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Preservation of the Biosphere - The Basis for the Saving Civilization

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Abstract: The development of civilization has occurred and is taking place with the unprecedented destruction of natural ecosystems and the rapid reduction of biodiversity. Only in the last quarter of the XX century, due to serious global changes occurring at a high speed, the question of the limits of destruction and the role of natural ecosystems and life in the biosphere was raised. Unfortunately, until now, science and technology are aimed at maximizing the exploitation of natural resources, meeting the needs of man and society at any cost — the consequences of such an impact have led to an environmental crisis. Natural ecosystems form and manage the environment, but the permissible limit of their destruction has already been passed. Further total harmful effects will lead to the final loss of the stability of the environment and life in general, and, consequently, there will be a problem of the survival of civilization and man as a species. Technical landscapes of production, the destruction of life in entire regions, the negative fruits of human technical impact on the environment — it becomes vital to change the nature of human relations with nature. Vernadsky was one of the first to write "Man destroyed the virgin nature. He introduced into it a lot of previously unknown chemical compounds and life forms — cultural breeds of animals and plants. He changed the course of all geochemical reactions." Even the great philosophers of antiquity taught that "one can command nature only by obeying its laws."

Keywords: Anthropogenic Influences, Signaling Molecules, Ecological Crisis

1. Introduction

The global ecosystem is one – it is the biosphere, it is the largest and most sustainable ecosystem. The biosphere is the outer shell of the Earth, which includes the atmosphere before the ozone layer, the entire hydrosphere and the upper part of the lithosphere. A huge number of living organisms and synthetic chemicals circulate in the biosphere [1]. Vernadsky V. I. the first emphasized: "Man has destroyed virgin nature. He introduced into it a lot of previously unknown chemical compounds and life forms - cultural breeds of animals and plants. It changed the course of all geochemical reactions. The face of the planet has become new and has come to a state of incessant upheaval" [2]. The formation in the future of a civilization capable of resolving the contradictions between nature and society, i.e. resolving these contradictions and observing the laws of the biosphere, should create a new strategy for the safe existence of mankind within the framework of sustainable development. The main task of sustainable development is the need to develop an ecological economy. Economic decisions should be made taking into account the reproduction of natural resources and other restrictions of the natural environment. Currently, anthropogenic influences on nature have jeopardized the normal implementation of its inherent biotic processes of reproduction of living matter and energy and information accumulated in it and has generated a conflict between society and nature - the strategic goal of state policy in the field of ecology is the preservation of natural systems, for the stable development of society and ensuring the environmental safety of the country [3].

2. Anthropogenic Influences on Civilization

A person may find himself helpless in the face of the oncoming infections caused by antibiotic-resistant pathogens and viral pandemics, which leads to an increase in morbidity and mortality from infections. In 2010, nearly half a million people were infected with a strain of tuberculosis resistant to a large number of antibiotics. As a result, a third of those infected died. At the same time, the UK has not signed a convention banning the testing of biological weapons, and the US has created about 600 laboratories around the world that are engaged in military projects related to virology issues. Advocates of democracy are evil to the world. Biological threat, as the tip of the iceberg, demonstrated in today's Covid-19 pandemic that bioviruses or bioweapons can hit humanity, create irreversible processes. Whoever initiated the launch of even more harmful viruses, he is not able to predict the consequences that can be fatal to civilization [4].

According to IPBES experts, in the coming decades, a tenth of all currently existing species of plants and animals will disappear. More than 40 percent of amphibians, 33 percent of reef corals and more than a third of marine mammals are threatened. Also at risk almost a quarter of all terrestrial species. According to IPBES, people have changed the face of 75 percent of the land and affected 40 percent of the oceans. Today, more than a third of the surface is used for agriculture, mainly growing plants and grazing livestock. About a third of commercial fish are caught excessively. In total, people produce up to 60 billion tons of renewable and non-renewable resources annually. This is twice as much as half a century ago. According to the work of American and Chinese scientists, the populations of many modern endangered vertebrates began to decline sharply at the end of the XIX century, when industrialization began in most countries of the world. It was summarized that the number of endangered animals decreases by 25 percent every ten years. At the same time, today the average population size of endangered species is only five percent of their number in the XIX century.

But it is impossible not to take into account the ecological catastrophe at the level of microorganisms. Microorganisms are constant companions not only of humans and animals, but also of higher plants. Currently, infectious diseases continue to cause significant damage to humanity. The biological threat associated with infectious diseases and their pathogens hangs over the entire planet, taking on the global character of the epidemiological potential of pathogenic microorganisms. In particular, among the 51 million people who die annually in the world, almost 17 million die from infections, while 9.7 million people die from cardiovascular diseases.

Pollutants of the atmosphere, hydrosphere and soils lead to the ingress of harmful substances into food chains, including those in which the final consumer is a person. Modern civilization, formed within the biosphere, has created many technologies that destroy it. The cascade of global crises that have hit the world since the end of the twentieth century indicates the beginning of a new spiral in the ten-thousand-year history of civilization.

3. Microbioplant Interactions (RMC)

3.1. Biofilm and Symbiosis in the Soil

The history of the biosphere is the history of microorganisms [5]. Prokaryotes constitute a special kingdom of living beings, they were the first inhabitants of the Earth, and they formed the biogeochemical system that remained the basis of the processes taking place on the surface of the Earth. This system determines the sustainable development of the biosphere.

Soil as a habitat of organisms is a heterogeneous three-phase system, including soil air, soil moisture, mineral particles. As a result of the activity of living organisms, dead organic matter - humus - and a living mass of roots and microorganisms are added to the soil [6].

Currently, it is shown that simultaneously with terrestrial plants in the soil formed a world of soil microorganisms. The development of microorganisms occurred not in the form of individual planktonic forms, but in the form of various kinds of clusters and structured biofilms and symbiosis of plants and microorganisms [7].

Plants have a substrate (rhizospheric microorganisms) and an above-ground part (epiphytic microorganisms) (Figure 1). The substrate part is located in the soil and is in continuous contact with soil microorganisms fungi, actinomycetes, bacteria, viruses and phages that can penetrate the roots or colonize the surface of the roots. The joint development of bacteria of the genus *Rhizobium* and plants of the legume family, as well as mycorrhizal fungi, actinorises and a variety of plants is a common example of symbiosis. The number of microorganisms in the rhizosphere can exceed their number in the surrounding soil from a few percent to tens of percent and even by an order of magnitude and can range from millions to hundreds of billions of cells per gram of dry soil. Numerous experiments on the study of the colonization of the roots of various plants by bacteria made it possible to establish not only endosymbiont existence of many species of bacteria, but also to isolate effective root colonizers in a special group of "rhizobacteria"*(PGPR)* [8].

In the process of joint development, plants and microorganisms integrate their genes into a single network, which allows expanding the adaptive abilities of MRS and controlling interactions from both the plant and bacteria. These processes occur against the background of increased control by the host of the development of the microbial population in planta, based on the signal interactions of partners. protection of microorganisms, and also serve as carriers, vectors for microorganisms [9].

The universal strategy followed by most RMS (plant-microbial symbiosis) includes the signaling interaction of plants with microbes, their exchange of metabolites, as well as the development of cellular and tissue structures specialized for symbiosis.

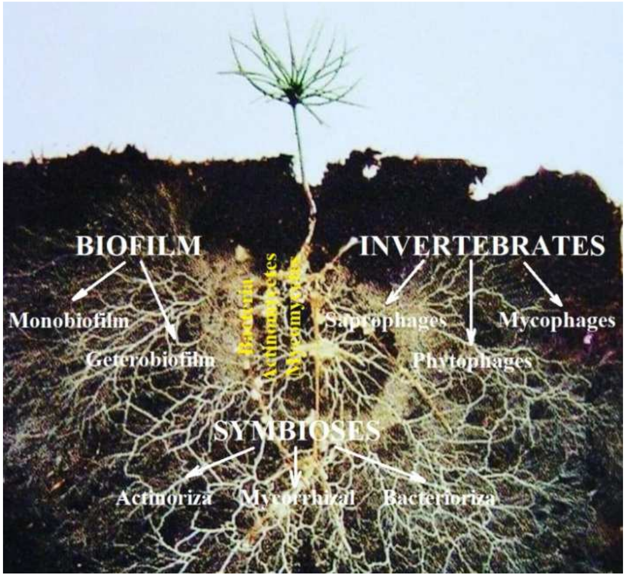

Figure 1. *Microbio-plant interactions, FLOWING IN THE SOIL.*

Signal exchange is a process that plays a key role in all symbiotics and biofilms, determining the cross-regulation and coordinated expression of partner genes [10, 11]. The high dependence of plants on these interactions is reflected in the saturation of their genomes with DNA sequences encoding the intended receptors for signals received from microsymbionts.

Symbiotic bacteria play a huge role in plant life, providing them with mineral nutrition, protection from pathogens and phytophages, adaptation to stress and regulation of development. The increase in the structural-functional and genetic integrity of symbiosis creates prerequisites for the transition of optional, optional relations of partners into ecologically obligate dependence of bacteria on plants (the need for symbiosis for the stable existence of bacteria in plant-soil systems), and under certain conditions - into an even stricter, genetically obligate dependence based on genomic reduction of bacteria [12]. In the process of joint development, plants and microorganisms integrate their genes into a single network, which allows expanding the adaptive abilities of MRS and controlling interactions from both the plant and bacteria. These processes occur against the background of increasing the strictness of host control of the development of the microbial population in planta, based on the signaling interactions of partners and the protection of microorganisms, and also serve as carriers, vectors for microorganisms [13]. The universal strategy followed by most RMS (plant-microbial symbiosis) includes the signaling interaction of plants with microbes, their exchange of metabolites, as well as the development of specialized for symbiosis of cellular and tissue structures The high dependence of plants on these interactions is reflected in the saturation of their genomes with DNA sequences encoding the alleged receptors for signals received from microsymbionts.

3.2. «Quorum Sensing» (QS)

Under natural conditions, all microorganisms do not exist in a planktonic state, but in the form of populations. One of the aspects of the population organization of prokaryotic and eukaryotic microorganisms is the morphological and physiological heterogeneity of its constituent cells, which form microcolonies within a larger multispecies population, including microorganisms and macroorganisms in the soil and in animal organisms in the form of biofilms and symbiosis [14]. In them, relationships are regulated at the population level through the mechanisms of intercellular communication "Quorum sensing" (QS) - this is the process of collective coordination of gene expression in the bacterial population, mediating the specific behavior of cells [15]. On a specific cell signal, cells in the population respond with a specific response that is controlled by acillactone homoserine derivatives in gram-negative and peptides in ga Thus, plasmid DNA tends to spread in the bacterial population and, as soon as there is a sufficient "quorum", initiates plasmid-carrying cells to conjugate with other bacterial cells [16]. Some systems with homoserine lactones as pheromones contribute to the elimination of competing microorganisms by synthesizing antibiotics, toxins and bacteriocins [17]. Multicellular associations [18] act as a chromosomal analogue of numerous bacterial plasmids that encode a stable cytotoxic agent in combination with a labile antidote to it *(addiction modules).* Plasmid DNA tends to spread in the bacterial population and, as soon as there is a sufficient "quorum", initiates plasmid-carrying cells to conjugate with other bacterial cells [18]. In the role of bacteriocin (inhibitor of bacterial growth) is one of the bacteria formed N- (3R-oxy-7-cis-tetradecanoyl)-Lept-lactone homoserine. It is established that density-dependent systems (quorum systems) with peptide pheromones regulate competence to genetic transformation in *Bas. subtilis* and *Strococcus pneumoniae* (where the transformation of antibiotic resistance genes from other types of *Streptococcus,* causing oral infections), as well as virulence, act as well as virulence *of numerous bacterial plasmids that encode a stable cytotoxic agent in combination with other types of Streptococcus that cause oral infections. Staphylococcus aureus* [19]. It is shown that peptide density-dependent regulatory systems in many cases function in symbiotic/parasitic microorganisms [20].

3.3. Symbionts of Plants

Bacterial symbionts of plants are much more complex, multicomponent (consisting of several comparable in size replicons) genomes that ensure the existence of microorganisms in complex host-environment ecosystems, in addition, for symbiosis, the unit of heredity is not a gene (as in an individual organism), but at least a pair of genes belonging to different organisms and contain, in addition to the chromosome, numerous plasmids that can reach unusually large sizes. The adaptive role of high genomic plasticity of symbiotic microbes is in regular gene rearrangements, which are the source of the "source material" for coevolyution with hosts [21].

Fungi, like bacteria, also enter into a symbiotic (dualistic) relationship with plants. Partners of such symbiosis are primarily higher fungi, and on the part of plants - non-sky plants, including perennial woody plants. In such respects, the fungus uses the plant as a source of nutrients without causing its disease. For a fungus that has established a connection with the plant, the competitive pressure from other micro- and macroorganisms is significantly reduced. In turn, the fungus contributes to the provision of the plant with appropriate nutrients, primarily phosphorus, nitrogen and potassium and moisture. The fungus "protects" the infected plant from real phytopathogens, in particular from *Fuzarium* fungi and contributes to the development of induced resistance in it - mycorrhizal formation does not lead to any significant external changes in the roots and is detected only during the formation of vesicular-arbuscular mycorrhizae (VAM).

Actinomycetes are an integral part of the microbial complex of the soil and act as symbionts of invertebrates and higher plants [22]. They form a symbiosis with plants (actinoriza), which provides plants with nitrogen, hydrolytic enzymes and mineral components. However, usually dead plants and animals are decomposed by heterotrophic microorganisms and saprophages.

3.4. The Simplest in the Soil

The simplest in the soil is an example of the highest density of living organisms known in natural conditions.

Today, about one million species of invertebrates have been discovered, but this is only a small part of the total number of species that inhabit our planet [23]. The complex of soil-dwelling saprophages is heterogeneous in the nature of the nutrition of the animals that make up its composition. It distinguishes trophic groupings: phytosaprophages, microphages (microphytophages), detritophages. Soil protozoa, mainly aerobes, and breathe oxygen dissolved in water, which diffuses through the cell membrane. The saprofile complex of soil invertebrates is divided into true saprophages - consumers of dead organisms and consumers, Saprotrophic microflora. Saprotrophs are organisms that feed on dead organic matter or animal excrement. These include bacteria, actinomycetes, fungi, as well as saprophytes (parasitic flowering plants and some algae). Microorganisms serve as sources of growth factors for animals - essential amino acids, vitamins, etc., which are poor in plant tissues that serve as food for animals. Animals, in turn, changing the ratio of fungal and bacterial block in the microbial community of the soil, affect the structure of the latter. In the last decade, studies of the interaction of actinomycetes with invertebrates in the soil were carried out on the example of many groups of soil saprotrophic mesofauna - earthworms, larvae of two-winged insects, termites, diplopods [24]. The search for mycelial prokaryotes in the chain links: litter - intestinal tract - excrement of saprotrophic invertebrates. Passing through the intestinal tract of animals, actinomycetes do not lose the ability to germinate. Feeding on bacteria, fungal spores, microarthromodes not only regulate the number of the latter, but contribute to their settlement in the soil [25].

4. The Symbiosis of Macro- and Microorganisms

4.1. Symbiont Digestion

The nature of the symbiosis of macro- and microorganisms can be different. A natural macroorganism cannot exist without symbiotic microorganisms. The microbial community is characterized by a certain species diversity - when conditions change, the succession of the community will occur, i.e. its change in time, accompanied by a change in the dominant species, fluctuations in the number of microorganisms of different groups and even a change in the composition of the members of the community. The microbiota of the cavities of the body of animals and humans is considered an exosymbiont, since it occupies an external position in relation to the tissues of the host, in particular, associations inhabiting the gastrointestinal tract (GIT), oral cavity and mucous membranes. Herbivorous animals (cows, sheep, horses, rabbits) have well-developed departments in which fiber is processed with the participation of microorganisms - the prestomach and the large intestine (mainly the cecum). Symbiont digestion is typical for herbivorous animals, which is caused by the need to decompose β-glycans, which cannot be processed by their own digestive apparatus, but are broken down only with the help of symbiont bacteria. Therefore, it is natural that the main organ of herbivores, in which the processes of preparing plant food for further utilization of its components take place, is the prestomach. It is not only the absorption of metabolites formed under the action of symbiont bacteria, but also the absorption of these bacteria themselves, which are the main source of protein for herbivores [26].

Carnivores have a gastrointestinal type of digestion. The protein and fatty foods consumed by them are digested mainly in the stomach and small intestines, the relative volume of the stomach is large. In omnivores (pigs), all parts of the gastrointestinal tract are more or less evenly developed, but the main role in the digestion of food belongs to the intestine, which has a larger volume and length than that of carnivores.

4.2. Symbiont Digestion Ruminants Mammals

In ruminants mammals (cattle, goats, sheep, giraffes, camels), the gastrointestinal tract has a complex structure, with a four-chambered stomach of particular importance [27]. One of its sections, a scar containing a huge number of microorganisms, provides animals with the opportunity to eat almost protein-free food. The rumen is inhabited by a variety of bacteria and archaea, as well as protozoa and fungi. The normal microbiota of the rumen is contained in the scar fluid and lines the surface of the mucous membrane. It is estimated that in 1 g of rumen contents there are up to ~10^{12} prokaryotic cells. Symbiotic bacteria in the gastrointestinal tract of piglets have a great influence on overall health and disease. Collectively, these microorganisms are called the "gut microbiota", and contain approximately 1,000-3,000 different species.

In a significant part, the microflora is the same in all animals in the biotopes being compared, but there are individual differences in the composition of the microbiocenosis. The automicroflora of a healthy animal remains constant and is supported by homeostasis. Tissues and organs that do not communicate with the external environment are sterile. The organism and its normal microflora constitute a single ecological system: the microflora serves as a kind of "extracorporeal organ" that plays an important role in the life of the animal, and the normal microflora is the barrier after the breakthrough of which the inclusion of non-specific defense mechanisms is induced. The small intestine contains a relatively small number of microorganisms. Here are most often resistant to the action of bile enterococci, E. coli, acidophilus and spore bacteria, actinomycetes, yeast, etc. The most active vital activity of microorganisms always occurs in the colon. Its main inhabitants are enterobacteria, enterococci, thermophiles, acidophilus, spore bacteria, actinomycetes, yeast, mold, a large number of putrefactive and pathogenic anaerobes *(Cl. sporogenes, Cl. putrificus, Cl. perfringens, Cl. tetani, F. Necrophorum).* Anaerobes develop here, carrying out fermentation, in which organic acids are formed, mainly acetic, propionic and oily. In the large intestine, complex microbiological processes occur associated with the breakdown of fiber, pectin substances and starch.

4.3. The Microflora of the Gastrointestinal Tract

The microflora of the gastrointestinal tract is usually divided into obligate (lactic acid bacteria, *E. coli,* enterococci, *Cl. perfringens, Cl. sporogenes,* etc.), which has adapted to the conditions of this environment and has become its permanent inhabitant, and optional, changing depending on the type of feed and water. Normal microflora competes for pathogenic; mechanisms of suppression of growth of the latter are quite diverse [28]. The main mechanism is the selective binding by the normal microflora of the surface receptors of cells, especially epithelial receptors. Normal microflora is a nonspecific stimulant ("irritant") of the immune system; the absence of normal microbial biocenosis causes numerous disturbances in the immune system. The antigen of representatives of normal microflora causes the formation of IgA antibodies in low titers. IgA form the basis of local immunity to penetrating pathogens and do not allow commensals to penetrate deep tissues. The community of microorganisms organizes a single genetic system in the form of plasmids - ring DNA that carry a behavioral code for members of population structures, their food (trophic), energy and other connections between themselves and the outside world. Populations of microorganisms have integral properties associated with the collective behavior of the population within more complex ecological systems, for example, a parasite (symbiont-host). The ability of microorganisms to create population structures is an essential factor in changing the genetic properties of cells. They are inherent in the spatial isolation of microcolonies of each species in natural habitats; i.e. the phenotypic heterogeneity of culture is the basis for differentiation of cells by the integrity of the culture in the process of development, the presence of integral properties that are absent in individual individuals; - the ability of the colony to influence the characteristics of the environment with sufficient population density ("quorum effect").

4.4. The Symbiotic Community of Humans and Bacteria

The symbiotic community of humans and bacteria is often considered as a complex regulatory system that controls potentially pathogenic endogenous and exogenous pathogens. The main number of human microorganisms is in the gastrointestinal tract in the form of a biofilm covering the intestinal wall in the form of a stocking, which weighs about two kilograms and contains about 10^{14} cells, which is 10 times higher than the number of human own cells.

This is possible for the host due to colonization resistance supported by indigenic microflora. The community of the human body and bacteria is a vital biosystemic volumetric space, and the colonization resistance of the host (human or animal) is a general biological factor that determines microecological homeostasis as a result of symbiotic interactions of the organism and its indigenic protection. This represents his immunity, both innate (constitutional) and acquired (adaptive). Protection in case of infection is its "pattern-recognizing receptors", which selectively recognize "alien" (infectious) from "their" (non-infectious). This function falls on the dominant (indigenous) microflora, which has taken up the main biotopes of the body, taking into account the ecological possibilities of"living". It is normoflora that has a direct antagonistic effect against associative pathogens due to the irritating effect of peptidoglycan of the associators themselves [29]. But this is probably the dual function of peptidoglycan as a factor of aggression (pathogenicity) for the pathogen and the factor of inclusion of immunity - protection for the host. Recognition of bacterial peptidoglycan is carried out by the mechanisms of innate immunity of the body [23].

Thus, in the soil there is a circulation of plasmids of soil fungi, actinomycetes and bacteria to plants and invertebrates in biofilms and symbioses, which are complex cascade systems, at the next stage there is a circulation of plasmids from invertebrates to higher animals, from animals to humans and from person to animals - this contributes to the rapid spread of natural biocenoses in the biosphere [10].

5. Unresolved Pose Significant

The global problems facing humanity and still unresolved pose significant threats to the security of civilization, form in their totality the system-wide crisis on the threshold of which states and the world community stand at the beginning of the XXI century.

The manifestation of the ecological crisis is diverse, accompanied by numerous dangers to humanity, fraught with a global environmental catastrophe. There is contamination of soils with harmful substances. Especially dangerous among them are radioactive substances and dioxins. Soils degrade - they lose humus, desertification and salinization are expanding. The shortage of fresh water is growing. Pollution of the ocean, surface and groundwater with harmful substances, primarily oilogenic, is increasing. Phytoplankton are dying, the basis of the food chain in the ocean and an important source of oxygen. Air pollution continues, temperature inversions, oxygen starvation in cities, acid rain falls. There is a change in the global climate, the phenomenon of El Niño is becoming more and more catastrophic. The ozone layer of the Earth's atmosphere is depleted. Irreparable damage is caused to the biosphere of the planet, its gene pool is impoverished. Many species of animals and plants are degrading, or even disappearing, biological diversity is falling. Forests are reduced - the most important regulator of the natural environment. Ecological troubles also affected near-Earth space - it is saturated with "space debris" - spent artificial celestial bodies.

The interaction of microorganisms and plants leads to the emergence of microbial-plant complexes in various ecological regions. The composition of the microbiocenosis is not the same, but depends on the environmental conditions in the region. Numerous studies in various parts of the globe have shown that everywhere there are microbial-plant complexes that differ in composition depending on the environment. it is the soil cover that ultimately takes on the flow pressure of industrial and municipal emissions and waste, playing the crucial role of buffer and detoxifier. Soil accumulates heavy metals, pesticides, hydrocarbons, detergents and other chemical pollutants, thereby preventing their entry into natural waters and cleaning the atmospheric air from them. In soil, many chemical pollutants undergo profound changes. Anthropogenic pressure on the natural environment has reached such proportions today that it has led to a global environmental crisis. Destructive human activity has generated a conflict between society and nature, created risks that are called ecological. The most important function of any biocenosis, biogeocenosis and biosphere is the regular reconstruction of living matter and the energy accumulated in it.

One of the examples of anthropogenic destruction of natural ldandschafts is the production of ethanol from cereals. In the production of liquid wort containing unused components of grain in the form of sediment in wort. Starch is used from wort, and the rest called post-alcohol bard is dumped on filtration fields that occupy tens of hectares of land. In this area, all biological films and biosymbioses are destroyed, toxic components are released into the atmosphere. Factiches To preserve this vast territory, it is necessary to develop waste-free production, something that scientists and production workers have managed to do. This is an example of preventing an environmental crisis in this region.

6. Summary

The interaction of microorganisms and plants leads to the emergence of microbial-plant complexes in various ecological regions. The composition of the microbiocenosis is not the same, but depends on the environmental conditions in the region. The ability of microorganisms to create population structures is an essential factor in changing the genetic properties of cells. the presence of integral properties that are absent in individual individuals; - the ability of the colony to influence the characteristics of the environment with sufficient population density ("quorum effect"). The universal strategy - the exchange of signals is a process that plays a key role in all symbioses and biofilms, which determines the cross regulation and coordinated expression of partner genes. The cascade process of the emergence in the biosphere is a multi-stage process - at the first stage, the plasmids of soil fungi, actinomycetes and bacteria circulate to plants and invertebrates in biofilms and symbioses, which are complex cascade systems. The next stage is the circulation of plasmids from invertebrate animals to higher animals, from animals to humans and from humans to animals.

Technical landscapes of production, the destruction of life in entire regions, the negative fruits of the technical impact of man on the environment - it becomes vital to change the nature of the relationship between man and nature. Even the great philosophers of antiquity taught that "it is possible to command nature only by obeying its laws." For the development of the material sphere, modern civilization, formed within the biosphere, has created many technologies that destroy it. Even environmental technologies imply damage to part of the biosphere and the removal of any resources.

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