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Problems of Mars Soil Bioremediation and Formation of the Atmosphere

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Abstract:- The problems of Mars soil bioremediation have been studied, taking into account such extreme factors, as the temperature, ionizing and ultra freezing, vibration, acceleration, etc. The use of microorganisms for bioremediation appears to be very perspective, as these microorganisms are distinguished by their large-scale distribution and a high ability to adaptation to the aggressive ecological factors. The experiments were carried out in the imitation climate chamber made by us, where the regulation of all Mars ecological factors took place by the use of specially constructed distant computer. It has been established that the vital boundaries of the biosphere, where the bacteria, actinomycetes, microscopic fungi, algae, the protozoa, etc. are really acting. Of particular interest is the fact that in the Mars superficial dust the zeolite has been observed, which is widely spread on the earth as specific rocks. It is supposed that the formation of these rocks in the prehistoric period of Red planet and terrestrial formation can be considered one of the stages of the planet's formation. It became possible to germinate wheat and bean seeds on the zeolite and the mixture of Mars soil and even to get the fruit. By the distance computer control of temperature (+30 – -200^{0}C), radiation and the atmosphere content on the Mars, the bioremediation of Mars "soil" was carried out in the imitation climate chamber. As a result, the bioorganic clusters were created. These are the first steps directed to the bioremediation for the rehabilitation of Mars soil and atmosphere.

***Keywords**:- Mars Soil, Microbiological Remediation of Mars Soil, Microorganisms, Adaptation to Mars Ecological Factors.*

During the last period the Red planet is of great interest for astronomers and astrobiologists, which is due to two main problems: Mars can become a classical model for the formation and bioremediation of "living planet". Based on the theoretical considerations, it is supposed that in perspective, as on the earth, the bioremediation will begin from the pre-formation of Mars soil, followed by the formation of living organisms, and as a result, the formation of the atmosphere, and water existence remains a problem. A number of new directions developed in the cosmic biology, in the most part of which the impact of cosmic extreme factors on living organisms on the planets and in free space. The study of their action will be possible by the use of biochemical, biophysical, microbiological and ecological methods of investigation.

Among the cosmic extreme factors low and high temperatures, ionizing and ultraviolet radiation, gases, water, freezing, vibration, acceleration, etc. are the principal. Unfortunately, the modeling of a number of extreme factors are pretty complicated in laboratory conditions. As to living organisms, the experiments on the microorganisms appear to be very perspective, which are distinguished by their large scale distribution and a high ability to the adaptation to aggressive ecological factors. Of course, the genome of those organisms is of particular interest, which are adapted to the extreme factors and those regulatory genes, which may be used in the perspective.

The vital boundaries of the biosphere, outside of which the life is practically excluded should also be taken into account,. In the above said boundaries of the biosphere the bacteria, actinomycetes, microscopic fungi, a number of algae and protozoa are really acting. Unfortunately, to establish the upper border of the biosphere because of its contamination by the stratostats (for example, "Explorer II") appeared to be not so simple. At an altitude of 20 km from the earth the sporadic bacteria and microscopic fungi have been observed. It is difficult to believe that at this altitude there is a habitat desired for the microorganisms. Therefore, the problem of their existence and origin practically still remains a mystery. The fact is that in the extreme conditions of the atmosphere (low temperature, ultraviolet rays and ionizing radiation) they retain their ability to life. Based on our data, not only in the atmosphere, but in artificially made soil of Mars, where the multiplication of pathogenic bacteria is impossible, during several months after the creation of appropriate conditions, they are easily subjected to the multiplication. According to the analysis studied by distant control of Mars soil, there are presented 10 earth mineral substances: SiO_2, Na_20, $Mg0$, Al_20_3, SO_3, Cl, K_20, CaO, TiO_2, and FeO. Of particular interest is the fact that the zeolite has been observed in the Mars superficial dust [1], which is widely spread on the earth as specific rocks [2]. We supposed that the formation of these rocks in the prehistoric period of Red planet and terrestrial formation can be considered as one of the stages of the planet's formation. This opinion was further strengthened, when a comparative analysis of Mars and earth zeolite chemical content was done.

As is known, zeolite appears to be a volcano-clastic silicate and is created after the transformation of basaltic rocks. Zeolite is a water-containing tectosilicate. Its formula is:

$$[R(2.42)Na(1.05)]3.47[Ca(0.92)Mg(0.5)]1.42[Si(29.55)Al(6.49)36.04[H_20(9.95)] \ldots\ldots (1)$$

On the earth, as well as on Mars, the zeolites are supposedly created from dust sediments as dense zeolite aggregates far from the volcanic center in the subaqual environment in the sea basins having various salinities. It once again indicates the necessity of water existence for the zeolite formation on Mars. Based on the data received from Mars-rover “Opportunity”, the areas covered with water should be in the *Meridian Lane* zone [3]. The life has been originated in water and there is no life without water. Therefore, it is naturally that in the investigations on life existence on Mars, a central place should be given to the existence of water and the subjects of its origination.

According to the data, obtained from Mars-rover “Spirit”, probably there have been water and hot water sources on this planet, which is indicated by the existence of the sediments of volcanic origin and white soil, the 91% of which is silica [4]. The formation of such pure silica is possible only in the presence of water. The formation of silica on the earth was shown in conditions of the impact of hot water on granite of rocky rocks. Water is also necessary for the formation of sulfates that also indicate the existence of water on Mars. The formation of ferumoxide, discovered on Mars, is also impossible without water. These facts once again corroborate the existence of water on Mars, in particular in “Gusev’s crater” [5]. The grooved surface of the planet should be caused by the existence of water and ice streams. The ruining of superficial rocks, erosive and tectonic changes in the landscape are related to the occurrence of subterranean waters on Mars. Probably, because of a low atmospheric pressure on Mars (pressure is 160 times lower), the drying out of waters should take place, and a part of it should be turned into ice. In the lower layers of Mars the flow of liquid water should be noted [6].

Based on the data of National Aeronautics and Space Administration of the USA (NASA), in deeply located layers of Red planet a great stock of frozen water had been observed, which was recorded by spacecraft „Mars Odyssey. It is true that the existence of water and life on Mars still is on a fantasy level, but many optimistic researchers think that these questions will be answered in the nearest future.

It is noteworthy that some organic substances were discovered on the moon, nebulas, asteroids and comets. The synthesis of abiogenically amino acids, nucleotides, peptides and nucleonic acids at the expense of electric discharges and natural radiation energy is experimentally proved. According to the data of Fox et al. glycine, alanine, glutamate, aspartate, serine and threonine have been discovered on the moon, practically the whole_gamma of amino acids, which may provide the formation of biopolymers having catalytic ability at the level of coacervates. They provide the formation of specific substances metabolism, necessary for a stepwise development of life.

As to the lower border of the biosphere, unfortunately, we have no opportunity to make final conclusions. For example, the living microorganisms were discovered in the depth of 11 km of the earth, where the pressure exceeds 1100 k^2/cm^2. The purple sulfur bacteria were also discovered in the underground oil waters [6, 7]. It is also noteworthy that the process of biorecovery of sulfur to hydrogen sulphide actively takes place in the environment. By means of the microorganisms this process is directed by two simultaneous ways: the formation of hydrogen sulphide from sulfur and then by the connection of hydrogen sulphide to iron, which is released in the recovered form (FeS). The latter gives a black coloring to the soil. The anaerobic processes actively take place in the soil. For example, the iron (Fe) oxidation to hydrate of oxidized iron took place by the participation of anaerobic bacterium *Sporovibrio ferooxidans*. The following microorganisms *Aspergillus niger*, *Azotobacter chroococcum, Corynebacterium auranticum Lactobacillus avabinosus*, *Pseudomonas sp.*, *Penicillium*, etc. play an important role in the mineralization of N, C, P, K, Mn, As, Zn elements. Still in 1913 M. Beijerinck has shown that fungi and bacteria oxidize manganeze carbonate ($MnCO_3$) into manganeze oxide (Mn_20_3). It has been established that the following fungi *Currularia brachyspora*, *C. inoequalis*, *Periconia circunala* participate in the process of oxidation of divalent manganum into trivalent manganum. The microorganisms which are easily multiplicated in conditions of a high temperature - $75\text{-}90^0$ (geysers, hot waters) were also discovered. The enzymes of thermophilic bacterial origin adapted to high temperature actively participate even in conditions of 100^0C, while the action of enzymes of mesophilic and psychrophilic organisms practically are maximally inhibited because of protein denaturation. The reason for thermostability can be an amino acidic specific content of proteins, hydrogen and electrostatic bonds, which compose 20.9-41.8 kJ/ mol of free energy. The distribution of hydrophilic and hydrophobic groups and a high structural organization of proteins with a minimum entropy are also variable in proteins.

The primary structure of the protein can be essentially changed by changing several amino acids, and relatively its thermostability. So, the change in one or several amino acids in the primary structure of the protein is a relatively simple evolutionary process for receiving protein with thermophilic properties. There is an experimentally proved opinion that polyamines and chaperones actively participate in the thermoresistence of the apparatus, synthesizing the protein of thermophilic bacterium, and a thermal denaturation of proteins is already observed without them at 50^0C.

A leading role of hydrogen bonds in the thermostability should not be forgotten. We should remember that nucleinic acids rich in G-C pairs of nucleotides appear to be more thermostable, because of the existence of three hydrogen bonds, as compared with the nucleinic acids rich in A-T pairs of two hydrogen bonds.

The period of protein semi decay also correlates with the thermostability. And finally, of course, it is necessary to recall a leading role of glycolization and lipidization (liquid-crystal condition) in protein thermostability. All the phenomena, determining the thermostability, which correlates with the thermostability of high molecular polymers in the process of evolution, should be considered as the determining elements of adaptation of the organism to the environment, including the multiplication of barotolerant bacteria in conditions of 400 atmospheric pressure, revealed in the seas.

Many types of bacteria tolerant to the acids have also been discovered. For example, *Thiobacillus thioparus* and other bacteria of this type are intensively multiplicated in conditions of acidic medium (pH 1). The bacteria revealed in the rocked containing sulfides are multiplicated even in strong acidic (pH 0.5) conditions. A number of prokaryotes and eukaryotes are normally developed in conditions of alcalic soil, when pH varies within the limits of 8-9. In the residual waters of the leather industry the microorganism *Bacillus mesentericus* is multiplicated in conditions of pH 11.

Based on our data, pH of Mars soil varies within the limits of 8-9. Therefore, the opportunity of multiplication of the bacteria tolerant to alcalic medium in conditions of Mars soil should not been excluded. The bacteria also display some tolerance to the gases. For example, *Polychaeta, bivalve mollusks (Bivalvia), sea cucumbers (Holothurioidea),* etc. actively inhabit at the depth of 10.000 m in the ocean, where the content of oxygen is minimal.

As is seen, we should have a new vision on the possible existence of living organisms on the alien planets. Based on the latest data, life has been revealed in such extreme conditions, where, in our opinion, the existence of life is hardly believed, as a great variation of hydrogen ions concentration is observed in the environment and there is a minimal amount of oxygen in waters and soil. It should be taken into account that a lot of bacteria use the following substances – hydrogen, sulfur-hydrogen, methane, carbon dioxide, nitrogen, etc., as "food", the affinity of which is revealed on many planets. At the same time, the fact that the microorganisms display a special tolerance to such extreme factors, as ultraviolet and ionizing radiation.

Thus, it is presumably that the terminal areas of the biosphere inhabited by the microorganisms should participate in the cycle of substances, the formation of the soil and biosphere. It should probably be considered a classical model of life formation on the planets.

The possibility of realization of adaptive mechanisms of living organisms against the background of extreme factors is of great interest. It has been established that in conditions of the growth of environment pressure the sensitivity to a high temperature significantly decreases. The plants grown in conditions of water deficiency easily adapt to the environment factors. Synergism or antagonism may be revealed in conditions of various factors, which has experimentally been proved in climate stations during the acclimatization to abiogenic factors. The important results were also obtained on the model "artificial Mars", while taking into account the abiogenic conditions existing on Mars.

From the point of view of bioregulation, among many extreme factors existing in the space, the temperature, water, a chemical content of soil and space internal area, ionizing and ultraviolet radiation, and the vacuum are of great interest for cosmobiology.

Low and high temperatures are those extreme factors, which fundamentally determine the existence of living organisms and their resettlement on the earth. Surprisingly, but the fact is that there are the microorganisms on the earth, which are tolerant to -270^0C. A number of species of the higher plants existing on the earth are tolerant to -10, -20^0C, and even to -50^0C. There are some microorganisms which easily maintain their viability in conditions of -270^0C by anabiosis, despite they have not underwent the impact of such a temperature during the last few million years.

The proteins having anti freezing properties and low molecular substances, as well as a quantitative distribution of free, bound water and sugars, etc. have a significant importance in the plants resistant to low temperature. It is known that the bound water unlike the free water does not freeze even at -20^0C. This prevents the cell from a damaging impact of ice crystals created at the expense of free water. As it turned out in conditions of a low temperature, the formation of damaging ice crystals is due to specific proteins of bacterial origin, which have the function of crystallization center, followed by the formation of ice crystals and the damage to the tissue of plants and membrane organelles. As a result of this a cell necrosis is formed. The same is indicated by the fact that a plant, grown in sterile conditions is more tolerant to the frost, as compared to those grown in natural conditions. The plant mutants which do not synthesize the proteins, which have the function of crystallization center are distinguished by a high endurance to frost.

As to sugars, the frost-resistance also increases by their infiltration in the leaves. Based on our experiments, in this regard, glucose, fructose, their spirits and oligosaccharides appear to be the most effective. There is an opinion on a particular importance of sugars osmotic effect in frost-resistant plants, which significantly prevents the formation of ice crystals in the vacuoles.

In some plants the substances having anti-freezing properties, free glycerol and multi-atomic spirits, sorbitol, mannitol have been discovered in small quantities, while in others, for example, in pomegranate, apple, gardenia and in the fruits of other plants the content of spirits exceeds the total amount of sugars by 35%.

The anti-freezing proteins significantly increase the frost-resistence of transgenic plants (e.g. tobacco). The anti-freezing proteins belong to the class of those polypeptides, by means of which the ability to frost-resistance increases. The formation of ice crystals and their damaging effect are inhibited by the impact of anti-freezing proteins. Currently, the transgenic plants, in which the biosynthesis of anti-freezing proteins intensively takes place, are created. This causes a great interest regarding the resettlement of plants on Mars.

Later a coding gene pAFP149 of anti-freezing protein was discovered in tobacco cell wall. As a result of its action, the gene-modified tobacco maintains its native structure even in conditions of very low temperatures, as compared to a wild plant of tobacco.

In conditions of low temperature according to the activity of enzyme catalase and superoxide dismutase protecting from a damage evoked by an oxidation stress, the various plants sharply differ. For example, as a result of the processing of seeds with hydrogen peroxide, the endurance of plants to frost increases, which correlates with an enhanced expression of coding gene of enzyme catalase and a sharp increase of the activity of enzyme catalase [8, 9]. It should be assumed that the adaptation of the microorganisms to a low temperature and the relevant changes in their genome should have been implemented as early as during the Ice Age in the first days of life on the Earth. However, the possibility of introducing the life from another planet should not be excluded.

Naturally, the question arises about the type of life formation or in which form the life on the extraterrestrial terrains, for example, on Mars will take place. Of course, the thinking about it is still at the level of fantasy, but the fact that the life has been discovered on the earth without the sun and oxygen, indicates a lot. Taking into account the considerations about the origin of life on the earth, perhaps, bacteria were the first living organisms there, which after the evolution during 1.9 milliard years were followed by the biotransformation of the space, the formation of the earth soil and the atmosphere. Currently, the synthesis of amino acids, nucleotides, proteins and nucleonic acids by means of the abiogenic mechanisms at the expense of electric discharges and the energy of natural radiation is experimentally proved. As a result, the biopolymers having a catalytic ability are created at the level of coacervates, and the formation of the metabolism of specific substances necessary for life will take place. It is interesting if there is a life on Mars, where day-night temperature varies between $+20^0$C and -120^0C. Proceeding from the currently existing scientific information, the only prerequisite of the possible existence of living organisms appears to be a short anabiotic periodicity of life, which, based on the conditions existing on the earth, may be implemented on the level of microorganisms. It is known that bacteria, yeasts, microscopic fungi, algae protozoa, larvae, insects, human sperm and some higher plants maintain their viability at -190^0C in conditions of fast freezing. Some bacteria and human sperm are tolerant even in conditions of absolute zero [10, 11]. It is also noteworthy that the bacteria, which are absorbed at the satellites and spacecrafts are also tolerant to low temperature in the space. This fact speaks that the bacteria of terrestrial origin, introduced by cosmic objects, have been revealed on the moon. Based on our data, Mars soil is not bactericidal. After the seeding of microorganisms and re-seeding to proper incubation area they maintain the ability to multiplication. The microscopic fungi are also resistant to low temperatures (-252^0C):

- -269 - -269.5^0C – spirochetes and trypanosomes
- -197^0C - protozoa
- -253^0C - black currant, birch [12]
- 195^0C – silk worm [13]
- -150^0C – Escherichia coli [14]

Regarding the bioremediation, the plants tolerant to low temperatures are of special interest. For example, the seedlings of black currant were acclimatized to -195^0C and -253^0C. As a result of the exposition, the formation of such a tolerance to low temperature is difficult to explain. The possible mutation is also less reliable. Perhaps, this phenomenon may be explained by an enhanced synthesis of the substances having anti freezing property as a result of the re-programming of metabolic processes.

The technology of freezing for the maintenance of vital signs is very important, which means a fast and delayed freezing or their combination. A multiple freezing-defrosting processes negatively impact on the maintenance of vital signs. In these conditions a great part of living organisms lose the ability to bioregeneration . The reason for this is the formation of water crystals in the cells, which significantly damage the membranes. Organelles and cells, and as a result of it, the living organisms die. The creation of intracellular water crystals does not occur in the conditions of vitrification, when the creation of separate water crystals is retained. Because of it water maintains an amorphic condition. Such a phenomenon is characteristic of bacteria having a small sized surface. In these conditions the creation of crystals does not take place in the cell.

Some representatives of homoitropic species of the fauna are distinguished by their endurance to a low temperature (polar bear, penguin, and fish). They easily get food and are adapted to -20, -50^{0}C. As to the higher plants and poikilothermic animals, they hardly adapt to a low temperature. Just in the Antarktica have been revealed psychopilic microorganisms, which are well grown in -6^{0}C and -9^{0}C conditions. It is also noteworthy the snow fauna and flora in the Himalaya Mountains (6000 m above sea level): snow flies *(Chiona*) and spiders (*Hypogstra*, *Poistoma*) that are quite normally developed in conditions of -5^0 and -17^{0}C. Red yeasts and microscopic fungi grow up and create spores in -37^0 and -44^{0}C conditions. It should be also noted that the coloring of snow and ice, presumably, is due to pigmented microorganisms or cyanobacteria [15, 16]. It has been shown that freezing temperature can be reduced by a significant increase of the amount of mineral substances and sugars in the nutrient medium.

The fact should be also taken into account that high-mountain flora and fauna are adapted to such aggressive abiogenic cosmic factors, as are the vacuum, ultraviolet rays and ionizing radiation. Vacuum appears to be a typical cosmic stress factor, the implementation of which is impossible on the earth up today (10-16 mm Hg). The modern equipments allow us to vary within the limits of -190^{0}C and +120^{0}C in vacuum conditions and in such conditions the experiments can last for years. The great value experimental data were obtained, on the basis of which the significant conclusions were made [17]:

- The bacteria creating spores maintain their vital ability during 5 years in conditions of a deep vacuum, the *Bac. subtilis* spores are distinguished by a special endurance.
- Non-spore bacteria are distinguished by a low sustainability to the vacuum.
- The algae, Aspergillus conidia and fungi micelles show a high sustainability to the vacuum.
- The cells located in the vacuum are especially sensitive to ultraviolet rays and radiation.

The enzymes show a definite sensitivity to the vacuum, though there are the exceptions. For example, the bacteria of alcohol fermentation maintain the ability to glucose oxidation and ATP synthesis in vacuum conditions. The activity of ferro-porfiric proteins of the same species bacteria decreased for 14-32%. Deep vacuum had practically no impact on trypsin, peroxidase, cytochrome-C. However, a partial inhibition of the activity of catalase, ribonuclease, α-amilase and urease is observed. Today it is difficult to suppose which mechanism underlies this event, though it is most likely that such changes are due to hydrating water evaporation and those structural changes, which leads to disorder of enzyme-substrate complex formation, as well as the reduction of the collision speed between the enzyme and substrate.

Ultraviolet radiation is considered to be one of the aggressive factors. As is known, only a small part of ultraviolet rays reaches the earth, as they are intensively absorbed by ozone layer, atmospheric water vapor and dust particles. It is also noteworthy that the microorganisms containing pigments are distinguished by a high tolerance to ultraviolet rays.

There are a lot of colonies of bacteria and fungi in the earth atmosphere, which are distinguished by yellow, orange, red, green, brown, violet and black coloring. Among pigments the carotenoids and melanins are represented in abundance, which practically protect them from the damage by ultraviolet rays.

A protective nature of pigments from ultraviolet rays is also confirmed by the fact that the bacteria spread in the soil of high-mountain regions and desert have a dark coloring with a high ability to pigment synthesis. Just by this fact is conditioned a wide spread of such coloring bacteria at 4000-5000 m above the earth. By means of pigments, they are protected from the radiation through the absorption of light quanta. As is seen, polysaccharides also significantly protect the bacteria from a harmful damage of ultraviolet rays (e.g. *Bacillus mucilaginesum*). The sensitivity of bacteria to ultraviolet rays depends on their functional condition, for example, bacteria are especially sensitive to ultraviolet rays in active division phase. In resting state they show less sensitivity to ultraviolet rays. The sensitivity to ultraviolet rays changes in a wide range in the same species. Such a difference often exceeds 300 in *Rhodotorula* yeasts. Red yeasts are distinguished in this regard. The endurance to ultraviolet rays maybe even developed by a periodic short irradiation (adaptive function), which will be realized on the example of *Rhodotorula*. For years this bacteria could stand $38.5x10^3$ erg/mm^2 after the radiation by 253.4 nm length waves on Bodo Marina, while the endurance of control ones could stand only $21.75x10^3$ erg/mm^2.

Based on our data, in the conditions of radiation and the dynamics of temperature changes, an intensive multiplication of sulfur and iron took place in Mars model chamber (Georgian Patent N 12522/01, 2012). In our opinion, it should be a result of mutation during adaptation, furthermore, the changes in coloring obviously are morphologically seen. The final conclusion can only be made after the morphological and genetic analysis.

There is an opinion that Mars dust can also protect plants from a negative impact of ultraviolet rays. This conclusion was made after the covering of *Bacillus cereus* by a thick layer of 800^{a0} chromium. Spores maintain their ability to multiplication even in conditions of $7.8x10^7$ erg/sm^2 [18].

Naturally, the question arises regarding the endurance of plants to ionizing radiation, which is directly related to the possibility of life on Mars. We should recall that the microorganisms isolated from radioactive waters are 5-10 times more tolerant to radioactivity, as compared to the microorganisms of the same species isolated from natural non-radioactive waters. As it seems, in case of the microorganisms, which are tolerant to radiation, we are dealing with the re-programming of substance metabolism [19]. The similar bacteria were isolated from radioactive soils and the waters of nuclear reactors, where the radiation level exceeded million of pags *(Micrococcus radiodurans*). The bacteria show different features also to and β particles. The non-pigment forms of the microorganisms (*Gliochadium fimbriatum*) are distinguished by a special high sensitivity to radioactive -rays.

Bactericidal effect depends not on radiation intensity, but on a dose absorbed by the organism. Based on the above-said, the term "A relative biological effect" is used in radiobiology.

From the point of astrobiology, the biology of xerophytes is also very interesting. The question is how tolerant will be the bacteria, microorganisms and higher plants in conditions of water deficit. Some higher plants, for example, *Myrothamnus flabelliafolia* maintain the ability to growth in xerophytic conditions for a long time [20]. Also the dried microorganisms in herbarium have shown the viability for 200-300 years. In nature such organisms have been revealed, which even in conditions of total water deficit maintain the ability to "revive". Such a condition was called as "hidden (secretive) life", nonhydrobiosis or xeroanabiosis (life without water). It once again indicates that xeroanabiosis or another form of adaptation can become a necessary prerequisite of the settlement and multiplication of specific nature microorganisms on Mars for the bioremediation and terraformation of Mars soil [21].

Although anabiosis phenomenon has been discovered in the 18th century, despite its general biological importance it has not yet been given a proper assessment. In the perspective, just by means of anabiotic microorganisms the bioremediation of Mars soil and its complete terrestrial formation will occur in Mars strict conditions and large scale temperature changes. In distant future anabiosis will gain a great theoretical and practical significance for the space exploration. It appears to be such a combination of time and space, when the biological time is practically stopped. Along with other materials, the photos taken on "Mars Orbiter", "Athfinder", "Vikings", "Spirit" and "Opportunity" rovers have been used. It gave us the possibility to make our own corrections in the selection of substances of supposed Mars soil content.

As is seen in the below figure, two weeks later after mixing Mars immitated soil with the microbiological nutrient medium, the flakes of rust color of iron bacteria have been observed on the surface. White color formation appears to be fungal hyphae, the development of which would be impossible, if under the impact of cyanobacteria the organic substances would not been accumulated in Mars soil. At this stage we did not create water deficit. In our opinion, a photo synthesis of cyanobacteria has conditioned the accumulation of sugars; iron-consisting minerals were absorbed by iron-bacteria, silicates - by silico bacteria. As a result, it became possible to develop a certain species of fungi. Based on the above-said, a conclusion has been made that only in conditions of systemic action of various bacteria, an aimed bioremediation of Mars soil and its use is possible for creation of proper conditions for plant development.

Plant development directly on Mars soil is related to great difficulties. It is necessary to enrich the soil with the substrates for transforming bacteria, by means of which it will be possible to biochemically transform of Mars soil and the accumulation of substances for the plants. The development of iron-bacteria (*Leptothrix spp., Acidithiobacillus ferroxidants*), silico- and sulfur bacteria on Mars innitiated soil is shown in the figure.

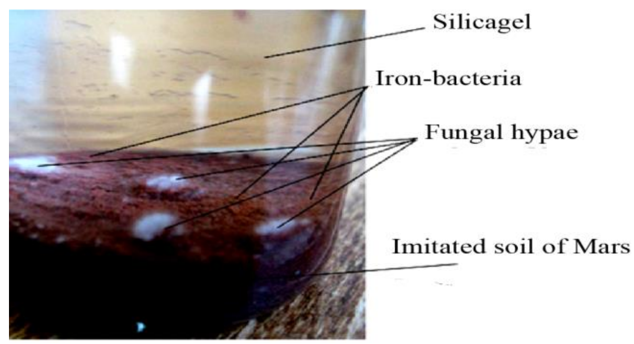

Fig 1:- The development of iron-bacteria, sulfur bacteria and fungal hyphae on Mars initiated soil in conditions of -20^{0}C temperature and the radiation on Mars in remote management in imitation climatic chamber ("Georgian Patent " # 12522/01,20)

As it is seen from the figure, initiated soil of Mars is not bacteriocidic and the bacteria are rather well multiplicated and maintain the vital ability, followed by the bioremediation of Mars soil and formation of bioorganic masses.

Fig 2:- The bioremediation of Mars "soil" with iron-bacteria (*Leptothrix spp., Acidithiobacillus ferroxidants*), silico- and sulfur bacteria (*Nitrosomonas, Nitrosospira spp.)* .

Also it should be taken into account that in Mars soils are presented not only rocks, but the products of their decay – oxides, sulfates and other type compounds. Based on various substances and rocks on Mars soil we have supposed that there is zeolite on Mars, which lately has been discovered in the dust of Mars surface. As zeolites appear to be of hydrothermic origin, we have also supposed that there should be water on Mars. This supposition was confirmed recently. The below figure clearly shows that wheat and been seeds are well germinated and developed by mixing Mars soil and zeolites. This indicates that by mixing zeolites and Mars soil in conditions of the affinity of microorganisms, it seems to be perspective to produce such vital products, as wheat and beans rich in proteins.

Fig 3:- By mixing zeolites and Mars soil in conditions of the affinity of microorganisms, the germination and development of wheat and beans, rich in proteins were shown

We think that the continuation of scientific-research works will bring us to the desired results in the near future.

CONCLUSION

The possibility of birth of anabiotic life on the red planet Mars has been considered. In conditions of Mars abiogenic (abiotic) factors the bioremediation and its full terrestrial formation will be performed by means of sulfur, iron and earth rust, which have anabiotic ability and is adapted to temperature fluctuations and irradiation.

REFERENCES

[1]. Httpwww.agu.otg/cgi-bin/sFgate/sFgate@listenv=table »multipl= »range.29.05.2008.
[2]. Proc. Of All. Union Sci. And Technical Conf. On Extraction, Processing and Utilization of Natural Zeolites. Georgia, Gori, 1986.
[3]. http ://galspace.spb.ru/nature.file/prmars.Itml.
[4]. http://x-mass.ru/articles.5.html.
[5]. http://nature.web.ru/db/msg.html.mid=1179559.
[6]. Fox S.W. et al. (1970). Bioorganic compounds and glassy microparticles in lunar fires and other material. Science, 167, 667-675.
[7]. Isachenko B.L. (1951). Selected works, 2. M.,-L., The publishing house of the USSR, 213 (in Russian).
[8]. Malyshev V.T., Malyants A.A. (1935(). Sulfur bacteria in plastic « pink » waters of Surakhan oil field and its significance in water geochemistry. Reports of Academy of Sciences of the USSR, 3, 221-2327 (in Russian).
[9]. E. Ashworth. Error! Hyperlink reference not valid..
[10]. Belehradek (1935). Temperature and living matter. Borntraeger, 200.
[11]. Jahnet F. (1938). Uber das Uberleben von Trypanosomon und Rekurrenzspirochaeten nach Abkuhlung in flussingem Helium bis -269.5oC d.i. vom absoluten Nullpunkten entfernt. Z. Immunitatforschung. 94 :328-339.
[12]. Timanov I.I. (1953). Frost resistance of fruit trees. Proceed. of Academy of Sciences of the USSR, biological series, 3, 459-470.`
[13]. Sakai A. (1967). Survival of Plant Tissue at Super-low Temperature by Rapid Cooling and nRewarming. Proc. Internat. Conf. Low Temperature Sci., Sapporo, 2:119-128.
[14]. Nei T., Araki T., Matsusaka T, (1967). The Mechanism of Cellular Injury by Freezing in Microorganisms. Proc. Ingternat. Conf. Low Temperature Sci., Sapporo, 2:157168.
[15]. Babieva I.L., Golubev V.I. (1969). Psychrophilic yeasts in the oases of Antarctica. Microbiology, 38, 518-524 (in Russian).
[16]. Gollerbach M.M., Sochava V.B. (1956). The glaciers and snowfields. In: Vegetation cover of the USSR. II, M., "Nauka", 835 (in Russian).
[17]. Imshenetski A.A. (1975). Biological effects of extreme conditions of the environment. The basics of cosmic biology and medicine. The Publishing House "Nauka", M., 500 (in Russian).
[18]. Solntseva I.O. (1967). The resistence of mountain strains of yeast-like organisms to ultraviolet radiation. Collection of scientific works of Institute of inland waters, 14, 84-88 (in Russian).
[19]. Kiselyov P.N., Kashkin K.P., Boltax Yu.B., Vitovskaya G.A. (1961). Acquisition of radioresistense by the cell when living in an environment with a high level of natural radiation. Microbiology, 30, 20-30 (in Russian).
[20]. Aleksidze N., Tarasashvili M. (2010). The biochemical mechanisms of living organisms adaptation to water deficiency. Metsniereba da technologiebi, 4-6, 20-31 (in Georgian).