the high plateaus of the Pamir and T'ien-Shang the temperature at times drops abruptly from +20° to -20° C. Plants have adjusted themselves to these caprices of the weather: when there is a cold snap flowers curl up headlong and at the first rays of the sun they quickly unfold.

The rarefaction of the Martian atmosphere is not too dangerous for life either. Prof. S. M. Tokmachev created under the bell of pneumatic pump an atmosphere like that of Mars in the summer months. Here he put plants, worms, and insects. They had not had any prior "training." All the same, flies, ants, and worms successfully stood the test. Seeds of maize developed to full leaf. Specialists reckon that "under the organic conditions laid down the earth plants and

experimental living organisms could live on Mars."

Without doubt it is very important that there is so little water on Mars. There is little, but it is there. Perhaps we will not be able to discover extensive reservoirs of water on our neighbor in space, but lakes, marshes, and, finally, subsurface moisture which plants can absorb through their roots are quite likely there.

Today almost no one will any longer deny that there is life on Mars. A general opinion is that the huge expanses of the seas and the dark strips along the canals are nothing else but vegetation covering moistened soil. And the change in the color of the seas when the seasons change is connected with the blooming of the plants in spring and their fading in autumn.

The opinions of scholars on the nature of life on Mars differ, however. Some hold that only the simplest forms of life are possible there, like mosses and lichens. Others confidently say that flowers bloom and bushes grow green on Mars. Many are inclined to believe that very genuine trees, coniferous and leaf-bearing, grow in the Martian seas. And, finally, a few are convinced that rational life exists on our neighboring planet, surpassing our terrestrial life in many ways.

Proponents of the idea that Martians exist or in any case existed in the recent past adduce opinions which, in their opinion, are weighty. Here they are.

The canals of Mars are very reminiscent of artificial irrigation installations.

A new dark spot discovered by Slipher in 1954, almost as large as the Ukraine, obviously owes its appearance to vegetation. Whence indeed did such a grandiose tract appear so suddenly? Isn't that a

case about which G. A. Tikhov wrote, asserting that the unusual changes in the dark regions on Mars might indicate agricultural activity of its inhabitants?

In 1877 Mars was unexpectedly discovered to have satellites unknown to that time, Phobos and Deimos. Much earlier the prominent astronomers Herschel and Lassell had tried in vain to discover Martian satellites in the most powerful reflecting telescopes. But after 1877 the satellites were easily visible in considerably less powerful telescopes. Had they not appeared only recently? Whence?

The dimensions of Phobos and Deimos are very small. Their diameters are only 16 and 8 kilometers. Certain peculiarities of their motion permit us to think that they are hollow spheres. Weren't they created artificially by the inhabitants of Mars?

It is hard to deny that all these guesses are keen. But, unfortunately, it is also hard to call them more than surmises. But after all let us be patient. Let a few months pass and the mysteries of Mars will be in great part disclosed. And then, perhaps, will be disclosed many secrets not only Martian but also terrestrial.

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