“LIMITS TO GROWTH” IN COMMUNISM?

Minutes of a conversation between soviet natural scientists

In November 1972, the journal Woprossy filosofii organised a round table discussion with scientists on the topic of "Man and his Environment". Representatives of the most diverse fields of science took part in the discussion; this enables a complex analysis of this current problem. Among others, the following spoke: P. L. Kapiza (academician, member of the Presidium of the Academy of Sciences of the USSR/[ADW], director of the 1nstitute for Physical Problems "S. I. Vavilov"); J. K. Fjodorov Academician, Head of the Main Administration Hydrometeorological Service at the Council of Ministers of the USSR); A.1Berg (Academician, Chairman of the Scientific Council for the Complex Problem "Cybernetics" at the Presidium of the AdW); M.I. Budyko (Corresponding Academician, Director of the Geophysical Observatory "A. I. Voyeikov" in Leningrad); N.V. Turbin (Member of the Academy of Agricultural Sciences, President of the Union Society of Geneticists and Breeders); A.G. Bannikov (member of the Soviet National Committee for the International Biological Programme, chairman of the Society for Nature Conservation of the USSR); 0. K. Gusev (editor-in-chief of the journal Ochota i ochotnichje chosjaistwo); D. S. Danin (writer); J.I. Ignatev (head of the sector for environmental problems in the Council for the Study of Productive Forces at the State Planning Commission of the USSR); V. P. Korshenko (scientific secretary of the section for international legal problems of the scientific and technological revolution in the Scientific Council "Study of Man's Environment and Rational Use of Natural Resources" of the State Committee for Science and Technology at the Council of Ministers of the USSR); J.G. Lipez (Institute of Economics and Mathematics at the AdW); A. J. Medunin (Institute of Economics of the Socialist World System at the AdW); N P. Naumov (Professor at Moscow University); I. B. Novik (Head of the Department of Philosophical Problems of Earth Sciences at the Institute of Philosophy at the AdW); N. F. Reimers (head of the Department of Ecology at the Central Laboratory of Hunting and Nature Reserves at the Supreme Hunting Authority of the RSFSR); Y. G. Rychkov (chairman of the Population and Evolutionary Genetics Section of the Scientific Council for Problems of Genetics of the AdW); G. I. Sidorenko (Director of the Institute of General and Communal Hygiene at the Academy of Medical Sciences of the USSR); G.A. Stepanski (Head of the Sector of Physiology of Man and Animals in the Department "Biology" of WINITI, Chief Toxicologist of the Ministry of Health of the RSFSR); K.J. Tarasov (Chair of Philosophy at the 1st Moscow Medical Institute); B. Z. Urlanis (Institute of Economics at the AdW); G.F. Chilmi (Deputy Director of the Institute of Applied Geophysics at the Main Hydrometeorological Service); G.S. Chosin (USA Institute at the AdW); G.I. Zaregorodtsev (Chair of Philosophy at the Academy of Medical Sciences); D. L. Armand, J. V. Medvedkov, L.S. Abramov, M.F. Grin, A.G. Doskatsch, M. I. Lvovich (all from the Institute of Geography at the AdW). Further participants in the discussion were I. T. Frolov (editor-in-chief of the journal Woprossy filosofii), correspondents of the Literaturnaja gaseta and the journal Priroda. At the suggestion of the editors, the discussion on human ecology focused on the following questions, among others: Society and ecology; factors causing ecological crisis; the relationship between social, cultural and technological aspects of ecological problems; tasks and ways to humanise relations between man, nature and society; relationship between scientific-technical, social and ecological revolution; ideological and socio-political problems of ecology, peculiarities of their solution in socialism and capitalism; philosophical and cultural-historical preconditions and ways of solving the ecological problem; natural-scientific foundations of the ecological problem; the paths of development of modern science and the ecological contradictions; problems of the biological nature of man, factors of man's adaptation to the changing ecological conditions; the ideological struggle over the problems of ecology.

By way of introduction, I. T. Frolov emphasised the necessity of understanding and solving the current issues of the interaction of man and nature as global and complex problems. Not only social and philosophical but also many political conclusions arise from the discussion of these problems, the successful solution of which requires the joint work of representatives of different fields of science.

J. K. Fjodorow named a number of questions, without the clarification of which, in his opinion, no unified position of Soviet science can be worked out on the problem under discussion. Firstly, is there really a danger of a crisis in the relations between man and nature if the development trends of society on which the forecasts of the "Club of Rome" are based continue? Fyodorov believes that this danger is real and that everything will hardly "sort itself out", as some bourgeois scientists believe. Secondly, is the crisis avoidable or not? The speaker took the view that no crisis will occur if socialist society is established all over the world. However, it is inevitable if the capitalist society with its present tendencies of development is maintained on a considerable part of the earth. The crisis can be significantly mitigated and perhaps even prevented if the peaceful coexistence of states with different social orders is secured, the arms race is stopped, and a firm and lasting peace is achieved. Fyodorov argued that this crisis could occur within the next 50 to 150 years. In this context, the following problems, among others, arise:

1. population growth and development.

The speaker pointed out the diversity of views on the question of whether population regulation is necessary and argued for leaving it open for the time being. He drew attention to another important characteristic of the population - its qualitative composition, i.e. its distribution according to interests, professions and qualification levels. The need to regulate the qualitative composition of the population is already obvious. In the socialist countries, such regulation is carried out through the whole system of cadre training, which is based on a long-term plan of society's development- In the spontaneously developing capitalist society, such regulation is not possible; this favours the growth of unemployment and the loss of interest in work.

2. the relationship of resources to the growth of the population and its needs.

As is well known, all estimates of the depletion of non-reproducible natural resources have proven to be wrong. The explored reserves of all the main mineral resources in the world are increasing in total and per capita. This process will continue for some time. But it is not unlimited, of course. One must also consider another process - the increase in our ability to produce any item from any resource. This process is faster than the depletion of individual natural resources. In perspective, the total amount of stuff we can use on our planet becomes the sole and general measure of natural resources. The question of the use of reproducible resources (forest, soil, fish resources, water, atmospheric oxygen, etc.) is of particular importance. The exploitation of their resources is rapidly approaching the limit; already, about 70% of the increase in the populations of the most important commercial fish in the world's oceans is fished out. However, the possibility of their cultivation is opening up, which can multiply the productivity of the reproducible natural resources. These possibilities are not considered by the members of the "Club of Rome" and other scientists.

3. the negative consequences of human impact on the natural environment, primarily pollution.

Fyodorov argued that technological progress and the growth of per capita consumption by no means make the persistence of pollution inevitable. The introduction of closed cycles in production can considerably reduce the pollution caused by industry. The use of highly selective biological pesticides and appropriate fertiliser systems in agriculture, as well as the processing of waste into building materials, are equally feasible. The costs of such systems in industry and agriculture would of course be very high, but in any case, lower than the expenditure on armaments. Through human activity, which is accompanied by wear and tear on objects, certain substances enter the material cycle on earth. While it is possible to prevent significant pollution of the natural environment, a certain degree of impact of human activity on the geochemical and thermal balance of our planet is unavoidable. So far, we have only extremely primitive ideas about the effects of introducing small amounts of certain substances into the natural cycle. However, science is quite capable of answering this question. It is also possible to find compensatory measures - methods of eliminating undesirable substances or methods of neutralising their effect. One of the basically unavoidable consequences of man's impact on the environment is the change in the heat balance. If we do not limit ourselves to using direct solar radiation, the hydro-energy of rivers and tides and the energy of the wind as energy sources, but also obtain energy from mineral resources or nuclear reactions, then a warming of the earth is inevitable. As M. I. Budyko assumes, this warming can lead to climate changes after only a few decades. Of course, measures can be found to compensate for the changes in the Earth's heat balance, for example by regulating the population. In any case, however, they would have to be large-scale measures that affect our entire planet.

In Fyodorov's view, it is not necessary to stop progress, as Western scientists believe. We should not strive to preserve the natural environment as a whole. One can create nature reserves, and we will continue to create them in certain areas. But you cannot turn the nature of the whole planet into a nature reserve. Growth in population, consumption and production is possible, but only in a carefully regulated way, and this is another weighty argument in our struggle for peace and socialism.

I.P. Gerasimov discussed the problem of improving and protecting the natural environment from the point of view of geographical sciences. In his opinion, the first priority for the solution of these tasks is the elaboration of a scientifically based general plan for the utilisation and purposeful transformation of nature in the USSR. The main aim of this plan is to optimise the living conditions and economic activity of Soviet society. The scientific preconditions for drawing up such a general plan include work in the following directions: Theory and methods of scientific foresight of positive and negative consequences of economic activity for the natural environment; ways and methods for forecasting and effectively combating spontaneous natural phenomena, especially natural disasters; ways of using natural resources that will enable not only their protection, but also their expanded reproduction; a modern theory of control and regulation of natural and anthropogenic ecosystems and geosystems. According to M. I. Budyko, we are on the threshold of creating a new science that could be called "global ecology". In this field, the tasks of numerous natural and social sciences overlap. Therefore, a complex approach is needed to solve them. What has been done so far in this field is pioneering work by individual scientists or small collectives whose potencies often do not match the magnitude of the tasks before them. Budyko referred to attempts in the USA to organise work on global ecology; for example, a special research group was created for this purpose at the Massachusetts Institute of Technology. The speaker stressed the need to improve the organisation of work in this field in the USSR.

Budyko argued for avoiding one-sidedness and simplification when assessing the few works on the global ecology of the future available so far - works by Forrester, Meadows and others. It is not difficult to criticise such studies, because they contain many theses against which one can raise well-founded objections. Moreover, the conclusions of these works are not free of sensationalism, which is perhaps related to the fact that the authors wanted to give more attention to the problems of ecology. Meadows' book has been translated into twelve languages and is published in very large editions. If it had been written in a restrained scientific tone, it would not have attracted such attention. However, it should not be overlooked that this work contains an attempt at numerical modelling of the natural and economic conditions of the future which is interesting in many respects. It would be very dangerous to dispense with such an approach to the study of problems of global ecology merely because the American authors have made a number of mistakes.

Budyko suggested that the Academy of Sciences consider the question of organising research on global ecology. He also recommended the publication of papers analysing in detail the method of numerical modelling of natural conditions of the future and the prospects of its practical application.

G.F. Chilmi argued that in our time the biosphere is becoming a new natural object of human activity, as the possibilities of technology and the scale of economic activity of human society have exceeded a certain critical level and have become a source of new processes of planetary scale. In the foreseeable future, the original biosphere will be connected with cities and enormous technical facilities to such an extent that a new system will emerge - the biotechnosphere, which will develop according to specific laws that are still unknown to us. The lawful and historically inevitable process of transformation of the biosphere into the biotechnosphere is superimposed on the spontaneous process of exploitation of nature by man, and this leads to pollution of the environment, destruction of natural resources and disruption of the ecological balance. The peculiar dualism of destructive and constructive human impact on the biosphere produces a corresponding duality of scientific and practical tasks. Many types of destructive human impact on nature are known today. Nevertheless, they require further study. This is necessary for a permanent regulation of the relations of society and nature. For this purpose, state services must be created and the scientific basis of their activity must be elaborated.

Having eliminated the destructive impacts on the biosphere, society must transform the biosphere into the biotechnosphere through rational and purposeful action. This transformation will be an action consciously undertaken by man, directed towards the progressive development of the environment and carried out on a scientific basis. Chilmi was of the opinion that the present state of basic knowledge is not yet sufficient for the solution of such tasks. The unification of the original biosphere with industrial-technical elements into a unified system brings forth new system laws that are to be uncovered by basic research.

Another aspect of this problem is the following. When man reshapes nature, he must reckon with the characteristics of the original biosphere, which he supplements with the artificially created environment. At the same time, however, a new and important phenomenon emerges that did not exist in nature before - the adaptation of the biosphere to the conditions created by man. The study of these adaptations is a novel task of science that must become the subject of basic research. According to Chilmi, it is necessary to gain clarity about the following possible adaptations:

a) Adaptation of the biosphere to changes in the previous geochemical migrations of substances and to the emergence of new migrations caused by human economic activity;

b) Adaptation to the entry of new energy flows of extrasolar origin into the biosphere;

c) Adaptation of all stages of the living matter of the biosphere to the urbanised environment emerging on Earth.

J. I. Ignatiev went into some economic questions of the environmental problem. According to Ignatiev's calculations, the Soviet Union suffers annual damage amounting to many billions of roubles as a result of the incorrect and irrational use of natural resources and also as a result of the inappropriate impact on the environment. Without appropriate measures to prevent this damage, however, it is practically impossible today to restore this sum to the national income. At present, Soviet expenditures for the preservation and improvement of the environment amount to about 2.5% of the national income. This is not a small sum. However, it cannot be said that We have already achieved the useful effect possible under the conditions of the socialist economic and planning system. The reason for this is the insufficient scientific basis.

As is well known, more purification plants will be built in the near future. However, this requires considerable expenditure. For example, in the Stschokino chemical combine, which has achieved good results in this field, the value of the cleaning plants is up to 40 % of the value of the basic production funds. The speaker expressed doubts as to whether the company could afford such expenditure, especially since up to now many enterprises have been working without any cleaning equipment at all. Apparently, it is necessary to work out a complex programme for keeping water and air clean.

Another path that can be taken is a more rational distribution of the location of the productive forces. In capitalist countries, the development and distribution of the productive forces takes place spontaneously. We strive for the greatest possible economic benefit when planning the distribution of locations. However, we should also take into account that industry should cause the least possible harm to human beings and nature. A complete, complex use of raw materials can be achieved, but not by building individual waste-free factories, but waste-free territorial production complexes. Then it will be possible, as P. Oldak correctly noted in a journal article, to expand the limits of economic analysis and, when evaluating the results of the work of the enterprises, to take into account not only the economic effect achieved in roubles, but also the damage done to the environment.

Ignatiev emphasised the need for a philosophical analysis of some problems directly related to the ecological issue. In particular, it is about such a regulation of needs that does not create additional contradictions in the relations of production and the environment.

A. G. Doskatsch raised the question of whether a rational distribution of the location of the productive forces was possible on the old basis or whether this would require major changes in production. J. I. Ignatiev commented that the problem of the economic effectiveness of complex waste-free production is extremely important. The leading enterprise of a territorial production complex can and must work economically effectively. However, the enterprises assigned to it, which process the waste of the lead enterprise as raw material, can sometimes be less profitable, i.e. produce their products more expensively than would be possible by other means. The key to solving this problem is to calculate the economic effectiveness not for individual plants, but for the entire production complex, taking environmental damage into account.

P.L. Kapiza explained that the problems under discussion are so important because they are global in nature. The planetary character of the relationship between man and nature has been felt for the first time in connection with the development of the atomic bomb and the danger of a nuclear world war. The danger that such a war could poison the entire globe in a few hours forces people to renounce the use of nuclear weapons.

Kapiza addressed three main aspects of the global issue:

1. the technical-economic aspect associated with the depletion of the earth's natural resources;

2. the ecological aspect related to the biological balance between humans and living nature in the face of global pollution;
3. the socio-political aspect, the need to solve these problems on the scale of all humanity.

The quantitative indicators that are usually used to characterise the dynamics of these processes are expressed mathematically as an exponential function of time. One characteristic of such processes is that their course ultimately accelerates explosively. Such exponential laws also apply to demographic processes. Today, the earth's population is 3.7 billion. If it continues to grow at the same rate (2% annual average) as in this century, then in 700 years our planet will be so densely populated that there will be one human being for every square metre of its surface. This is, of course, impossible, and the population increase must come to a halt long before that time. When and depending on which factors this will happen and what consequences it will have for civilisation is a global problem for the near future.

Modern computing technology makes it possible to investigate this complicated problem using global statistical data. In recent years, the most interesting and convincing results were obtained by J. W. Forrester, the couple D. H. and D. L. Meadows and their colleagues. L. Meadows and their colleagues. In their work it was shown that the "explosive character" of ecological processes does not result from exponential population growth alone. A number of other processes (the increase in the consumption of electrical energy and mineral raw materials, the poisoning of the environment) are also growing exponentially and could lead to a global crisis in the near future that would erupt explosively. On the technical-economic aspect, the level of modern civilisation and humanity's prosperity is critically dependent on natural energy resources. Today, the main raw material for energy production is coal, and if its consumption remained at the present level, coal reserves would last for about a thousand years. Even assuming that humanity does not continue to grow, if energy consumption per capita continues to grow at the same rate as in the last hundred years, coal reserves would only last for 100 to 150 years. For other types of raw materials, a crisis may occur even earlier, for example for silver or lead. Today, it is already known that science is able to show a way out of the impending crisis. The energy problem can be solved by using controlled thermonuclear reactions. The energy source is the heavy hydrogen isotope deuterium, whose supply in the world's oceans can be considered unlimited.

The exhaustion of raw material resources can be prevented by transferring industrial production to "closed processes", i.e. to those processes that take place in nature, where there is no waste because all materials are reused. From a scientific point of view, closed processes are certainly feasible, even if they are significantly more complicated than the ones that have been common up to now; the main problem here is the larger amount of energy required. Therefore, these processes can only be introduced on a global scale when people have practically unlimited energy sources at their disposal; at present, this can only be thermonuclear energy.

The ecological problem arises from the disturbance of the balance in nature as a result of environmental pollution and also has global dimensions. Although this problem is secondary in importance to that of the depletion of raw material resources, it is felt more strongly by people and is therefore at the centre of attention both in individual countries and in the UN. The main difficulty in solving this problem is that global technical processes at the current level of civilisation have begun to change the environment (air, water and soil) in such a way that the biological balance that previously existed in nature can no longer be maintained; this leads to the extinction of animals and plants that are essential for human existence.

Since the technical processes required by today's civilisation inevitably cause disturbances in the previous ecological processes, other types of biological equilibrium in nature are now required. It is

one of the main tasks of ecology to determine under what conditions these processes can take place in harmony with the requirements of human culture. As an example of this, one can consider the problem of Lake Baikal. Industry needs fresh water. Lake Baikal contains it in large quantities. However, its value is not simply that it contains a lot of water, but that it is a biofilter of enormous capacity that transforms the polluted water of the rivers flowing into it into clean water. This purification effect is based on biological processes in Lake Baikal. If clean, so to speak distilled water were to flow into Lake Baikal, life in it would die out and the lake would lose its purifying capacity. Our concern for Lake Baikal is to preserve this purifying capacity. Therefore, the motto "Don't touch Baikal>> is not correct. Lake Baikal must be used, but in such a way that the life in it is not destroyed and its purifying properties are preserved. The biologists must determine the ecological processes that take place when production waste enters Lake Baikal. The chemists must develop technological processes that produce waste that can be processed by Lake Baikal. As is known, the effectiveness of biological processes in the water depends largely on the amount of oxygen dissolved in it. Therefore, in those regions of the lake where pollutants flow in, one could increase the intensity of the biological processes by aerating the water (as one does in aquariums). With the right solution, the purification capacity of Lake Baikal could even increase. Under socialist conditions, the state is able to coordinate the work of scientists and industry accordingly.

A vivid example of what can happen when lakes are misused is provided by the Great Lakes in the USA and Canada. These lakes have become so polluted by industrial waste that life in them has ceased and their water is already no longer usable for a number of productions. Therefore, the USA government has now decided to regenerate life in these lakes. To do this, the methods of water use must be reorganised in such a way that the ecological process required to renew life in these lakes begins. To this end, the US government is providing $5 billion over the next three years. Experts assume, however, that up to 25 billion dollars will be needed for this.

Ecology must now become one of the central biological sciences. Its main task is not only the study of the biological equilibria existing in nature today, but above all the study of those equilibria that are possible when nature is exploited in modern industrial and agricultural processes. All these processes are now reaching global proportions, and because their development follows an exponential law, their uncontrolled course can lead to an explosion. On the socio-political aspect of global problems: This is about creating the social conditions under which technology and industry can develop on a scientific basis in such a way that the balance of civilisation remains secure and no catastrophe is conjured up. While it can be reasonably assumed that science will be able to fulfil the first two tasks, the implementation of corresponding measures on a global scale is a social problem whose solution is still in the embryonic stage. Because its solution requires action on an international scale, there may be conflicts of interest between individual countries. Let us take a simple example. Two neighbouring countries produce cellulose, one with water pollution, the other without. The country that does not pollute the water produces the paper more expensively than the other. One country's industry pollutes the sea, the other's does not. It is clear that keeping the water clean is necessary for many riparian states. This gives rise to the task of persuading the country that pollutes the water to adopt the more costly method. So far, there are no effective methods of influencing countries that pollute the environment. The example of those countries that still carry out nuclear explosions in the atmosphere testifies to this. Obviously, therefore, it will be necessary to create an authoritative international organisation to control global problems in the near future.

At present, a broad discussion is unfolding on such global social problems. Even in Western countries, some economists and sociologists admit that the techno-economic problems on a global scale can only be solved on the basis of a socialist organisation of industry. For example, the important Dutch economist S. Mansholt expressed himself in this sense. However, there are also representatives of the

view that capitalism has always found new possibilities of self-regulation through prices and taxes and that the current global problems could also be solved in this way. Undeniably, however, the socialist organisation of the national economy secures a reliable basis for the solution of global problems. It can already be seen that ecological problems of a large scale can be overcome in the USSR. That is why the example of the use of Baikal water is gaining international significance. It could be used to demonstrate that it is possible to use the riches of the lake without destroying the balance in nature. Here it could be empirically proven that socialism by its very nature is better suited to solving such ecological problems than capitalism.

The need to solve global problems on an international scale will have a favourable effect on solving the problem of peaceful coexistence and disarmament. People are beginning to feel that they live in a common house and that the whole of humanity has a common enemy: the looming global crisis, which must be fought with united forces. For all their differences of opinion, all who speak out on this issue agree on one thing: These problems are extremely important for humanity now, and the forces of all countries must be used to solve them.

W. F. Kormer, I. I. Kravchenko and R. V. Sadov opposed an abstract approach to ecological problems and emphasised their close connection with social factors. Man's metabolism with nature has always caused disturbances in the ecological balance; originally these manifested themselves in the depletion of natural resources - of food (soil fertility, certain animal and plant species) and working resources (forests, mineral resources, water, etc.). From the beginning, these disturbances demonstrated the ambivalence of human activity and of human existence in general, its ability to both build and destroy, both to create a new environment and to eliminate the natural milieu. Before the stage of humanity's industrial development, these disturbances were limited in space and time, they touched only individual sides of man's relations with nature and were overcome by the restoration of balance on a qualitatively higher level. On this basis, a certain relationship to the external world emerged - that type of civilisation and consciousness linked to the idea that man's activity in the external world has a limit (in line with this, a system of ecological prohibitions, of norms of ecological activity, emerged). The ecological defence that spontaneously emerged within the framework of culture was an analogue of the natural ecological defence at this stage of man's development: Destructions are limited and something new, "artificial" is created in place of what is destroyed and missing (reclamation of new arable land, breeding of domestic animals in place of hunting game, etc.). Basically, man only became aware of the disturbances of the ecological balance when his destructive impact on nature could no longer be compensated for by his creative activity (for example, when the extinction of a biological species could not be compensated for by breeding domestic animals). This way of thinking can still be found today.

In the epoch of industrial development, the emergence of modern science and technology, alongside the idea of the unlimited possibilities of reason, science and technology, the idea of the possibility of unrestricted activity by man in his interactions with nature also emerged. These relations were seen as interactions that man, as the sovereign subject of activity, enters into with nature as the object of that activity. The industrialisation of European society (and subsequently of societies in other regions) was bound to create the danger of an ecological crisis. It became a real danger not because of the use of technical means in the metabolism between man and nature, but above all because the original type of industrial development in capitalism was linked to an attitude that absolutised technical progress and saw it as a self-sufficient factor of development.

The current ecological contradictions that have arisen on this basis take on the character of a crisis because, in contrast to earlier conflicts of man with nature, they are global in scale and affect the totality of the relations of society and nature, the material as well as the spiritual life of society. In

human consciousness, ecological contradictions appear as contradictions of the natural and the artificial. This is the only possible way in contemporary culture for human beings to reflect on their relationship to the outside world and to themselves. This path is mediated above all by the idea that only that part of the surrounding "cosmos" which is in some way involved ("humanised") in human activity exerts a significant influence on man. This idea suffices as long as human activity is of a relatively limited, local character.

However, the juxtaposition of the natural and the artificial is relative. Certain empirical realities and conditions of human existence function in some life and cognitive situations as artificial, man-made ones, in others they appear as natural realities given to man, as *nature in the* true sense of the word.

The term "ecological" should therefore be used more comprehensively than just in the sense of man's relationship to the biogeographical milieu. This term is basically applicable when we are dealing with a totality of man's relations to his conditions of existence, which appear as natural for the respective concrete historical situation. The most important factor mediating the ecological activity of society and the individual is a sum of social causes. The concept of the ecological is in a very complicated interaction with the concept of the social and the social conditions of existence, *the social milieu*. The socium is a creation of man, but at the same time it confronts him as something given, as "nature", as objectively existing. In this sense, society can be seen as a natural condition of man's existence, which affects all spheres of his activity and, for its part, is subject to man's influence, just like the biogeographical milieu.

Labelling certain parameters of human existence as ecological does not cancel out their social characteristics. At the same time, the concepts of the ecological and the social must not be confused with each other. With the disintegration of the original social wholeness, the emergence of the division of labour and the division of society into classes, the problem of society's relationship to nature and to man arose, the problem of the mutual relationship of classes, groups and individuals. Inevitably, ecological problems are also raised. The different interests of classes and individuals in their relationship to nature and to other members of society are expressed in their interest or disinterest in the knowledge, preservation, development or destruction of the object of ecological relations. The opposition between the subject and the object of these relations arises precisely in the social sphere.

The current ecological crisis is not limited to the biogeographical milieu, but encompasses the entire system of man's relations with nature, i.e. everything that appears as something given and in this sense "natural" for the existence of the historical man in question, especially such parameters as his own biophysical and psychic nature, the totality of demographic factors, the communication and information aspects of his life and the various institutionalised forms of his existence (family, etc.).

In our view, the process of resolving ecological contradictions - the "ecological revolution" - represents an organic interweaving of ecological and social principles and factors. In this process, on a new social, economic, technological and cultural basis, the separation and opposition of the elements of the system "individual - society - nature" will be gradually overcome. Such an ecological revolution will be the result of the social transformation of the world according to socialist and communist principles. On this social basis, the positive technological methods for solving the ecological contradictions brought about by the scientific and technological revolution can become effective on a general human scale. The ecological revolution does not begin after the completion of any other stages of human development (the social, the scientific-technical or the industrial revolution), but simultaneously with them; like the revolution in science and technology, it becomes an organic part of the construction of communist society.

M. M. Kamshilov noted that science is not only the basis of technical progress, but also a means of eliminating the negative consequences of scientific and technical progress and ensuring the survival of humanity. The latter function of science will become increasingly important. So far, however, science has not been able to fully satisfy this new need of society. There are several causes, including social ones, that explain this situation. One of them is the imperfection of production technology itself. Industry and transport cannot yet develop without polluting the environment. Therefore, regrettably, it is not yet possible to completely eliminate the emission of harmful substances into the natural environment, but only to limit it substantially.

Among these causes is the inadequate study of the problem of the interrelationship between the biosphere and human society. In this context, three moments must be taken into account. First, human society is a part of the biosphere; second, technology is not something alien to the biosphere, but a qualitatively new stage in its development; third, human society must to some extent follow the laws of the biosphere, since it is its part. At the same time, of course, human society is not identical with the biosphere. Special social laws prevail in it that are not peculiar to the other parts of the biosphere. However, these laws only work as long as they do not contradict the laws of the biosphere. Otherwise, the biosphere interposes its "veto" against human activity. The laws of social development form the top of a pyramid, which only exists with the whole pyramid at the same time. In our activity, we must consequently subordinate ourselves to certain laws of the biosphere or at least take these laws into account.

The biosphere exists for about $3*10^9$ years. The basis of this long existence is the cyclical organisation in the biosphere. What is useless or even harmful for certain organisms serves others as food and a condition of existence. Life exists in the form of a biotic cycle. In the evolution of life on earth, two basic tendencies emerge: the increased influence of living on inorganic nature through the formation of new adaptations and the inclusion of every new formation of life in the biotic cycle with the help of destructively acting organisms (especially microorganisms). The interaction of these tendencies ensured the progressive development of life on our planet for billions of years. If we aspire to the goal of unlimited progressive development of human society, we must pursue the same goals in our relations with living nature. As their human equivalent would be the rational planning of innovations, the concern for the preservation of the biosphere. If technology belongs to the biosphere, it must model the laws of the biotic cycle and consequently be ecological itself. All processes of purification of air, water and soil must be localised in technological systems that contain biological links. Free nature must by no means be regarded, as is currently the case, as a purification system. Multi-stage, relatively closed purification systems must be interposed between production and free nature as a buffer. The evolution of the organic world has gone through several stages. The first was the emergence of the biological cycle - the biosphere. The second was the complication of the cyclical structure of life through the emergence of multicellular organisms. These two stages took place under the influence of purely biological factors and can be called the period of biogenesis. The third stage is the emergence of human society. Human activity, which is rational by nature, is by no means always rational on the scale of the biosphere. It often has a destructive effect and restricts the possibilities of further development. However, as the example of the USSR in particular shows, the principle of rational, planned action is already beginning to dominate over the principle of spontaneity; gradually the biosphere is being transformed into a sphere of reason - the noosphere. A revolutionary transition is taking place from biogenesis (as an evolution controlled by spontaneous biological factors) to a development directed by human consciousness, that is, to noogenesis. In this stage, the second social function of science as a means of survival unfolds in full measure.

Under socialism it will be possible in real terms to create research institutions of a new type, in which representatives of various theoretical disciplines of natural science will work together with engineers,

agronomists' medical doctors and sociologists. Their main task should be to evaluate the achievements of science and technology not only from the point of view of their immediate usefulness, but also from the point of view of their influence on the interrelations of human society and nature. They would have to recommend scientific results, discoveries and inventions for introduction into the national economy and medicine, analyse the consequences of this introduction and explore ways to eliminate harmful side effects. These institutions would have to represent a reasonable human equivalent to the selective function of the biosphere, which only gives room for development to those innovations that do not impair the cycle of organic matter. The criterion for the value of innovations should not only be their immediate benefit, but also their compatibility with the progress of life. In the tactics of human activity, it is essential to take into account the strategy of the biosphere, the "wisdom of life" accumulated over billions of years.

The science of controlling the relations between human society and nature could be called noogenics. Its main task would be to correct the disturbances caused by the progress of technology in the relations of man and nature and in man himself. In addition to performing protective functions, noogenics should also provide for greater diversity of life forms by creating new species of plants, animals and microorganisms in the noosphere. These new species would not only serve as a source of food, of oxygen and of industrial raw materials, but by assuming buffer functions they would also help humans to combat the harmful by-products of technological progress. They could promote the more active appropriation of inorganic nature and accompany humans on cosmic flights.

P. G. Oldak and D. R. Darbanow spoke about a "bio-economic programme>> as a research project. The middle of the 20th century marks a certain turning point in the development of social production: the transformative activity of man reached the scale of natural processes in this period. As a result, a two-way dependence began to manifest itself more and more distinctly: The state of the environment depends on the scale of production and the level of technology, and the rate of growth of social production - viewed over longer periods of time - depends on the state of the environment. The analysis of this dependence shows that natural environmental processes and human economic activity cease to develop as separate systems. They touch each other and become a unified meta-system "production - environment" (bio-economic system). At the same time, the problem of managing social production goes beyond the scope of the traditional economic approach and becomes one of the most complicated scientific problems of the present - the problem of managing the bioeconomic system.

We still know very little about the nature of the bioeconomic system and the equilibrium conditions for the development of its subsystems (social production and the environment). Much of the material available in this field has not yet been theoretically processed. Nevertheless, it can be argued that a new branch of research is emerging at the border of ecology and economy: the theory of bioeconomic systems governance. This new science could be called bioeconomics. The bioeconomy is based on the research results of the three fundamental fields of knowledge - the natural sciences, the social sciences and the technological sciences. At the same time, it has its own object: the relationship between the rate of growth of production, the level of technology and the quality of the environment (if production reaches certain proportions, then the quality of the environment can only be maintained on condition that the rate of growth is in line with the progress of production technology).

S. J. Tschikin emphasised that the pollution of water, air and soil already poses a threat to life. A considerable role is played by the production of many new chemical substances and materials that were previously not found in man's natural environment. Furthermore, the automation of production and the introduction of assembly lines have significantly changed working conditions, often resulting in greater fatigue compared to heavy physical work. These and many other factors pose new challenges for medicine and health care. Those responsible for building new factories must ensure that the

technological process takes into account the physiological possibilities of the human being and does not lead to the destruction of the external environment to which the human being is adapted. With the help of the scientific-technical revolution, it is necessary to overcome the ecological dependence of man on machines and to design the technology as well as the work process in such a way that the state of health of man does not deteriorate.

This approach to solving the problem is quite natural for socialist society, where the development of productive forces and scientific-technical progress should primarily serve the further improvement of people's living conditions and their health. This objective is also expressed in several government decisions of recent years. In July 1968, the Soviet government passed a resolution on the further development of the health system and medical science. This document also contains measures for the improvement of the environment; every manager of an industrial enterprise is obliged to take measures to reduce the entry of harmful substances into the environment to a maximum. In December 1969, the Supreme Soviet of the USSR adopted the "Fundamentals of Legislation of the USSR and Union Republics on Health Protection". This decision determines responsibility not only for an adequate sanitary condition of production sites, but also for measures to prevent pollution of the environment by chemical production waste harmful to health. These and other decisions testify to the fact that under socialist conditions the socio-political problems of the interaction between society and the natural environment are solved in a positive way. For example, in the last four years about two hundred Moscow factories have been relocated to sites outside the city. Furthermore, 1200 boiler plants in the capital were converted from coal to gas and 4000 industrial objects were equipped with dust and gas filters. As a result, the dust content of the air in Moscow was reduced to one fifth to one sixth and the sulphur dioxide content to one third to one quarter between 1961 and 1971.

However, the problem of environmental protection cannot be solved effectively if only individual countries deal with it. The atmosphere is polluted on a global scale. For example, air pollution around the Hawaiian Islands has increased by 30% in the last ten years, even though there are no large industrial operations on these islands.

In the opinion of A. G. Doskatsch, the problem of human ecology at the present stage is practically determined by man's reaction to the environmental conditions he himself has changed and created. Alongside the harmful consequences of mechanisation, however, the possibilities of controlling the dynamics of the biosphere and the technical impacts on it are constantly increasing. The realisation of such control is determined not only by the state of science, but primarily by the formation of the socialist social order and its growing influence on the fate of the world.

The possibility of practical "environmental control" presupposes the following; knowledge of the laws of development of the biosphere; analysis of the reaction of its components to external impacts; determination of the reversibility limit for changes in the biosphere; prognosis of these changes under different variants of impact; evaluation (also quantitative) of the changes both from the point of view of natural history and from the point of view of benefit or harm for human society and for man as a biological being.

In the current constructive-geographical conceptions of the biosphere and the living environment, the problem of the protection of nature is viewed in inseparable connection with the problem of its use, purposeful transformation and control. From this position, a general plan for the transformation of nature should be drafted. The aims of this plan would be, first and foremost, the creation and preservation of an environment optimal for human life; the elaboration of such procedures for the utilisation of natural resources as will ensure their expanded reproduction; the establishment of a

scientific-technical <<control desk" with the help of which the complicated system of processes, relationships and chain reactions resulting from the transformation of nature can be regulated.

All activities for the elaboration and realisation of such a general plan must be coordinated. The main causes of the situation called the ecological crisis of the present are the uncoordinated activities in the mechanisation of the economy and the technical impact on nature, the insufficient scientific basis for determining an optimal way for society and nature to use natural resources and, finally, the attitude in the capitalist countries which disregards the concerns of the people. On the way to the transformation of the biosphere, the important theoretical question for scientists and practitioners is whether this transformation can be based on the laws of nature already recognised by science or whether we will have to deal with new kinds of laws of development of the biosphere. One cannot exclude the possibility that fundamental qualitative changes in nature will occur if the natural, relatively balanced conditions are disturbed. Their modelling, prognosis and evaluation is an important moment in the project planning of control systems. It is not a matter of adapting the biosphere to the increasing pressure of technology, but of establishing such equilibrium conditions that are favourable "for both sides" and correspond to the humane goal of preserving and transforming nature.

According to N. P. Naumov, the problem of urbanisation of landscapes deserves special attention. The concentration of a considerable part of the population in cities is beneficial in many respects, but it is inevitably accompanied by a number of undesirable phenomena. Foremost among these is the disruption of biogeochemical cycles. Food consumption in cities removes numerous substances from the fields and meadows, and these do not return to the fields but enter the groundwater, rivers and finally the ocean via the sewage system. As a result, the water bodies are enriched with nutrients. This apparently positive change, however, causes not the fish stocks but the blue and green algae to develop tumultuously, displacing the beneficial flora and fauna. Since the nutrients do not return to the fields, it is necessary to increase the extraction of mineral fertilisers, whose explored reserves (especially of phosphorus) are no longer very large. One way to eliminate the disruptions to biogeochemical cycles caused by urbanisation is to process wastewater and waste into fertilisers, but much work remains to be done to solve this task.

Special mention should also be made of the problem of agro-zonosis. The creation of large fields with high-yield monocultures is undoubtedly the most important advantage of the agricultural use of the territory. However, the species population of the agro-zonosis is drastically reduced. At the same time, it loses resistance to pests, and these can multiply to a greater extent. This circumstance makes it necessary to spend a lot of money on pest control. Obviously, the biologically rational design of the agricultural landscape requires serious thought. The results of work in this field are still limited. It is necessary to break up the uniformity of the landscape to a reasonable extent, to increase the richness of its plant and animal population and, if possible, to disperse enemies and competitors of harmful species.

A. V. Medvedkov pointed out that planetary ecological changes are preceded by local changes. Many local environmental crises are well known in geography. In this context, experiences made in the study of cities are instructive because the transformation of natural systems is particularly profound there.

Medvedkov explained that in his work at the World Health Organisation he had the opportunity to assess the effectiveness of the factor ecology of cities. Within the framework of this work, it was possible, with the help of the computer of the UN agency in Geneva, to test simulation models such as those used by the "Club of Rome" in the analysis of the "Limits to Growth". These models have already been tested several times on the material of urban systems.

The study of local environmental crises in cities has shown that the issue is not reduced to pollution and "waste-free technology". The difficulties are not linked to the metabolism of the systems, but to their growth. They are the flip side of the successes of the scientific and technological revolution, if the innovations are not backed up by a complex of structural changes to the city. These difficulties are only partly due to the lack of resources; essentially they arise because the significance and extent of the changes are understood too slowly. The example of urban planning shows how often the transformations lag behind the increase in the standard of living, the increase in the flow of passengers, motor vehicles, buyers, etc. With a rapid succession of innovations, additional burdens arise in people's lives associated with the need to retrain and change activities, jobs and habits. Expenditure on adaptation to changing living conditions increases.

The history of cities shows a very specific, techno-oriented way of fighting the local environmental crisis (increased expenditure per capita of the population, more intensive transformation of the territory through the construction of high-rise buildings, underground railways, etc.).). However, the perspective of more and more complete incorporation into artificial areas, which is pointed out by technology and does not take into account alternative social solutions, cannot be fully satisfactory. The systems of technology do not have the longevity and reliability that nature has produced over millions of years. If we have established the connection of adverse environmental changes with the "diseases of growth", then we must not exclude those solutions that consist in the transition to optimal growth rates. Maximum growth rates are not always and in every case the best solution. In fact, a self-regulation of the growth rate is already taking place, namely in the birth rate. The measures to curb the expansion of large cities in the USSR are also well known. If there were no limit here, a spontaneous self-regulation associated with losses would set in.

In popular publications as well as in radio and television programmes, one encounters such sentences as "Nature is always right", "In nature there is no emptiness", "In nature there is nothing harmful and superfluous ", "Nature is a chain in which the destruction of one link means the destruction of the whole chain". According to O.K. Goosev, the strategy of idealising nature is based on a primitive conception of the balance of the biosphere and is basically a strategy of complete non-interference in the natural environment, which logically, as S. S. Schwarz aptly noted, "must lead to the denial of the expediency of the struggle against harmful forms, against pathogens and vectors of diseases, etc.".

If the process of reshaping the natural environment is consciously guided and proceeds with consideration of the complicated interrelationships in the biogeocoenoses and all possible side and long-distance effects, then it can and must lead to human welfare. Based on this optimistic point of view is a behaviour that could be called the strategy of enriching nature. The followers of this strategy do not consider nature without reference to the needs of human society. Therefore, they are far from considering nature as an ideal system. They also rely on biogeocenology's basic notion of the equilibrium of the biosphere, but they view it as a dynamic long-term equilibrium of its main building blocks. One such basic building block is undoubtedly the Earth's flora, on which basically depend the chemical composition of the atmosphere, the quantity and quality of fresh water, the amount and distribution of precipitation, etc. Man must not avoid any interference with nature; on the contrary, he must contribute with all his strength to the consolidation of the balance of the biosphere.

In nature, the balance is constantly disturbed. The geological chronicle shows profound changes in nature: Ages, periods and epochs change; relief, climate, animal and plant life change fundamentally; new types and classes of animals appear; numerous organic forms die out. In even shorter periods of time, sometimes before the eyes of only a few generations of humans, many natural landscapes are transformed, plants or animal communities are replaced, the number and

composition of botanical and zoological species change. Strong fluctuations in the population of numerous animals and plants occur at an even faster pace - so-called "population waves". All these changes in nature do not seem to have any catastrophic consequences for the balance of the biosphere, but some of them are unacceptable to humans because they contradict the requirements of regulated economic management. Therefore, the mitigation of population waves is an important task: prevention of a precipitous decline in the population of farm animals, prevention of an undesirable increase in the number of harmful animals, stabilisation of the population density of animals at an optimal level.

The supporters of the strategy of enriching nature also consider nature to be a non-ideal system because its capacity to produce products useful to humans is very small and can be magnified several times over. They also cannot agree with the assertion that there is "no emptiness" in nature . The existence of "emptiness"- of unoccupied ecological "niches" makes the phenomenon of acclimatisation possible. The prevention of natural settlement and spontaneous acclimatisation of harmful animals and the scientifically based acclimatisation of beneficial animals can considerably increase the biological productivity of the biosphere. There is also no reason to assume that "nothing is superfluous" in nature. In a well-organised human economy, just as in its living environment, many species of animals, plants and microorganisms cannot be tolerated. Regulating the incidence of pests of agriculture, forestry and fisheries is a difficult but indispensable duty of man; it is a powerful lever for increasing the productivity of the biosphere. Adherents of the latter strategy do not construct a contradiction between exploiting nature and protecting it. They regard the protection of nature as an organic part of its rational use, transformation and enrichment.

G. I. Zaregorodtsev assumed in his contribution that the speed and extent of environmental change place new social-hygienic demands on environmental protection. In the normal and in the pathological state, the organism adapts to both constant and constantly or periodically changing milieu factors. Under present conditions, human activity influences both groups of factors. Therefore, a situation arises in which the previously stable environmental factors lose their stability and the variable ones not infrequently become even more unstable. All this affects the functioning of the compensatory and adaptive systems of the human organism. The disturbance of the ecological balance between the environment and the organism can lead to a disorganisation of the adaptive mechanisms and to the development of diseases, which sometimes develop in a hidden (latent) form in the first period and are temporarily and partially compensated. The adaptive process can only be considered normal as long as it does not reduce the viability of the organism and does not exert a negative influence on its genetic mechanisms. The adaptation of humans to their environment and the changes taking place in it is not limited to biological adaptation alone, but also contains a socio-psychological aspect.

All somatic and neuropsychic characteristics of the human organism are the result of a long-lasting evolution, the result of the formative influence of relatively stable ecological conditions (atmosphere, temperature, gravity, etc.). A drastic change in these conditions in the course of the life of one or a few generations can lead to the emergence of bioecological disharmonies, i.e. to the development of "situations in which the environmental parameters no longer correspond to the biological needs of the organism. In the process of human interaction with the environment, two important stages can be distinguished from an adaptive point of view. In the first stage, the impact of economic activity on the environment did not yet lead to the human organism and its adaptive mechanisms being stressed beyond the norms that arose in evolution. In the second stage, however, a completely new environment is created; thus, it becomes necessary to study the organism's reaction to this new environment. The human organism is not adapted to some of the new environmental factors. These include, in particular, new chemical substances, new types of energy and various types of radiation. Therefore, new occupational diseases, mass allergisation of the population, etc. are occurring.

When man changes the surrounding nature, he by no means frees himself from the effect of its laws. The possibilities of man to change the natural milieu are basically unlimited, but the adaptability of the human organism is limited. The pace of the organism's adaptation does not always correspond to the pace of change in the natural environment reshaped by man. Consideration of the biological norm of adaptive possibilities is an important methodological principle of any research on the interaction of organism and environment. The consequences of the influence of environmental factors on the organism depend on its genetic plasticity. This influence is compensated within certain limits by complicated autoregulations of the organism, which neutralise disturbances in the most important life processes. However, if the physico-chemical changes in the environment exceed the limit of the organism's adaptive capacity, this can lead to disease and even death.

In the past, most factors of external nature did not influence the organism directly, but mediated through various socio-economic complexes (housing, clothing, etc.). Today, however, the number and intensity of physical, chemical and other factors that directly affect the human organism and are only partially or not at all stopped by the various social buffers (this applies to radiation, ultrasound, electromagnetic fields, highly toxic chemical substances, etc.) is growing.). The intensive development of technology, the introduction of new substances and types of energy into all spheres of life, the development of chemistry and pharmacology, the mass use of chemical preservatives, fertilisers, etc. have the consequence that humans (as producers and consumers) are increasingly coming into direct contact with the new, "artificial" environment. The spread of a whole series of new diseases - genetic, toxicological, allergic and endocrine - is linked to the use of new types of substances and energies. For example, the incidence of "smog disease" is directly related to the level of air pollution. The so-called smog absorbs up to 25% of the solar radiation and about 50% of the ultraviolet radiation necessary for normal human development.

The maximum permissible concentrations of chemical additives in foodstuffs, the intensity standards for noise, vibrations, etc. must be set taking into account not only their possible pathological effect on the human organism, but also their possible direct and indirect influence on the socio-psychological and moral characteristics of the personality. In addition to the natural extreme zones (Arctic and Antarctic), artificial extreme zones (overpopulated, noise and smoke-filled cities in a number of capitalist countries) are also emerging today. Without special measures, a normal human life cannot be guaranteed in such zones.

The most important methodological and socio-hygienic principle for solving the problem of "man and the environment" is not to preserve the existing ecological balance, but to create a new system of bio-ecological balance under the conditions of growing material and scientific-technical possibilities, starting from optimal medical-hygienic normatives. For this purpose, social-hygienic prognoses of environmental change are necessary.

In the prognoses of environmental change, the concerns of the human being must not be pushed into the background by utilitarian understood economic interests. The essence of the socialist conception of the interaction of man and the environment consists in the demand to transform the environment according to the needs of the organism and in accordance with scientifically founded hygienic standards which ensure the physical and mental health of man. An environment must be created for human beings that meets not only their biological needs, but also their psychological, aesthetic and other needs.

G. A. Stepanski described the view that humans can adapt to a chemically altered environment in the same way as animals as biologically correct, but anti-human in its social nature. The adaptation of

animals takes place over the course of many generations due to the effects of variability, natural selection and heredity. From this biological point of view, however, the possibilities of human adaptation cannot be considered. Human adaptation must be examined primarily from social positions. Humans adapt to the environment by reshaping it according to their needs and interests. The specificity of human adaptation consists in its active character. In contrast, biological adaptation plays a secondary role in humans.

When chemical agents alter the psychological status of humans, they can lose their creative potencies and become incapable of performing their social functions. Chronic intoxication can make people socially invalid. It is very dangerous to underestimate the influence of a new chemical environment on man. In the complex study of the problem of "man and environmental pollution", chemobiology, which studies the reactions of living organisms to chemical effects, and toxicology as one of its branches play a major role. However, this science has not yet received the necessary attention in our country.

To illustrate the dangers of increased concentrations of chemical substances in the environment, some data on carcinogenesis are of interest. Each quantity of carcinogenic substances that enters the organism corresponds to a certain latency period of tumour formation. One can regulate this quantity in such a way that no tumour forms in the respective individual. However, because these carcinogenic substances circulate in the maternal organism, they influence the fruit, and tumours can form in the offspring. Therefore, we do not have the right to judge the significance of the chemical environmental factors solely according to their effect on the immediate individuals concerned, but must also take into account their influence on the state of health of the next two to three generations.

When projecting various economic measures, one must forecast their possible consequences. This applies first and foremost to chemical pollution. We must learn to predict their possible biological consequences already at the stage of laboratory testing of new substances, without waiting until their industrial production.

G. S. Chosin spoke about the need to search single-mindedly for new international forms of organisation of scientific and technological activity. One of the essential socio-political consequences of the present scientific and technological progress is the emergence of new directions of "technological" diplomacy, that is, new aspects of international relations regulating the activity of states in such relatively recent fields as the "exploitation of atomic energy", the appropriation of cosmic space and the exploration and use of marine resources. The cooperation of states in solving problems of conservation and rational use of natural resources is closest in character to these new branches of international activity, although it also has a number of specific features. One specific feature of international cooperation on the conservation and rational use of the natural environment is that it is topical for all states without exception.

In recent decades, international relations have undergone certain transformations that favour the organisation of cooperation on environmental problems. These changes include: the realisation by governments and the public of many states of the ecological dangers of a general nuclear war; the obvious increase in the interdependence of the economic activities of many countries and the consequent expansion of intergovernmental cooperation; the re-evaluation of the criteria and symbols of the strength and possibilities of states, since the power of a state is no longer derived from the size of its territory' but from the level of industrial and scientific-technical development and the mechanism of the state; the closer connection of problems of domestic and foreign policy; the increasing interest of states in finding ways to solve global problems such as the non-proliferation of new types of weapons, the development of marine resources, cosmic research' the rational use of natural resources, etc.

Particularly difficult in this context is, on the one hand, the connection between national and international interests and, on the other hand, the interaction of economic, political and ideological principles according to which states with different social orders strive to shape cooperation in the field of environmental protection. Such contradictions, however, should not be taken as an argument that the elaboration of a system of international measures to solve ecological problems is itself hopeless. Some concrete problems of this kind are already on the agenda of the practical activities of states. The joint activity of states in this field can fulfil the following main functions:

1. Exchange of information, collection and analysis of data on various physical phenomena ("monitoring"), consultations and provision of expert opinions at the request of governments of interested states, elaboration and implementation of national, bilateral, regional and international programmes, coordination of international activities, joint planning and financing.
2. Elaboration of appropriate international standards, creation of the information base necessary for such activity, introduction of standards to regulate the activities of governments and industries, sharing of expenses and profits associated with the implementation of ecological programmes.
3. Ensuring compliance with the established standards and mediating conflicts.
4. Development of international cooperation in the application of technology, in the rational use of existing resources' in expert assistance, research and development of new projects, etc.

The fulfilment of all these functions can be ensured by specialised international organisations in which as many states as possible participate fully and, as far as possible, on an equal footing.

American authors have set up projects for the creation of an autonomous World Centre for Environmental Problems or one operating under the auspices of the UN. Such a centre could develop conceptions of "ecologically rational" interactions of man and the natural environment and help to set the policy course of individual governments in accordance with the latest trends in technology and the ecological situation.

The diplomacy of the USA and other leading imperialist states is striving to extend its traditional methods of solving international problems to include measures to protect the environment. In view of this, our own initiative to formulate and implement international ecological programmes is very important. If our scientists and the institutions and specialists interested in solving this problem actively carry our ideas on ecological problems, our methods and forms of dealing with them into the international discussion, this will be of great significance for the protection of the living environment of man all over the world. The fact that the Soviet Union, with its centralised planning system, has already gained experience in the field of coordinating national and international plans is a pledge that our principles can be used as a basis for a global model of cooperation in this field.

A. A. Gorelov was concerned with the ecological relevance of the work on opening up the Earth's interior. For a long time, the exploration and transformation of the Earth was limited to its surface and atmosphere. At the turn of the century, a new stage in geology began. The construction of large buildings as well as dams and melioration plants and the enormous demand for various kinds of mineral resources led to the emergence of new branches of geology. Whereas 15 to 20 years ago it was generally believed that the extent of engineering geological processes lagged significantly behind the scale of natural processes, today this assertion can no longer be upheld without qualification. We also encounter negative consequences of human activity, the significance of which we are only just beginning to realise. How could this come about?

Here, the relics of a metaphysical approach to geology left over from the end of the 19th century once had an effect. The individual parts of geological systems were seen as autonomous entities that humans could reshape at will. Only those parameters were considered that directly and immediately influenced the functioning of the objects of production. This tendency to narrowly limit the field of research, dictated by technological and economic considerations, was aptly called the "tunnel perspective" by V. Hine. It was also expressed in the names given to the new sections of geology - engineering geology, economic geology, geotechnics.

The negative consequences of man's influence on geological processes also have social roots: the intensification of the contradiction between the objective needs of research and the uncontrolled, chaotic development of industry, characteristic of capitalism, whose goal is profit. These negative effects have become pronounced in recent years and have forced scientists to take a more realistic approach to the study of geological processes. Today, geologists are once again turning to the view of the earth as a unified organism, originating from Hutton, one of the founders of geology, and to Wernadski's doctrine of the structure of the earth as a mechanism coordinated in its parts.

The present biosphere is the result of the interaction of three qualitatively different subsystems - the geological-meteorological, the biological and the cultural (noosystem). Each of these subsystems develops according to specific laws. The field of functional connections and interactions between these subsystems is becoming increasingly dense. With the appearance of man and the expansion of his radius of action, the organising role in the biosphere has passed to the cultural system, which is at the highest level of organisation. The present-day extent of man's impact on the environment requires that the transformation of the biosphere be planned rationally. This requires the study of all interrelationships between geo-, bio- and noosystem.

New directions in geology are currently developing. In 1963, the Geological Survey of the State of Illinois (USA) proposed the term "environmental geology"; this science is intended to study the relationships between geological processes and human activity. As an analysis of the work of representatives of this direction shows, environmental geology deals with such issues as groundwater pollution, waste disposal, sanitary conditions for miners' work, protection of mineral resources and soil, but also with issues that until now fell within the competence of engineering geology and hydrogeology. This circumstance is explained by the fact that environmental geology has developed from engineering geology and hydrogeology, but has not yet completely separated from them. The theory of environmental geology is still undeveloped; the ideas about which specific problems this science must solve and with which methods this should be done are still unclear, which is also expressed in the term itself. Geology belongs to the sciences that mainly study the living environment of humans; consequently, the term "environmental geology" does not express the specificity of this direction. Perhaps this direction should be called ecological geology. Its task should be to study the functional laws of the geosystem under the conditions of its interaction with the noosystem. For this purpose, corresponding sections from practically all branches of geology would have to be united in ecological geology. Ecological geology would also include, for example, the (so far poorly developed) so-called medical geology, which deals with the effect of the composition of rocks on human health. Ecological geology is thus a part of human ecology and at the same time a part of geology; it represents a bridge between these sciences.

In recent years there has been much talk of a revolution in geology. Both the perfection of research methods on the basis of electronic technology and new, original hypotheses in tectonics are cited as its cause. However, we see its essence in the effort to investigate geological objects holistically, which already played a major role in the emergence of geology as a science. It is precisely with

this that the future progress of geology is likely to be connected. Man becomes a "geological force" in the true sense of this word, not only in scale but also in direction, when he studies the functional geological laws and learns to apply them in his activity.

D. V. Panfilov pointed out that human beings as living beings are subject to biological, ecological-geographical and social regularities. None of these laws excludes or replaces the other. At the same time, biological, ecological-geographical and social processes in human society come into contradiction, which not infrequently create conflict situations. This results in the need for a more thorough understanding of the relationships between human society and the environment.

In Panfilov's view, the pessimistic view that humanity, like other animal and plant species, will inevitably disappear in the future is not accurate. In principle, a species can exist indefinitely if only the environment remains relatively constant and suitable for the life of the species. If every species had to become extinct according to law, then the evolution of life on earth would be impossible.

Natural selection not only brings about a change in species; if the milieu is relatively stable, it can also stabilise their biological qualities. As is well known, social life arose and developed primarily to protect the biological interests of human beings, to protect individuals against the action of natural selection. In the early stages of the intrauterine life of individuals, natural selection in its stabilising form exercises its role without restriction. It reliably protects humanity from genetic degeneration. All other dangers threatening humanity (excessive increase in population, environmental pollution, decline of spiritual culture, etc.) can be successfully overcome on the basis of the development of just social conditions, cultural growth, humanism and demilitarisation. This is in the hands of the people themselves.

An important task of philosophy in solving ecological problems, as L. S. Abramov pointed out, is the struggle against hostile ideology. In bourgeois theories about the future of humanity and in anti-socialist, anti-Soviet machinations, ideas of catastrophic degradation of the natural environment, depletion of resources and a lack of space are now appearing more and more frequently. The nature of the earth is presented as a limiting factor in the development of humanity.

Soviet geographers share the basic principles of an optimistic conception of development and work on constructive problems of the transformation of nature, the location of the economy and optimal forms of settlement. Of great importance here is the way in which the general problem of ecology itself is posed. Abroad, and also in our country, the question of nature conservation has for a time been brought to the fore and any alteration of the biosphere has been considered undesirable. In this view, the activity of society and its needs function as a disruptive factor. However, the biosphere itself is the result of the development of an older system - the geographical envelope of our planet. A deformation of the biosphere is constantly taking place, with the influence of human society playing the decisive role in the final stages of its development. Restrictions, recommendations, prohibitions, control and propagation of nature conservation alone cannot prevent predatory destruction of nature. W. A. Geodakjan specifically addressed the scientific aspect of the problem of "man and the environment". The goals and tasks of science can be ordered as follows: Description, explanation, prediction, control and redesign. The better the system to be studied is described, the easier it is to explain it; the more correct the explanation, the easier it is to predict its behaviour; the better the prediction succeeds, the easier it is to control it; finally, when we have learned to control systems, we can also create systems with the behaviour we need. Of course, this does not mean a ban on approaching the solution of subsequent tasks until one has

solved the previous ones; but if we engage in control or redesign without the necessary understanding of what we need to do, then the chances of success are slim.

For the problem discussed here, we have so far only a certain description and unfortunately quite little knowledge, although the need to control the environment is already emerging. At the present time, we should concentrate our efforts on the *links of explanation and prediction*, because that is the most effective thing we can do at the moment. To solve this task, it could be very fruitful to use ideas and methods from general systems theory.

The problem of "man and the environment" is part of the more general problem of "living system - environment", which in turn is central to clarifying the question of the nature of life. Therefore, our discussion must inevitably touch on these more general questions.

If we consider a system as a totality of interacting elements, then we automatically define the environment as everything that does not belong to the system. Both the environment and the system evolve. But because the environment is larger than the system, the evolution of the system must be subordinate to the evolution of the environment. From the environment, both "harmful", degrading influences (hunger, cold, heat, etc.) and "useful", information reach the system. The idea of evolution includes two main aspects: maintenance and change. They are alternative - the more change, the less conservation, and vice versa. Many evolutionary systems resolve this conflict by differentiating into two subsystems: an inner one (which is further away from the environment) and an outer one (which is closer to the environment).

The question of whether humans are capable of further evolution is very important for understanding the problem of "humans and the environment". Some scientists assume that selection has lost its significance for humans and that humans no longer evolve. In our opinion, this is not correct. Human evolution is intense, only the factors that determine its direction have changed. Selection has only lost its importance for humans in terms of their resistance to "traditional" environmental factors (cold, hunger, predators, etc.). Instead, new environmental factors (above all social and technical) have appeared on the scene, which require humans to develop new characteristics. Among them, one can mention the ability to learn, the ability to cope with stressful situations, the speed of reaction and others. If these socio-psychological traits that are selected are connected with any morphological peculiarities of man (and this is necessarily the case), then these will also evolve rapidly. The evolution of man according to psychological and morphophysiological characteristics is therefore continuing. It is even more intense than it has ever been.

The question of whether humanity is threatened with a population explosion must be answered in the negative. The demographers who scare humanity with predictions of a population explosion overlook an essential fact - the existence of negative feedbacks that regulate population growth. Experiments by the American biologist Christian have demonstrated intricate feedback mechanisms in populations of rodents. When their numbers increase, their adrenal function increases; at the same time, their mortality increases and their reproductive function is suppressed. There is also an external feedback loop: reproduction –lack of food and starvation– numerical decline. Evolution has thus even produced a double feedback mechanism in rodents. Other such examples are also known. In all likelihood, such regulatory mechanisms also exist in humans. The cessation of population growth or the slowing of the rate of growth observed in many developed countries, in large cities, in individual social groups, etc., testify to the existence of such mechanisms. In examining them, we must ask whether we can rely solely on natural regulatory

mechanisms, whether they satisfy us from the point of view of humanism and ethics, or whether artificial regulation is necessary.

Another natural way to regulate the size of a population is to regulate the sex ratio. When the population increases and the environmental conditions are unfavourable, the sex ratio of the animals shifts in favour of the males, and this leads to a reduction in the number of offspring. If conditions are favourable and the population is small, on the other hand, the fertility of the females increases, and as a result the number of offspring in the population increases. An example of the underestimation of the role of negative feedback is the view that artificial regulation of sex could be dangerous for humanity because the parents could preferentially choose one of the two sexes. In fact, if children were free to choose their sex, the optimal sex ratio in a human population would be established by social feedback. After all, parents also freely choose the names of their children, and yet there is no danger of all parents giving their children the same name.

According to A. J. Medunin, for the first time in history a situation has arisen in which the existence of Homo sapiens as a biological species is called into question. Among the various factors of the ecological crisis, the pollution of the environment by harmful production waste is of particular importance. Industry today produces in principle new kinds of materials that never existed in nature in the past and are in many respects alien to living organisms in terms of their physicochemical structure. The harmful pollutants released in the industrial zones spread over the entire surface of the earth as a result of the natural circulation of water and air masses and reach the stratosphere and the deep sea. In addition, trade, tourism and the various forms of international cooperation that have developed unusually in the 20th century cause new materials, medicines and foodstuffs, and with them bacteria and viruses, to spread throughout all countries, creating a biogeochemical living environment similar for all humanity.

Almost every human being can, within certain limits, adapt to a change in the physical parameters of the environment (temperature, pressure, humidity); many people can, over time, become accustomed to mechanical pollution such as dust and smoke and acquire natural or artificial immunity to a number of pathogens and to relatively inert chemical compounds. However, no human being (regardless of health status) is able to resist for a long time the impact on his organism of arsenic, mercury, lead, sulphur and fluorine compounds, of various pesticides, etc., the amount of which is constantly increasing in our environment.

There is another priority problem, on whose solution depends not only the preservation of humanity, but also the preservation of our planet's fauna. It is well known that almost all the free oxygen in the atmosphere is of biogenic origin; about 30% is released by the green plants of the land and 70% by the algae of the world's oceans. Considering that two-thirds of the world's forests have already been destroyed and that logging has so far significantly exceeded new planting, the ecologists' calls to keep the ocean clean and to increase green areas all over the world become understandable. The earth's population needs more and more oxygen not so much for breathing purposes as for the rapid development of industry and transport. A motor vehicle, for example, uses as much oxygen to travel 1000km as a person needs to breathe in the course of a year. A jet plane needs 35 to 50 tonnes of pure oxygen for a transatlantic flight. However, a considerable part of this oxygen combines with the carbon in the fuel to form carbonic acid, which is decomposed again by the green plants of the ocean and the mainland. In the last quarter century, however, two new factors have become operative in the biosphere that greatly reduce the effectiveness of photosynthesis. One of these factors is petroleum and petroleum products, the other is pesticides, especially DDT.

Every year, more than 6 million tons of petroleum and petroleum products are spilled into the ocean as a result of tanker accidents, oil drilling in the sea, cleaning of tanks, etc. The oil spreads on the surface of the water over thousands of square kilometres and impedes the exchange of gases between the ocean and the atmosphere; at the same time, it increases the reflectivity of the water surface, which lowers the temperature and reduces the productivity of phytoplankton. Petroleum in large concentrations also directly kills not only unicellular organisms, but also marine animals, fish and birds.

In the last quarter of a century, more than 1.5 million tonnes of DDT have been sprayed on fields, gardens, forests and swamps around the world to control agricultural pests, malaria mosquitoes, etc., not counting other even more active pesticides. Rain and wind ultimately cause the pesticides to collect in the sea and be carried across the globe by ocean currents, so that high concentrations of DDT can even be found in the liver and fatty tissue of Antarctic seals and penguins. Because this pesticide decomposes extremely slowly, two thirds of the DDT used (i.e. **1** million tonnes) has retained its activity to this day. The interaction of petroleum, pesticides and harmful chemical production wastes can produce a combined effect on living organisms that significantly exceeds the sum of the effects of the individual components. Growing pollution can severely reduce the productivity of single-celled organisms other than phytoplankton, disrupting the chains of the biotic cycle in the foundations of life. Despite warnings from eminent scientists about the harmful consequences of pollution, the public and politicians in many countries have only recently become aware of this danger. Because the atmosphere, oceans and major rivers know no national boundaries, the pollution of the biosphere can only be stopped by the efforts of all countries. Developed countries bear a special responsibility in this regard. Recently, there has been increasing news that the USA is trying to exploit its activities in the field of environmental health to achieve traditional imperialist goals. In this context, measures must be taken so that when a situation of conflict arises between humanity and the biosphere, the economy and science of the socialist countries are more prepared to study and solve this problem. The recent decisions of the CPSU, the Soviet Government and the Supreme Soviet are characterised precisely by such an approach to ecological problems. The movement for the protection of nature in the Soviet Union, which began soon after the October Revolution, did not, as a rule, go beyond national borders - although a great deal of work has also been done within this framework to preserve at least individual territories in an untouched state and to transform nature, especially in climatically and agriculturally unfavourable areas (deserts, swamps, etc.).), our philosophers and sociologists have for a long time almost completely ignored this problem. l963 saw the publication of the first major work on philosophical problems of the sciences of the earth. This had been written by a collective of philosophers, geographers and geologists on the basis of materials from a scientific conference held in 1961. In the mid and late sixties, research on the interaction of society and nature continued to develop, but in "arithmetic progression", so to speak, while the world literature on the subject increased in "geometric progression" and has literally grown exponentially in the last three years. If the stream of such literature found its readers and buyers, it testifies to a certain social need. There is no doubt that Western scientists have conquered certain positions in the field of ecology, but one must not simplify the situation and claim that bourgeois propaganda has profited from it. Among contemporary Western scientists and publicists writing about the ecological crisis of today's civilisation, there are in fact a considerable number of progressive authors who examine the problem objectively and attribute the blame for the aggravation of the ecological crisis wholly or partly to the capitalist order. But where there is a real "vacuum" of constructive and positive ideas on the problem of the interaction of humanity and the biosphere, this vacuum is naturally filled somehow, including with ideological rubbish and with superficial, ill-founded conceptions. Insufficient work on problems of the biosphere, the ecological crisis and especially pollution would lead to a serious backwardness in the USSR in the coming years compared to the level of advanced

research. Because the problem of the ecological crisis itself bears a complex character, the investigations and solutions to these problems must also be of a complex nature. Inadequate analysis of the philosophical and sociological aspects of the ecological crisis can cause not only ideological but also material damage. So far, it is not uncommon in the USSR for facilities to prevent harmful effects of production on nature to be built only after industrial complexes have already been built or are even already producing. This is always technically complicated and economically costly. But if the factor of environmental protection is taken into account at the research and development stage, the new technology will not only meet the requirements of environmental hygiene, but will also be significantly cheaper. The problem also has an important foreign trade aspect.

If one takes into account that the ecological contradictions can only be overcome by united efforts of all countries in the process of the inevitable Ecological Revolution in industry and agriculture, in transport as well as in the communal economy and finally in the thinking of the people themselves, then one can say with full conviction that in five to seven years only such industrial equipment and means of transport will be saleable on the external market that pollute the environment minimally. Perhaps by the end of the 1970s the ecological value of new technology (i.e. its harmlessness to the environment) will become the decisive quality feature. In such a situation, it will be quite natural that, taking into account the perspective, not only industrially developed but also developing countries will buy on the world market only those industrial and transport equipment that function according to the principle of waste-free technology or are equipped with effective purification systems. We must not underestimate the possibilities of the industry of the capitalist countries in this respect. The largest American companies expect to bring out cars in 1975 or 1976 which will be more expensive but will reduce harmful exhaust gases to fractions of their present value. Various companies are already looking for waste-free technologies and new ways to reuse waste products in chemical, metallurgical, textile, cellulose and paper production. After the American president spoke out in a series of messages on environmental protection, the share prices of all those industrial companies in the USA that are engaged in combating water pollution, cleaning smoke and exhaust gases, designing apparatus for absorbing and processing pollutants, etc. have risen very rapidly.

A new area of peaceful competition between the socialist and capitalist systems is emerging: the struggle to overcome the ecological crisis, to keep the environment clean. So far, we are ahead in this contest; but we must not lag behind, because lagging behind in the field of economic ecology harms nature and also our social prestige.

Man today, noted J. G. Rychkov, has recognised as never before the finiteness of his habitat and the uniqueness of the system of the biosphere in which he is included. The question of determining the optimal limits and norms that ensure man's equilibrium with the other components of the biosystem can no longer be considered unjustified or an expression of pessimism today. These limits and norms can only be determined by taking into account the natural history of human development. Like all other forms of life, the human being of today is adapted to the concrete environmental conditions. This adaptation is a condition for the viability of our species. As long as the system of life is not threatened by cataclysms, it keeps the adaptability of each of its forms - humans included - at a certain optimum, which corresponds to the equilibrium state of the system. We should finally move from the still dominant ideas about the development of humanity as a process of further "subjugation", "transformation" and "improvement" of nature, the creation of a "biotechnosphere", etc., that is, from the extensive type of development of life to the philosophical, psychological, ethical-aesthetic and scientific analysis of the possibility of a stationary state of humanity in the system of nature. The realisation of this possibility would mean the transition to

an intensive type of development of the human form of life, as can be observed in all new forms of life after a phase of expansion. It is of course no coincidence that the ecological crisis began precisely in the developed capitalist countries and that the type of capitalist society with its spontaneous regulation exerts a correspondingly spontaneous influence on the environment. But the developed socialist countries can also be confronted with such a crisis if the scientific study and philosophical reflection of the relations of nature and society lag behind the pace of economic and cultural development in these countries.

The question is whether the object of our discussion is not the product of a certain type of development of culture and civilisation, which could be called the Western European (now European-American) type. In elaborating measures on the problem of "man and the environment", we in the USSR have a somewhat larger reserve of time and can therefore analyse in depth all aspects, including the latter, since the type of culture is at the same time a type of interaction of man with his environment. One of the parameters for determining the type of culture is the conception of man's role in the world. In the history of European civilisation, a view has emerged according to which man is the crown of creation, the ruler over nature, the final stage of evolution. In this system of thought, man is placed above all the rest of the world. This is also connected with another parameter of Western European civilisation: Its development always followed the principle of negation of equilibrium with the environment. This enabled rapid progress in economy, science, and culture, but at the same time it also led by law to a state of affairs that we discuss today as catastrophic. It is significant that today's leading countries of the Western world, in determining measures to stabilise their own environmental situation, resort to the resources of the environment in other countries and on an international scale- Such measures grant a respite but are not a positive solution to the problem.

If one agrees with these considerations, one must ask the question: Is it possible to choose a different path of development of civilisation, in which the achievements of European culture are preserved, but its fundamental parameters are changed, and its conceptions of values and its conception of the world are revised? Turning to the experiences and cultural history of the peoples of the USSR and other socialist countries shows the possibility of another path of harmonious development of man and his culture in the system of nature.

W. A. Los emphasised that an adequate interpretation of the problem of the biosphere requires the elaboration of theoretical principles and a category apparatus. Until recent times, one of the leading tendencies in the development of science was its "physicalisation". Physics most actively assimilated the results of other sciences and, on the other hand, stimulated their development. Investigations into philosophical questions of physics found a special resonance. One of the determining developmental tendencies of modern natural science is that it is no longer individual sciences that play the central role, but rather certain problems for whose solution natural and social science research results must be used. Since about the mid-1940s, the problem of nuclear physics and the associated technological, economic, social, ethical and other questions have been in the foreground. This problem is still relevant today. However, the needs of practice have meant that it now appears in a wider context. Since the early sixties, the problem of the "biosphere" has become such a focal point of knowledge. In dealing with their specific topics, the basic sciences are increasingly forced to focus on solving problems of the biosphere. Thus, physics is required to develop such methods of supplying society with energy that do not contaminate the environment with radioactivity; biology is to breed plants with a high photosynthetic capacity; chemistry must develop such plant protection agents that do not lead to chemical pollution of the biosphere, etc. For the concrete solution of certain aspects of the problem of the biosphere, mathematicians must try to find a common language with biologists (biocybernetics), and both in turn must cooperate

with chemists, physicists and geographers. One could speak of a tendency towards the "biologisation" of natural science, or more precisely its "ecologisation". The science that studies the interactions between humans and their environment is ecology as a branch of general biology. Traditional" ecology studies the interrelationships of plants, animals and humans from a biological point of view: today, however, it is urgent to "socialise" ecology. In perspective, it is ecology that can become such a complex discipline, drawing equally on natural and social sciences to solve its problems. The "ecologisation" of modern natural science by no means means that other structure-determining developmental tendencies of scientific knowledge ("physicalisation", "cosmisation") disappear or lose significance. It is only a question of a certain dominance of the tendency towards ecologisation in the current developmental stage of the scientific-technical revolution. The role of philosophy here obviously consists in the methodological unification of the special conceptions and in the elaboration of a unified conceptual model for solving the problem of the biosphere.

I. T. Frolov drew attention to the fact that in this discussion the philosophical and sociological aspects of the problem have almost not been discussed at all. The discussion must be continued in this direction. The discussion group should promote the study of these problems and also draw more attention to them from philosophers. However, working out these problems is a lengthy process. Philosophy's contribution to solving these essentially sociological problems can be to work out certain general methodological principles for this purpose. The ecological problem will undoubtedly always provoke discussion. This is a new way of interaction between technical, natural and social sciences. Obviously, it is now necessary to specify the principles of the division of the sciences themselves, including their organisational division; the existing division does not ensure the intensive treatment of the problems of nature and society. The most current of these problems seem to require non-traditional, new forms of research and also of their organisation.

Notes

1. For J. K. Fyodorov's views on the problem under discussion, see also his essay "Current Problems of the Interaction between Society and the Environment". In: "Soviet Science/Social Science Contributions", 1973, issue 3. In the same issue the following contributions on the environmental problem appeared: "On the strengthening of the Nature Conservation and the Improvement of the Use of Natural Resources in the USSR"; N. Fedorenko, K. Gofman: "Rational Design of the Environment as a Problem of Optimal Planning and Management"; B. Maklyarsky, K. Tarasov: "Monopolies versus the Environment"; G. I._Zaregorodtsev: "The 'Technification' of the Environment and Human Health". - Red. SW/GB. See also M. I. Budyko: Tschelowek i biosfera, "Woprossy filosofu",1973, issue 1. See P. Oldak: Scientific and Technical Progress and New Aspects of Economic Analysis. In: "Sowjetwissenschaft/Gesellschaftswissenschaftliche Beiträge" , 1972,Heft 1.

2. J. W. Forrester: World Dynamics, Wright-Allen Press. Inc, 1971.

3. Cf. R. L. Heilbroner: Growth and Survival, "Foreign Affairs", Vol. 51, 1972, No. 1.

4. S. Mansholt e. a.: Ecologie et révolution. "Nouvel Observateur", Paris 1972,No. 397, Suppl. spec., p. II.

5. 7 Cf. the article by C. Kaysen in: "Foreign Affairs", July 1972,pp. 660-.