EARTH SCIENCES

VERNADSKY'S NOOSPHERE AND CRITICAL POINTS OF ITS REALIZATION

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Abstract

The analysis of the possibility of implementing V.I. Vernadsky's noosphere in the most critical areas and points of development of the biosphere and human life is carried out. The tasks are solved to assess the potential of the formation of the noosphere, depending both on human activity and on the laws of nature: the development of the economy and the growth of scientific and technological progress, the sources and limits of long-term energetic and climate conditions, the stabilization of the Earth's population, the preservation of the natural environment, the cessation of wars.

Keywords: Noosphere, critical point of development, eschatological concept, teleological principle, bifurcation point, systemic economic crisis, population stabilization, global warming, low-carbon energy, age distribution.

1. Introduction

The author of this article set the task to assess to what extent V.I. Vernadsky's faith in the noosphere can be realized and is being realized at critical points of modern and future reality. V.I. Vernadsky was the author of the noosphere doctrine, he believed that the noosphere must necessarily arise, and even wrote in the midst of World War II that humanity was already entering the era of the noosphere.

In the early 20s of the XX century, the theory of the noosphere was developed almost at the same time by Eduard Le Roy, Teilhard de Chardin and V.I. Vernadsky. We can celebrate the centenary of this concept and three theories together with the 160th anniversary of V.I. Vernadsky.

All three were famous scientists, and Teilhard de Chardin was also a member of the Jesuit Order and a priest. They were united by a high moral attitude to the idea of the noosphere, which E. Leroy and T. de Chardin considered to be discovered by V.I. Vernadsky. If E. Leroy and T. de Chardin saw in the noosphere the main phenomenon of connection with God, then V.I. Vernadsky was, first of all, a geologist and sought to find a material connection of the noosphere with human activity.

E. Le Roy was a mathematician, paleontologist and anthropologist, the most complete embodiment of his theory was found in the idea of vitalizing of matter, that the final point of the development of the noosphere will be merging with God.

A more complex concept of the noosphere was developed by T. de Chardin [28, 29]. In his understanding, the noosphere is based on the divine will, and the noosphere is a qualitatively new state of concentration of consciousness of the creator of the world, embedded in primary atoms and molecules, subsequently developed into new forms that form a special sphere of the spirit, a "thinking layer" covering the Earth. Like the biosphere, it is another earthly shell, a cover unfolding "over the world of plants and animals – outside the biosphere and above it." The culmination point of the noosphere development will be a kind of higher consciousness, in which, having received a new quality, the whole set of individual consciousnesses will gather. The personality will not be lost in this higher consciousness. Individual human consciousnesses will continue to be aware of themselves in this common consciousness, moreover, thanks to the mutual convergence of their individuality will be enriched.

While on a business trip to Paris in the early 20s, V.I. Vernadsky conducted intensive scientific work and lectured on geochemistry at the Sorbonne and at the Ecole de France. The result of this work were his articles on mineralogy, geochemistry, biogeochemistry, problems of studying living matter and the biosphere. He emphasized that with the appearance of man in the history of the Earth, a new geological period and even a new geological era began. As a result, three concepts of the noosphere were formulated and developed in those years. The concept of V.I. Vernadsky will be the object of our research.

In 1924 V.I. Vernadsky published the book "Geochemistry" in French [32], the Russian translation of this book was published in 1927 [35]. He wrote: "Over the past decade or two, we have seen an amazing growth rate of geochemical work of mankind. With man, undoubtedly, a new huge geological force has appeared on the surface of our planet. The balance in the migration of elements, which has been established during geological times, is disturbed by the mind and activity of mankind."

In those years, V.I. Vernadsky confined himself to a descriptive interpretation of the discovered phenomenon. E. Le Roy was one of the listeners and admirers of his lectures in Paris, he proposed to call the new stage of the biosphere's existence "noosphere". Since then, the term "noosphere" was supplemented by the term "noosphere", which was proposed in 1875 by the Austrian geologist Eduard Suess.

In those years, V.I. Vernadsky limited himself to a descriptive interpretation of the open phenomenon. E. Le Roy was one of the listeners of his lectures in Paris and admirers, he proposed using this term to call a new stage of the existence of the biosphere "noosphere". Since then, the term "biosphere", which was proposed in 1875 by the Austrian geologist Eduard Suess, has been supplemented by the term "noosphere".

V.I. Vernadsky published a detailed teaching about the biosphere in 1926 in his classic work "Biosphere" [34]. Unlike his contemporaries, who believed that the purpose of organisms is to adapt to the environment created by nature, he introduced the classic concept of "biosphere", which consists in the fact that the living matter of the planet acts as a powerful geological factor that has changed the surface of the planet for many years of the existence of "living matter".

The doctrine of the noosphere has become a new, no less important achievement of V.I. Vernadsky. He argued that the noosphere develops from the biosphere and is formed by human labor and intelligence. The most important ideas about the noosphere were formulated and presented by him during World War II in 1943, the article [33] was published in 1944. This was his last lifetime publication. V.I. Vernadsky became the creator of the two most important modern concepts "biosphere" and "noosphere", as well as the corresponding sciences.

According to V.I. Vernadsky, the noosphere arises from the biosphere and human labor. It develops with the participation of conscious work of people. He wrote: "Humanity, taken as a whole, becomes a powerful geological force. And before him, before his thought and work, there is the question of rebuilding the biosphere in the interests of free-thinking humanity."

V.I. Vernadsky believed that the conscious activity of people leads both to the improvement of the geological environment and man: "The noosphere is a new geological phenomenon on our planet. In it, for the first time, man becomes the largest geological force. He can and should rebuild the area of his life with his work and thought, more and more creative opportunities are opening up before him. And maybe my granddaughter's generation will already be approaching their heyday."

For V.I. Vernadsky, E. Le Roy and T. de Chardin, the noosphere was an eschatological concept (from the ancient Greek "last"), the same as "the last judgment or "communism" - each of them will come at once for all mankind, no one knows when it will come, if it comes, then should last forever. V.I. Vernadsky wrote in [33]: "The noosphere is the last of many states of biosphere evolution in geological history".

Two authors of the doctrine of the noosphere , E. Le Roy and T. de Chardin , were also convinced that the noosphere is a teleological concept, i.e. having a predetermined goal, and it must necessarily be realized. Aristotle formulated this concept, believing that just as human activity contains an actual goal, so natural phenomena have an immanent potential external goal, which is realized in the process of their development. Teleological views were mainly used by defenders of the idea of expediency established by God. V.I. Vernadsky was not a believer. He wrote in his scientific works that the noosphere is a phenomenon discovered by him, it arose from the biosphere, thanks to human activity, and that his conclusion is the obligatory onset of the noosphere. However, there are no his statements that noosphere is teleological object and it has a divine origin. He wrote: "I do not see God's manifestations in the world and I think that this has entered into the representation of humanity not in a scientific way and it was the result of a misinterpretation of the nature around us".

2. The realities of the noosphere

V.I. Vernadsky had no expectation of possible destruction of the geological and natural environment by human action. However, he was aware that development can and does have not only positive achievements. He wrote: "The face of the planet is changing by man physically and chemically. Man must now take greater and greater measures to preserve for future generations the riches of the sea that do not belong to anyone."

There is some ambiguity in the statements of V.I. Vernadsky. On the one hand, for him the noosphere was an object, the potential purpose of which must necessarily be realized in the process of development. So, he wrote: "We can look at our future with confidence." On the other hand, as a geophysicist, he understood that "the biosphere – chemically changes dramatically by a person consciously and mainly unconsciously" and that "the course of this process is just beginning to become clear to us." Apparently, his thoughts - from the certainty of the transition of the biosphere into the noosphere to the realization that the onset of the real noosphere is not inevitable, did not have time to form. In addition, there were no noticeable negative impacts on the biosphere in those years, and the current task of fighting for the preservation of nature was not so urgent.

Currently, there is a numerous literature evaluating the meaning of the concept of the noosphere, its connection with the concept of the biosphere and others, but there are no works evaluating the possibility of implementing the noosphere and analyzing the critical regimes of humanity and the biosphere responsible for its onset. V.I. Vernadsky did not identify the problems of the possibility or impossibility of the future formation of noosphere factors, without which its onset would be impossible: violation of the natural environment, development of energy and a long-term energy source, economy, demography, human mentality, and others. At the time of V.I. Vernadsky, such problems either had not yet arisen, or he did not associate them with the noosphere. The formulations and the importance of awareness of these problems appeared later, and the analysis of the possibility of their implementation became possible only today.

Previously, the author investigated the current level of development of the world and the direction of its development according to the principle based on the concept of "current weaknesses" or "current minimum levels" [23, 24]. The presence of severe poverty in countries was seen as a denial of the noosphere, high "medieval" mortality rates in some countries were con-

sidered incompatible with the noosphere. This approach allowed us to identify many previously undetected "weak points" in the development of the world.

In this article, the author intends to explore the possibility of implementing the noosphere in the most critical areas and points of development of the biosphere and human life, that is, to assess the extent to which V.I. Vernadsky's faith in the noosphere is realized in the modern and can be realized in the future reality. The purpose of this article is to assess the potential for the formation of the noosphere, depending on both human activity and the laws of nature.

3. Economy and high-tech development

According to Fernand Braudel [2] ancient civilizations developed mainly on the basis of slash-and-burn agriculture according to a cyclic agrarian scheme. The tribe burned the forest, cultivated the fertile land until the soil was depleted or the number of the population grew greatly. As a result, hunger appeared, it was necessary to move to a new, untreated place.The cycle was repeated in a new place or in a new civilization.

This situation is confirmed by mathematical modeling based on the economic model of A.M. Tarko [21, 25]. Fig. 1 shows the rise and decline of the development of individual civilizations for more than ten thousand years in the presence of the growth of technological progress. Several complete cycles of the civilizations development are reproduced: the dynamics of capital, population, agricultural resources, the level of scientific and technological progress (high tech progress) from the beginning of growth to degradation, and then the emergence and development of a new civilization. It can be seen from the figure that the model reproduces an increase in the rate of development and frequency of civilizations change over time. It also reproduces an increase in the minimum and maximum population, an growth in the living standard (an increase of capital) and, importantly, an increase in the minima and maxima of resource fluctuations.

In the ancient primitive scheme, a civilization perishes and a new one is reborn, in the modern one, a complex restructuring and rebirth takes place with new parameters of the system and sometimes participants.

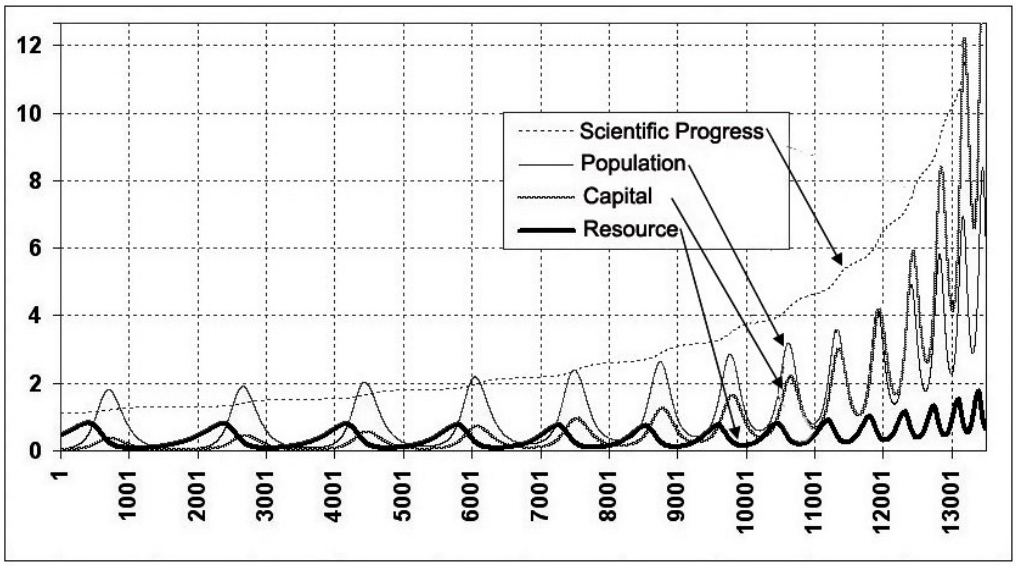

Fig. 1. Modeling of cyclic development of civilizations in the Ancient and Middle Ages

In the works of I.G. Pospelov [17], A.M. Tarko and V.N. Novokhatsky [27], M.Y. Portnoy and A.M. Tarko [16], economic models were developed that reproduce the dynamics of the both ancient civilizations and modern world system. The models were confirmed by computer calculations. There are many variables in the models, but the main ones are six main ones: population, capital, the amount of natural resources, the amount of pollution, the share of capital in agriculture, and high tech progress. In real life, the influence of epidemics and wars was added to this. Also, the death of civilizations was sometimes caused by climatic catastrophes. In these theories and mathematical models of economics, high tech progress is presented from the very beginning as an element of theory.

It followed from the simulation that the possibility of positive development of mankind in modern life can be provided only with the constant growth of high tech progress. Another property feature of the model was a decrease in mortality with an increase in living standards. Taking into account the high tech progress proved to be necessary and also made it possible to obtain sustainable development with a high standard of living within the framework of the model and to achieve stabilization of the population. The absence of high tech progress and the associated with it non effective use of resources led to depletion, starvation, increased pollution and the subsequent death of the biosphere, and with it humanity. Another result of modeling obtained by I.G. Pospelov was the possibility of periodic occurrence of economic crises of the world system as a result of oversaturation of sales markets in a successfully developing economy [17].

The model of modern civilization which is based on J. Forrester [7] has a mathematical model of the world containing the same main variables, but without high tech progress. The main result of his work is the conclusion about the final insurmountable catastrophic decrease in the population, the growth of pollution, the depletion of biosphere resources, which is interpreted as the degradation of human civilization and the biosphere. Measures such as reducing the use of natural

resources, limiting fertility, reducing the impact of pollution are not able to eliminate the outcome, at best they can delay it.

Similar conclusions on other models of this class were obtained by D. Meadows, a follower of J. Forrester [10, 11]. The main conclusion from the works of J. Forrester and D. Meadows, consists in the fact that the technologies that existed in the early 70s were not able to provide a high standard of living for humanity for a long period of time.

These models were important and very popular for the time of their creation, they gave an understanding of the processes taking place then. The main result at the models of J. Forrester and D. Meadows from modern positions, is that, in fact, they reproduce one of the periods of the cyclical agrarian scheme of F. Brodel. In the books of J. Forrester and D. Meadows, at best, considered several constant levels of high tech progress, which in principle could not give a forecast of sustainable positive development.

From the conducted modeling, it can be determined that it is fundamentally important for the noosphere to determine what the development of the economy is, how the high tech progress is developing, whether there is a long-term energy source, whether the preservation of the natural environment and climate that satisfies a person is carried out, whether it is possible to stabilize the population of the planet.

In the article, data for plotting and analysis were obtained in the World Bank [36] and the Gapminder organization [18].

4. Economy and rising living standards

Fig. 2 shows the dynamics of GDP in three groups of countries of the world – with European Union, North America, and High–income (World Bank classification) over a period of time with a lifetime of one generation from 1971 to 2019, as well as the group of the poorest countries - the least developed countries (LDC) (UN classification) during 1981-2019. We see fluctuating curves, while from 1972-1973 to 2018-2019, annual growth[1] rates decreased in the European Union from 5.4% to 1.9%, in North America from 5.5% to 2.6%, in high-income countries from 5.9% to 2.1%. During this period, five times the GDP growth rate in the group of the most successful countries in the world became less than zero – economic growth was slowed down. These were the years of several economic crises, including the systemic crisis that began in 2008 and three years of the serious global COVID-19 pandemic that claimed many lives.

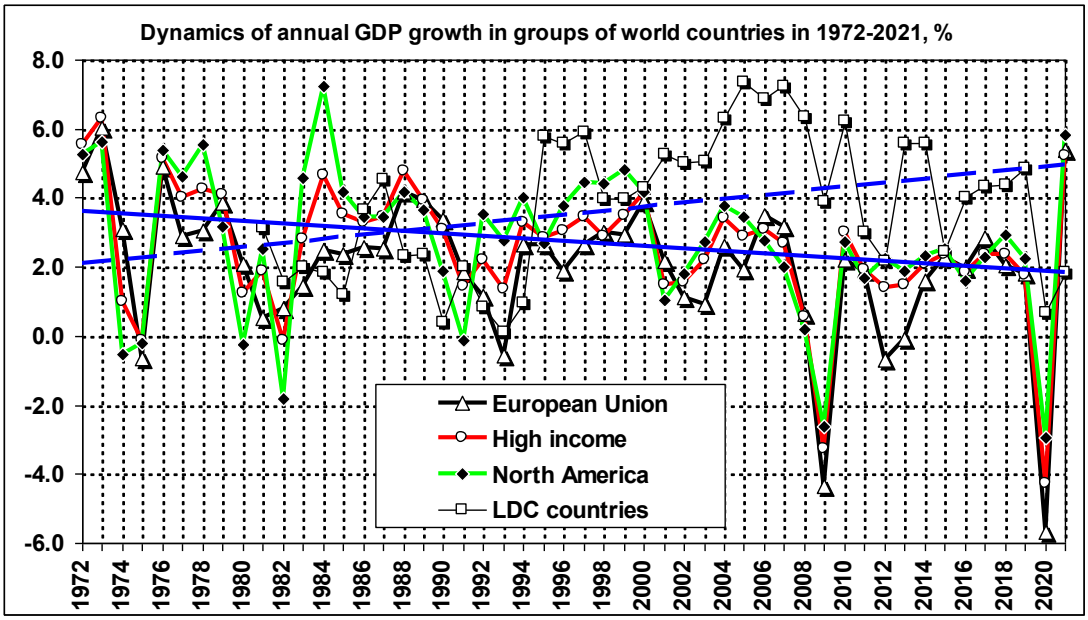

Fig. 2. Dynamics of GDP growth rates of four groups of countries in the world in 1972-2019. Linear regressions were carried out for High-income countries (solid line) and LDC (dashed line).

However, under these circumstances (Fig. 3), GDP per capita increased significantly in 1990-2020 - 2.6 times in the North America group, 2.3 times in the group of High-income countries, 2.2 times in the European Union, 3.1 times in the the LDC.

During these years, income from exports of goods and services increased 3.3 times in the European Union compared to 2000, 2.9 times in high-income countries, 2.2 times in North America, 6.3 times in the least developed countries.

Table 1 presents data on the increasing growth of exports of goods and services in a number of advanced developed countries and in three groups of countries in relation from 2000 to 2010 and 2021. Income from the export of high–tech goods increased from 2000 to 2021 in the European Union - by 3.3 times, in High-income countries by 2.9 times.

[1] The values of the mode (the most frequent values) of empirical distribution functions are given.

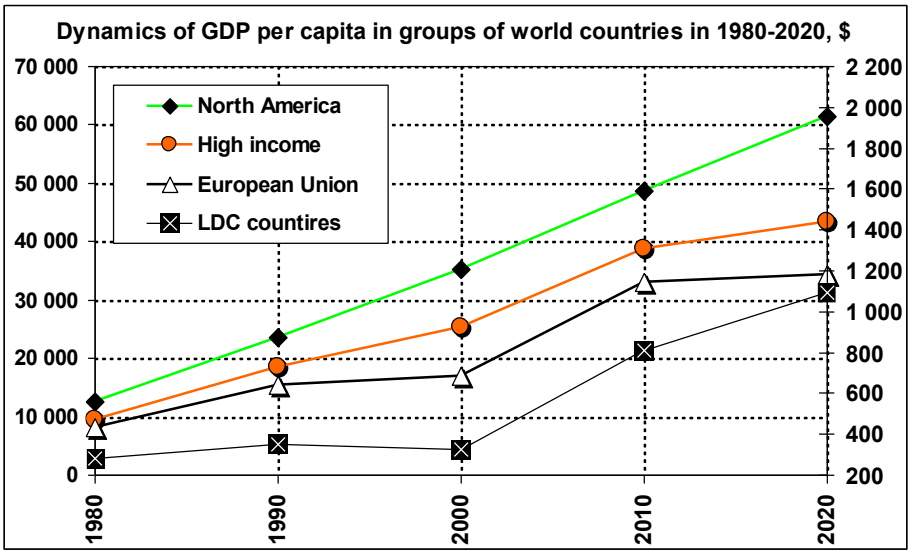

Fig. 3. Dynamics of GDP per capita of three groups of developed countries of the world (left coordinate axis) and the group of LDC (right coordinate axis) in 1980-2020.

Table 1. Growth of exports of goods and services (in current US dollars) in relation to 2000.

Country	2000	2010	2021
Ireland	1.0	2.4	7.2
Germany	1.0	2.4	3.3
Netherlands	1.0	2.1	3.0
Belgium	1.0	2.1	3.0
Spain	1.0	2.2	2.9
Italy	1.0	1.8	2.3
USA	1.0	1.7	2.3
France	1.0	1.8	2.2
Finland	1.0	1.8	2.2
Great Britain	1.0	1.7	2.1
European Union	1.0	2.3	3.3
High income	1.0	2.1	2.9
North America	1.0	1.6	2.2

These data indicate an increase in the standard of living of the population and the technological level of highly developed countries to new heights. Despite the existence of a global systemic economic crisis in these countries, over the past 30 years, the standard of living of their population has more than doubled.

Fig. 4 shows the dynamics of GDP per capita of several advanced developed countries of the world: Denmark, the Netherlands, Austria, Iceland, Germany, Sweden, Belgium, Australia, Finland, Canada, Great Britain, France, and Italy in 1900-2022 [29].

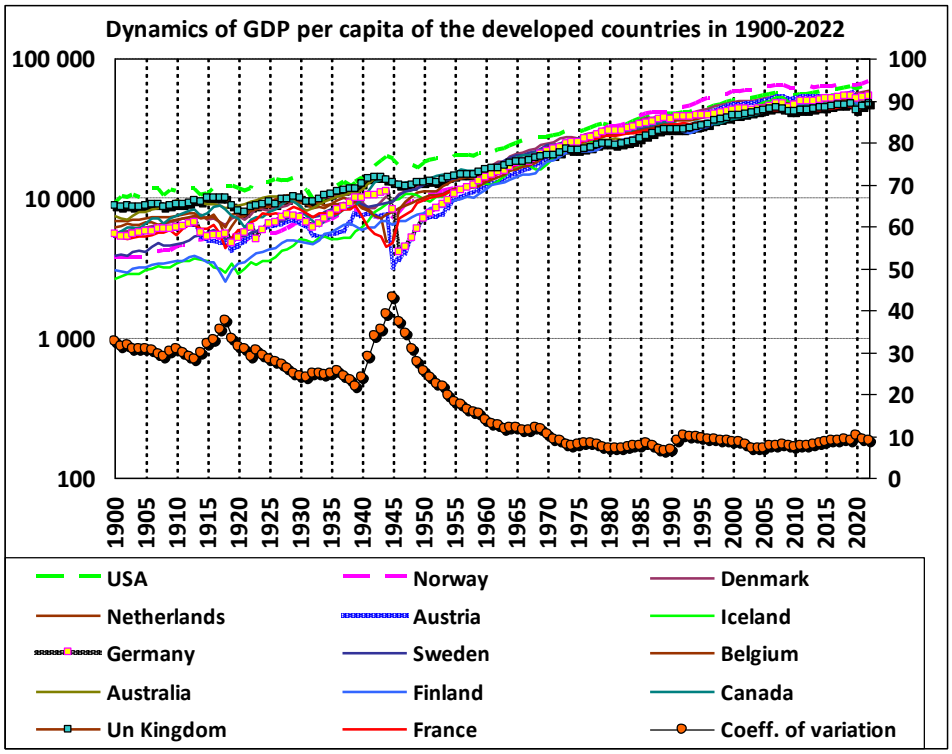

Fig. 4. Dynamics of growth of GDP per capita (left axis, US dollars) and coefficient of variation (right axis, %) of the group of highly developed countries of the world in 1900-2022. The left coordinate axis has a logarithmic scale

The curve of the coefficients of variation is also shown – it is the characteristic of the scattering of the specified parameter of these countries in each year of the considered time interval. The figure also shows the income curves of Norway and the United States, the values of which exceed the values of other countries indicated here at certain time intervals. This group of countries does not include small, island and purely raw-material countries.

The graphs show both an increase in income per capita and a decrease in their variations during the period under review: from $2,660 - 8,830 in 1900 to $42,800 - 59,100 in 2022 and, accordingly, the coefficient of variation from 32.5% to 9.0%.

On the graph we see a local maximum of income and at the same time a minimum of variability in 1913. With the beginning of World War I, the direction of income growth and the decrease in variability are reversed, the minimum of income and the maximum of variability is reached by the end of the war in 1918-1919. After that, incomes grow again, and variability decreases until the beginning of the global economic crisis of the 30s. After – the beginning of World War II in 1939 until its end in 1945 there is a strong decline in income and an increase in their variability (note that in the United States, income growth occurred from 1934 to 1944, with the exception of 1938).

After the end of the war in 1945, the incomes of the countries began to grow again, but faster than before; their variability decreased also faster. The income curves were simultaneously going up and converging. The strong ups and downs of both income values and their variations have disappeared. Since 1971, income variability has become less than 10%, with the exception of local maxima (10.2%) in 1992 and in 2022 (the year associated with the COVID-19 pandemic), the minimum variability value of 6.5% was in 1989. The recession of 2008, associated with the beginning of a new global economic crisis and the decline from the impact of the COVID-19 pandemic in 2022, turned out to be little noticeable in these countries. At the beginning of the economic crisis in 2008, the averaged income of the mentioned advanced developed countries was positive: 0.07%, and the largest decline was 1.7%.

It should be noted that the incomes of Norway and the USA differed from other countries considered here by exceeding the values over the incomes: the USA had more input than the other countries before 1982, and Norway - after 1980. Their parameters were not taken into account when analyzing income variability.

The presented data on the dynamics of income per capita indicate that over 122 years, the development of the economy of the most economically developed countries as a whole grew and had similar fluctuations, the corresponding curves converged over time, reaching a certain limit. This is evidenced by a decrease in the income variability of countries – the coefficient of variation decreased with some exceptions, and after 1971 the variability almost did not change, remaining in the range of 10% (from 6.5% to 10.2%). The curves on the graph began to represent an upward tube of trajectories of constant thickness.

The indicated results of changes in the parameters of economic development which are shown in Fig. 2-4 and Table 1 show that the modern economy is developing very unevenly, but in general has a socio-economic model in which the standard of living of the population is constantly increasing – not only in rich, but also in poor countries. There are two important points.

The first point is the uneven development of the economy – its inherent property: it is the unevenness that is a manifestation of the normal development of a market economy, which is stochastic in its core. It is important that the unevenness should not exceed some reasonable limit, then there is a positive growth of the economy as a whole. Systemic economic crises are a special case of unevenness, this is also an inherent property of the economy, they are not a defect of development [24, 25]. With the development and growth of the economy, variations in its parameters decrease, including the magnitude of economic crises decreases.

The second points is that development is possible only in the presence of scientific and technological progress. This is the most important factor of rapid and effective development at the same time. high tech progress is at the heart of successful modern economic growth.

These circumstances mean that, despite uneven development, including the presence of economic crises and the COVID-19 pandemic, the standard of living in the world is constantly growing. The economy is developing most successfully in developed countries. The author believes that in the part of economic development and living standards, the world is moving towards the noosphere. Developing countries are moving forward more slowly, but they can reach the level of developed countries, their path can be passed faster – if the experience of the predecessor countries is taken into account.

5. Stabilization of population growth

One of the most important problems of the world's development is the possibility of stabilizing the population in the future. Limited in size, the Earth will not be able to feed the population with unlimited growth in its number.

Let's consider the dynamics of population growth in the countries of the world. Fig. 5 shows the dynamics and regression lines of population growth rates of three groups of the richest countries – the European Union, North America, High-income countries in 1961-2022. It can be seen that in these years the growth rate in each of the groups decreased. The population growth rate decreased from 0.8% - 1.7% in 1961 to 0.2% – 0.5% in 2022. The indicated decrease in growth rates is confirmed on the graph of the population growth rate of developed countries: the USA, North Korea, France and Japan (Fig. 6) – the rate decreased during 1990-2029, and after 2009 in Japan it became negative.

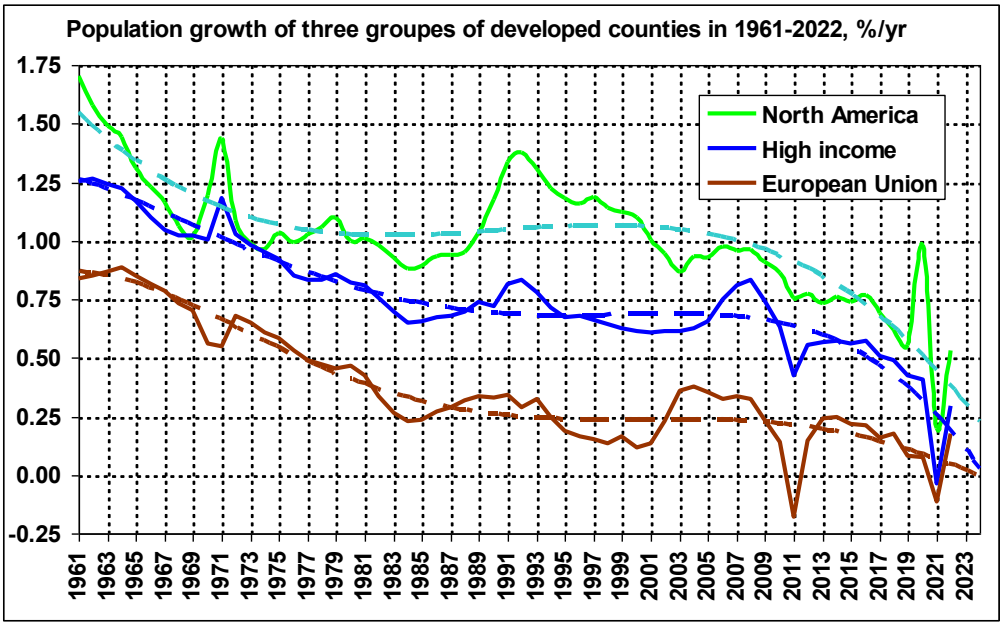

Figure 5. Dynamics of population growth rates in groups of countries: the European Union, North America and High-income countries in 1961-2023. Regression lines for each group of countries are given

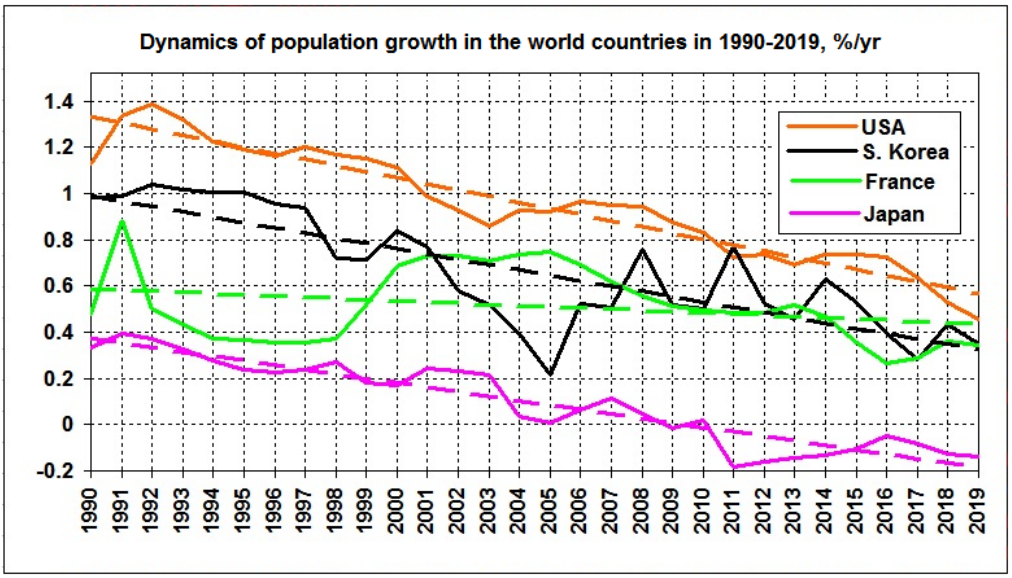

Fig. 6. Dynamics of population growth rates in the developed countries of the world in 1990-2019. Regression lines for each group of countries are given

We can explain the mechanism of population stabilization using the example of the population of Japan (Fig. 7). Currently, two processes are taking place simultaneously in developed countries: a decrease in the birth rate and an increase in life expectancy. The first process leads to a decrease in the number of the age group of young people "0-14 years", the second – to an increase in the number of elderly people in the age group "65 years and above". The change in the number of the group "0-14 years" is determined by the process of fertility in the group "15-64 years", which gives offspring and actively working people. Therefore, with a decrease in the birth rate, the number of young "0-14 years" first decreases, and then as they grow up and move to the "15-64 years " group, its number also decreases. The number of elderly people "65 years and above" is determined by the decreasing number of people coming out of the "15-64 years" group, but since life expectancy is increasing in the "65 years and above" group, its overall number is increasing. Birth rates in reality are regulated by the population themselves, as a rule, this happens unconsciously due to changes in living conditions and mentality. In general, the number of the population is decreasing and gradually comes to stabilization at a level acceptable for the continuation of life and economic activity.

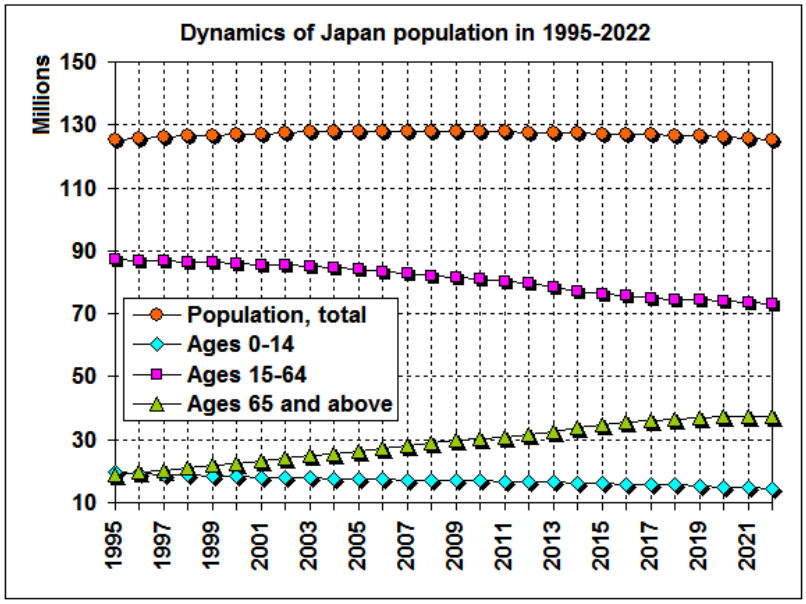

Fig. 7. Dynamics of the population and its age groups in Japan in 1995-2022

6. International migrations

In recent years, a new circumstance has appeared in the dynamics of the world's population. There have been significant international migrations in European countries, which have led to a visible increase in visible mortality in a number of countries. It turned out that the population migrations taking place now in Europe have noticeably distorted the usual parameters of demographic processes. A.M. Tarko [24] found that for several years the total mortality in Bulgaria has become the highest in the world – 15.4 per 1000, and is ahead of all, even the poorest countries in Africa. It is followed

by Latvia – 15.0 per 1000, Serbia – 14.6 per 1000, followed by Lesotho – 14.2 per 1000 (Table 2).

In these and a number of other new EU member states, part of the young able-bodied population, taking advantage of the opportunity for free movement, moved to work in richer European countries. Since the mortality rate of the elderly people remaining in these countries is known to be significantly higher than that of the young (Gompertz–Makeham law**)** a strong "paper" increase in population mortality has appeared in statistics[2]. Analysis of age-related migration parameters and other indicators confirmed this (Fig. 8). In this case, the violation of global demographic indicators turned out to be an indicator of the unfavorable situation in these countries.

Similar phenomena also occur in the countries of the former USSR. Their mostly young and middle-aged residents move to work in more profitable countries. This helped to raise the standard of living for them and their families at home, but also affected demographic statistics. In this case, the violation of global demographic indicators also turned out to be an indicator of the unfavorable situation in these countries. It should be noted that in the table, the positive values of growth and lower mortality values in Central Asia compared to countries in Europe are due to the fact that migrations have not yet had time to significantly change the historically established parameters of age distributions and other demographic parameters there.

Table 2. Values of parameters characterizing migration of the population of Europe and Central Asia in 2019: population growth (%), migration (% of the population), total mortality (per 1000). Sorting was performed by the parameter total mortality.

Country	Population growth, % of population	Migration, % of the population	Total mortality, per 1000
Bulgaria	-0.70	-0.16	15.50
Ukraine	-0.53	-0.02	14.70
Serbia	-0.54	0.01	14.60
Latvia	-0.70	-0.41	14.50
Lithuania	-0.26	-0.48	13.70
Romania	-0.53	-0.13	13.40
Moldova	-1.60	-1.06	13.09
Georgia	-0.17	-0.15	12.88
Croatia	-0.55	-0.31	12.70
Greece	-0.11	-0.20	11.70
Poland	-0.02	-0.01	10.80
Montenegro	-0.03	-0.26	10.60
Armenia	-0.56	-0.90	9.66
Albania	-0.43	-0.31	8.48
Kazakhstan	1.29	-0.20	7.19
Kyrgyzstan	2.09	-0.53	5.20
Tajikistan	2.26	-0.08	4.84
Uzbekistan	1.88	-0.21	4.60

[2] This is not the first case when the mortality rate leads to an inadequate description of population dynamics. After the end of World War I, both the ratio of numbers and the age structures of men and women were greatly changed. Therefore, ordinary statistics could not correctly predict the dynamics of population growth. The introduction of the fertility indicator – the number of births per woman – helped.

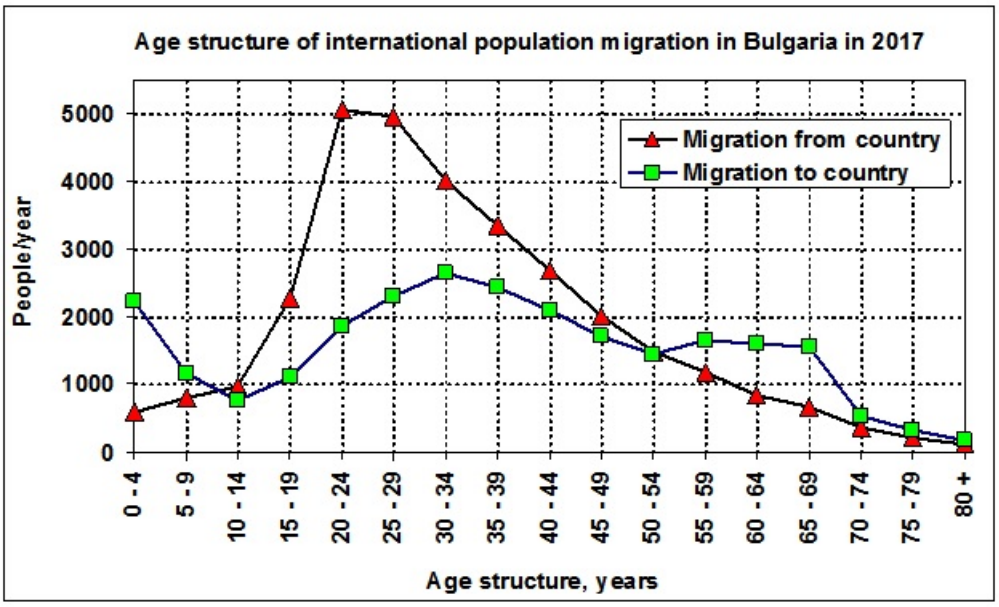

Fig. 8. Age distribution of migrants in Bulgaria in 2017

According to the forecast of A.N. Chumakov and M.S. Stychinsky [3], migration from less developed to more developed countries will increase significantly around the world in a few years and will become a new factor in global development.

The increase in migration to other countries in the world demonstrates the expansive manifestation of the idea of the "Devil's pump" by N.N. Moiseev [12]. He expected that rich countries take and will take talented people from developing countries, but it turned out that modern migrations attract everyone – from illiterate to educated and talented people.

The author considers effect of migration to be an important addition to the analysis of the development of the world economy and population growth. Already, this is manifested by a noticeable change in the nature and pace of economic development. Migrations do not change the previously made conclusions about the achievement of the noosphere in terms of the possibility of stabilizing the population. They show that unexpected delays are possible on the way to the noosphere.

7. Regional pollutions

In the early 1970s, two crises occurred in developed countries. The first was energy, the second was environmental. The energy crisis arose when Arab countries refused to sell oil to the United States and parts of Europe[3] in 1973. This crisis was completed by March 1974. But the ongoing economic boom in developed countries suddenly was ended and was replaced by a drop in the pace of economic development and a serious stagnation of business activity. He gave a reason to think about the development of the economy, the use of energy resources, pollution of the natural environment and the further development of the West.

At that time, a serious environmental crisis began. In developed countries, it was suddenly noticed that by the 1970s there was a strong and widespread pollution of the natural environment by industrial waste. For example, in some years in summer, acid rains in Europe and Canada killed large tracts of forests, heavy pollution was in most rivers and lakes. Fish became inedible in the lakes and died. Awareness of the threats and understanding of the causes of what is happening – uncontrolled and unintended regional growth of pollution in developed countries - came quite quickly. The leadership of developed countries belatedly realized the danger, but then took decisive action and solved the environmental crisis on the basis of the rapid development of high tech progress.

In the developed world, the problems of rational nature management and environmental conservation have become one of the top priorities. In those years it became clear that the achieved high standard of human life should be based on living in an environment with clean air, clean water, nature should not be disfigured by urbanization. Strict legislation on the preservation of the natural environment was adopted, the norms of impact on it were radically revised. In industry, technologies have been significantly improved, the energy industry began to produce more electricity per unit of fuel, the same was done in the production of steel and other products. New concepts of urban development were developed, the economy was rebuilt in terms of minimizing the production of pollution per unit of production and new technologies were developed in technology, including those providing for minimizing pollutions per unit of production [19, 24].

By the 1990s and by the 2000s, all technological processes in industry and agriculture were revised and significantly improved. Measures have been taken to restore local and regional environmental parameters – emissions released during the burning of coal, oil and products from them – sulfur and nitrogen compounds,

[3] Then on October 17, 1973, OPEC countries announced that they would not supply oil to countries that supported Israel during the 1973 Arab-Israeli War in its conflict with Syria and Egypt. This concerned, first of all, the United States and its allies in Western Europe. Over the next year, the price of oil rose from three to twelve dollars per barrel. In March 1974, the embargo was lifted.

which are the main component of acid rain that destroys forests and lakes, have been reduced.

In addition, it was possible to achieve a significant reduction in emissions of heavy metals in the production of steel and other materials. In general, the task of normalizing regional and local pollution in developed countries has been solved.

If earlier in the countries of Western Europe and North America large tracts of forests died from acid rain in dry and hot summers, then after the measures taken from the 1980s to the end of the 1990s, this phenomenon practically disappeared. Previously heavily polluted Great Lakes on the American continent and almost dead lakes in Scandinavia have come to life, water, plants, fish stocks in them have returned to normal [21, 24], the water in the rivers has become clean.

As a result of these actions, the environmental crisis and the problems of local and regional environmental pollution in developed countries have been largely resolved. One of the confirmations of this is that after 2000 the World Bank stopped publishing data on the release of sulfur compounds, the main source of acid rain.

Solving the problem of pollution and environmental conservation by developed countries does not mean that it is removed for developing countries. Now in the most developing countries solving of such problems has either not begun, or is just beginning. The task of preserving the environment in these countries has passed to new generations [24].

Problem of the preserving of natural environment and decent human life in it has required and requires great efforts of mankind. There have been many sad cases of severe and almost complete destruction of nature for economic purposes. As an example, it is worth mentioning a unique historical event when in England in the XVIII century all primary forests were cut down for the active introduction of looms. Now few people know about it.

The extraction of many minerals in developing countries, in many cases, is accompanied by large pollution, which is unacceptable in developed countries. For example, the extraction of rare earth metals (from which, in particular, computers and phones are made all over the world) is carried out in developing countries with high pollution. It may happen that the consciousness of their population will not want to put up with it. It follows from this that the price of the metals produced will become very high. Therefore, it is useful for residents of developed countries to realize that the construction of the noosphere is not cheap and morally difficult.

In general, the problem of the transition of the biosphere to the noosphere in terms of preserving its natural environment and a decent human life in it, as we have seen, has required and requires great efforts of mankind.

The author has no doubt that the task of regional and local conservation of the natural environment is a direct task of creating the noosphere as a sphere worthy of a person according to V.I. Vernadsky's plan and can be solved by humanity. Its solution by the developed countries will undoubtedly be continued by the developed ones. It is worth recalling that according to V.I. Vernadsky's plan, the noosphere is a biosphere transformed by man, and therefore he is responsible for its preservation and transformation.

8. Global warming

A new environmental crisis, now global, is global warming. The fight against it was launched with the adoption of the UN Framework Convention on Climate Change in Rio de Janeiro on May 9, 1992 and on December 11, 1997 with the adoption of the Kyoto Protocol to it on reducing greenhouse gas emissions into the Earth's atmosphere to counter global warming. However, this did not give a noticeable braking result. It was replaced on December 12, 2015 by the Paris Climate Agreement [31]. The authors of the Paris Agreement have put forward a new ambitious goal – to stabilize the temperature of the atmosphere and, thereby, stop the development of global warming.

If a quantitative limit was set in Kyoto on the total amount of emissions of the main greenhouse gas – CO_2, then a new criterion has appeared in the Paris Agreement – all countries together must achieve by the end of this century a steady achievement of the average global atmospheric temperature of 2.0 °C (or even better, 1.5 °C) exceeding its pre-industrial value. This is supposed to be achieved by reducing industrial CO_2 emissions and switching to a low-carbon economy and alternative energy sources with the inhibition of the development of new nuclear-fueled power plants. Ideally, the initiators of the implementation of the Paris Agreement saw the future in the form of a complete transition to alternative energy by total abandoning gas, coal, oil and nuclear energy.

The author of the article has previously done a lot of work, including numerous calculations on mathematical modeling of the global biogeochemical cycle of carbon dioxide on a high spatial resolution model, on climate models, calculations on a mathematical model of the global economy [20, 23]. He made the conclusion that, in general, the planned fulfillment of the conditions for reducing industrial CO_2 emissions is impossible [19, 26]. There is only hope for its partial implementation by developed countries. The author sees the main problems in the impossibility of reducing CO_2 emissions by most developing countries, in the overestimation of the possibilities of alternative energy sources (which has already been catastrophically manifested), and in wrong estimation of the use of nuclear power plants. Thus, it can be argued that the Paris Agreement in modern terms is, in fact, a document of intent.

As mentioned above, developed countries during the 70s and 80s reached the level of development of high tech progress, at which normalizing regional and local pollution in developed countries has been solved. That is why, having raised the level of high tech progress, they are able now to solve new global problem – reducing CO_2 emissions into the atmosphere.

Developing countries have not passed this way. Most of them must first go through the development, accompanied by an increase in pollution, passed by de-

veloped countries many years ago, then the stage of reducing these pollutants, and only then proceed to the implementation of the most technologically difficult stage of reducing CO_2 emissions. This is a difficult and long way, only after reaching a sufficiently high level of high tech progress, developing countries will be able to make the implementation of the most technologically complex stage of reducing CO_2 emissions.

The required time to transition to a new technically advanced state of high-tech development will take at least several decades [6,16, 21, 26]. It needs the decisive participation of the leadership of the countries in it, therefore, few developing countries are ready for such a complex development.

Another disadvantage of the Paris Agreement, which has clearly emerged in recent years, is an unreasonably high attention to alternative energy sources. Thus, the share of solar and wind energy in Germany by 2021 has reached the level of 33%. However, the windless cloudy and cold weather that occurred in January and February 2021 and the almost complete freezing of the blades of wind turbines caused a massive failure of this technique on January 8, 2021, led to a disaster. 30 thousand wind turbines in Germany stopped generating electricity, other connected systems failed, as a result. A disaster in one country almost turned into the largest man-made catastrophe in Europe.

In this case, the catastrophe would be the direct fault of the organizers of the Paris Agreement, since the increase in climatic anomalies is a statistically proven feature of global warming.

The biggest mistake in the sense of understanding and planning the future of world energy is the complete disregard of the leadership of the Paris Agreement for the use of nuclear power plants.

According to the research materials of the EU Scientific Center, during the life cycle of a nuclear power plant emits into the atmosphere only 6 g of CO_2 per 1 kWh of generated energy, while emissions in wind power are 11 g, and the emissions of solar panels do not exceed 80 g per 1 kWh [8]. To complete the picture, it is worth adding that the most modern gas turbines in Germany have an emission level of 420 g per 1 kWh, and coal plants - 820 g of CO_2 per 1 kWh [8].

Thus, nuclear power is the most technologically advantageous for low-carbon energy in terms of its technological parameters, it emits a minimum of carbon into the atmosphere per unit of electricity.

We will evaluate the possibilities of nuclear energy from the point of view of its reliability. It is known that at the beginning of the use of new equipment and technologies, the greatest flow of failures and breakdowns occurs. At the same time, there is also a "burnout" of poorly made options and the "run–in" of new equipment, the improvement of the technology of production and operation of equipment - in the future, accidents of complex equipment stop. An example may be the absence in recent years of accidents in the technology that ensures the launch of satellites and the presence of astronauts in space.

In the case of nuclear power plants, "burnout" and "run-in" can be considered complete. Two accidents at the nuclear power plant confirmed this. The first, on April 26, 1986 in Chernobyl in April 1986, was caused by incompetent decisions of the management, which forced improvements to be made for the next holiday and insufficient training of service specialists. The second – "Fukushima" – March 11, 2011 – the designers, having located the nuclear power plant near the ocean shore, did not take into account the extremely unlikely, but possible simultaneous occurrence of two natural disasters – an earthquake and a tsunami. However, this really happened – a powerful earthquake, the strongest in the entire history of the country, and after that a 17-meter tsunami hit the station located on the ocean shore. In the current situation, the operators were not able to take sufficient measures.

Speaking about the future of energy, the author believes that only nuclear power plants can provide energy for a long period - this is the future of mankind and the noosphere. Alternative sources of electricity can supplement its production. Only nuclear power plants have the largest reserve for the future. If all available reserves of uranium are used, it can last for 800 years, and the use of "fast nuclear reactors" will allow for a period of up to 2500 years [8]. The supply of fossil carbon sources is much smaller, besides, it is difficult to wish descendants life in the new "Cretaceous" period.

Our analysis has shown that the long-term existence of mankind is possible only on the basis of the transition to nuclear power with partial use of alternative sources and with a maximum reduction in the use of fossil fuels that produce atmospheric CO_2 emissions. Nuclear power plants are necessary, only they provide a basic source of energy for humanity for a long period of time, this is the most important element for moving towards the noosphere. The world cannot yet stop using fossil fuels due to the impossibility of reducing it in developing countries. The positive development of humanity will undoubtedly come to such an opportunity. The complete cessation of the use of fossil fuels is not yet possible, including, it is impossible to do without them in the metallurgical and chemical industries. Additional research is needed for an appropriate replacement. Nuclear power enriches with new hope the scientific picture of the world moving towards the noosphere

9. Sustainability of the biosphere

Let us turn to the problem of global and regional stability of the biosphere in terms of the possibility of its unintentional transition as a result of anthropogenic impacts to a significantly degraded state. To do this, let us consider an important problem for the noosphere about the conditions of minimal possible state of coexistence of man and the biosphere.

N.N. Moiseev suggested that humanity may unintentionally bring the biosphere into such a significantly destroyed state that it will not be able to live in it [12]. This idea was born from the analysis of simulation results in the 80s of the last century by scientists of the USSR and the USA of the "Nuclear Winter" - the consequences of a large–scale nuclear war [1, 4, 5]. In mathematical terms, this means that in the biosphere model there are two or more equilibrium state under the same external conditions.

Consider the consequences of anthropogenic CO_2 emissions into the atmosphere, which have a global impact on the climate and cause global warming. Calculations based on a mathematical modeling of the global biogeochemical cycle of carbon dioxide with high spatial resolution of A.M. Tarko [19, 20] showed that anthropogenic CO_2 emissions cannot cause degradation of the biosphere. For each new value of the CO_2 content in the Earth's atmosphere, there is only one stable equilibrium state in the model.

A similar case was obtained by V.P. Parkhomenko on a climate model – a three-dimensional global model of the general circulation of the atmosphere and ocean [15]. In the model, under modern climatic conditions, there are two equilibrium state – one corresponds to the modern climate, the other corresponds to the almost frozen Earth (perhaps such a state is realized on Mars). Calculations show that the transition to a new equilibrium position requires significant changes in environmental parameters that technically exceed the capabilities of humanity. It follows from this that within the framework of climate models, there is a single stable state of the modern biosphere with the only possible climate.

This means that the mathematical models of biogeochemical and climatic processes do not show the possibility of the transition of the biosphere to a state unsuitable for human life. The simulation also showed that the greenhouse effect of CO_2 has saturation, and the largest release of CO_2 cannot lead to an increase in atmospheric temperature by more than 4.5^0, which is acceptable for human life.

Another impact in the biosphere is the regional pollution which we have considered. As mentioned above, in developed countries, it was possible to achieve acceptable levels of pollution for most indicators. If we hypothetically consider pollution in developing countries, increasing several times more than their current values, then we will see that, at least for the territory of Europe and North America, such pollution will not be able to lead to disasters. This is due to the fact that wind directions from west to east prevail in the atmosphere, and the territories of these regions have huge oceans from the west, crossing which, most of the atmospheric pollution from other countries can reach only in a significantly reduced amount. Mathematical modeling shows that at the same time, the pollution that has come there will be significantly weakened and will not be able to lead to disasters for the population living there. Consequently, it is not necessary to expect a catastrophe for developed countries located in these regions in case of pollution.

If we consider the decrease in species diversity occurring all over the world, then, as the analysis of modern data and expert opinions shows, regional effects prevail here, and we cannot expect its significant decrease in most regions of the world.

Analysis of problems in the ocean and freshwater systems with the involvement of experts shows the possibility of severe biota disturbance in a number of regions, but under no circumstances are global effects detected.

Thus, the idea of N.N. Moiseev about possible transition of the biosphere to an unacceptable life state is not confirmed in the modern science. Therefore, it can be argued that the biosphere is globally stable, therefore, the transition to its successor, the noosphere, is possible.

10. COVID-19 pandemic

On December 30, 2019, the Municipal Health Committee of Wuhan, Hubei Province, China, announced the appearance of a new viral disease. On December 31, the Chinese authorities reported the new virus to the World Health Organization (WHO). On January 28, 2020, cases of the disease were reported in 15 countries, including the USA, Germany, and France. Within two months, the coronavirus infection spread all over the world.

Thus began the acute viral disease COVID-19 with predominant respiratory damage caused by the SARS-CoV-2 virus, an RNA genomic virus of the genus Betacoronavirus of the family Coronaviridae. Infection has certainly taken a special place among the world's pandemics. In general, according to WHO, 14.8 million people died from COVID-19 in the world.

According to the World Health Organization, 218 countries and territories have administered more than 13 billion doses of the COVID-19 vaccine. Several different vaccines have been developed at record speed, largely due to previous years of research on related viruses, as well as investments in billions of dollars. Technologically new in the fight against the pandemic was that, in addition to the classic ones containing specially weakened viruses, a new type of vaccines based on nucleic acids containing neither the virus nor its proteins were used – only sections of nucleic acid encoding information about the structure of the virus element. The active ingredient in them is a part of the DNA molecule that is incapable of self-replication in human cells, into which the necessary genes are embedded. Together with the vaccine, it penetrates into cells and triggers the synthesis of copies of viral proteins, to which immunity is subsequently developed.

Table 3 provides information about the countries with the highest number of diseases and deaths.

Table 3. Countries with the highest number of diseases and deaths from COVID-19 on March 5, 2023 [37].

Country	Total cases	Total deaths	Total deaths, %
USA	105 392 498	1 146 723	1.09
Brazil	37 076 053	699 276	1.89
India	44 687 496	530 775	1.19
Russia	22 314 520	396 216	1.78
Mexico	7 459 860	333 038	4.46
Peru	4 486 665	219 485	4.89
United Kingdom	24 370 154	206 952	0.85
Italy	25 603 510	188 322	0.74
Germany	38 210 850	168 397	0.44
France	39 634 146	165 030	0.42
Indonesia	6 736 787	160 925	2.39
Iran	7 569 483	144 867	1.91

Active measures to reduce the spread of the disease in 2020-2022, the development of vaccines and vaccination, as a result of the rapid and unexpected end of the pandemic – all this suggests that now humanity, despite the disunity of countries, acted without delay and in uniform ways. The past pandemic differs from previous ones in two important ways. The first is the high mobility of the population, contributing to the rapid spread of the disease, which implemented both between countries and within them. The second is the ability of the leadership of most countries to quickly find and solve the most important areas of combating the pandemic and its manifestations: the introduction of communication restrictions, mask mode, the use of home mode for work, food delivery to the house without going to the store, strong restrictions on tourism and cultural events. The third is the implementation of organizational measures and significant funding of large centers for the development of vaccines, a risky but important reduction in the mandatory timing of vaccine testing, free vaccinations for the population in many cases. The last two properties ensured the speedy end of the pandemic and saved many lives.

The results of the fight against the pandemic of 2020-2022 showed that humanity is technologically and organizationally is on the way to the noosphere. The world is able to cope with new dangerous mass diseases.

11. Aggressiveness, wars and terrorism

The analysis of the relationship between wars and terrorism will begin by mentioning that man is not only an intellectual being, but also controlled by his biological nature. This is based on the genetic mechanisms inherent in man by nature. The direction and strength of their manifestation in each person are individual, therefore, the individual behavior of different people is different. Among the primary properties of human nature, we will see positive and negative. The most important for our analysis are the positive qualities of a person: kindness, inclination to work, self–sacrifice, and the most important negative ones are evil [9], aggressiveness [13], passion for individual leadership. The combination of positive and negative qualities is an inherent property of people in human society. In the process of development of society, negative biological properties of a person have often been and are a serious obstacle to development, including the noosphere. Aggressive leaders are the main engine, which, in our opinion, are the basis of wars and terrorism.

As a factor bringing us closer to the noosphere, we note that a new world war has become almost impossible in the modern world. It depends on the availability of strategic nuclear weapons by the two largest nuclear states, the United States and Russia. The discovery by scientists of the USA and USSR of the phenomenon of "Nuclear winter" in the early 80s greatly contributed to the realization of this [1, 4, 5, 22].

In recent years, US scientists – part of the participants in the simulation of the "Nuclear winter" of the 80s, conducted a new computer simulation of the consequences of regional wars with the use of tactical nuclear weapons [38]. Thus, the consequences of possible war, in particular, between India and Pakistan with the use of nuclear weapons were simulated [30]. Calculations have shown that more than 2 billion people may die as a result of such a nuclear war, global and regional changes in climatic factors will occur for several years. There will be a massive shortage of food, animal husbandry and the production of aquatic feed will not be able to compensate for the decline in yields in almost all surrounding countries.

Currently, two forms of regional and local wars are a serious danger. One is the unification of regional wars with terrorism. This refers to aggressive Muslim fundamentalism, which is supported, of course, by the aggressive nature of man. Another military phenomenon that exists in some African countries is the abnormal situation when the leaders of countries conduct civil interethnic wars, increasingly religious. Wars are one of the mechanisms that slow down the development of the economy and preserve poverty in these countries.

It should be noted that their "material" base are poverty and high and uncontrolled birth rate, leading to rapid population growth, increasingly unemployed and less and less having food and water. This type of aggressive wars and terrorism was most clearly manifested during the Arab-Israeli War of 1973 and in New York in 2001, when two skyscrapers were destroyed by suicide bombers who hijacked peaceful planes.

Let us turn to the events of one of the aggressive wars for the liberation of Kuwait in the armed conflict

between the Multinational Forces (MNF) and Iraq (Operation Desert Shield) [14].

On August 2, 1990, four regular divisions of the Iraqi army invaded Kuwait. Due to the complete military superiority, by the end of the day, the capital of Kuwait was under the control of Iraqi forces. On August 8, the actual annexation of Kuwait was announced. On November 29, 1990, the UN Security Council adopted a resolution that gave Iraq the opportunity to "use all necessary means in order to restore international peace and security in this region." The UN granted the Multinational Force Coalition (MNF), which had already formed at that time, the right to conduct a military operation to liberate Kuwait. More than 40 countries participated in the MNS.

On January 17, 1991, the MNF troops launched a combat operation to liberate Kuwait. Massive air strikes were carried out, in which up to 1,000 aircraft were involved, which were based both on ground air bases and on 6 aircraft carriers. Iraq responded by shelling the territories of Saudi Arabia and Israel (which did not take part in the war) with ballistic missiles and actions of "environmental terrorism" – oil discharge into the Persian Gulf. The capital of Kuwait was liberated in two days. The ground operation lasted 100 hours. On February 28, 1991, the ground operation ended with the liberation of Kuwait and the restoration of the status of an independent State. In four days, the MNF troops completely liberated Kuwait and occupied about 15% of Iraq's territory. Directly on the battlefield during the offensive, the ratio of MNF and Iraqi losses was approximately one MNF soldier killed per one destroyed Iraqi division [14].

The situation is such that now there is no understanding of the ways and availability of effective political or other mechanisms that could lead to the absence of the possibility of the emergence and termination of modern local wars of any type. This is fundamentally different, for example, from the two World Wars, the mechanism of termination of which was clear, the actions of states wishing to end the war were clear.

In general, the existence of wars in the modern world is incompatible neither with the positive development of mankind, nor with the idea of the noosphere and its approach. The emergence and existence of wars is a problem of humanity and fundamentally unsolved in terms of the offensive and implementation of the ideas of the noosphere.

12. Developing countries

We need to understand whether developing countries will be able to reach the level of development in the future to enter the noosphere. There are two circumstances. The first is whether hot climatic conditions will not hinder economic development, because the first civilizations arose in places with a hot climate, and then they were overtaken by countries located in Europe and North America with a temperate climate. The second is whether the mentality of developing countries will change in the right direction. Will the system of their life values, largely left over from the primitive communal or tribal system, be able to transform into a modern one, without which it is impossible to exist in modern society.

The problem of assessing the impact of natural and climatic conditions on development has already been solved in the world: in modern life people are less and less dependent on them. With the growth of high tech progress, the share of costs for "overcoming" adverse climatic and natural phenomena is constantly decreasing. Costs here make up an ever smaller share of GDP, their influence in the economy is constantly decreasing. The costs in cold countries for the construction of expensive buildings with thick walls, for warming in winter, in hot countries the costs of air conditioning, earthquake resistance of structures, strengthening buildings due to frequent typhoons and hurricanes – all this is reduced, thanks to the development of high tech progress.

Let's look at an example with a change in public consciousness and lifestyle on the example of Tunisia. Fig. 9 shows the age distribution (women) in Tunisia in the 50 years apart – from 1971 to 2020.

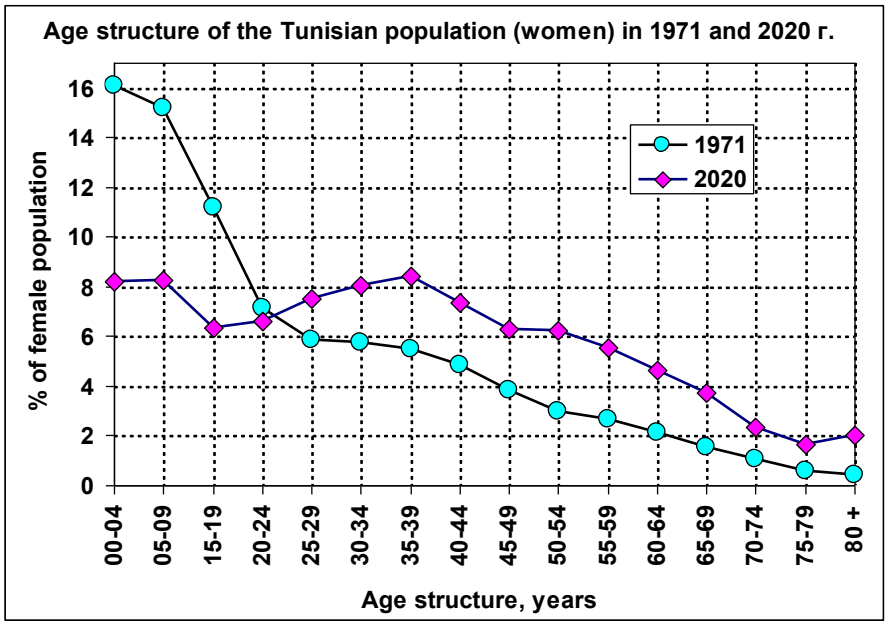

Figure 9. Age distribution of the Tunisian population (women) in 1971 and 2020

In our case, age distributions are both an indicator of the dynamics of the mentality and the standard of living of the people. The distribution of 1971 is typical "medieval" and indicates the proximity of the population to the corresponding lifestyle: a high birth rate in a country with a proportion of the population aged 0-4 years – 16.1% (with a fertility of 6.4 births per woman), then by older ages – a monotonous decline to almost zero by the age of 80 years and older – 0.4%.

By 2020, the country has undergone major changes in lifestyle and standard of living, they have manifested themselves in the form of age distribution – the birth rate has decreased, while fertility has tripled: from 6.4 to 2.1 births per woman, and the proportion of the population aged 0-4 years has almost halved – from 16.1% to 8.2%. Mortality has also decreased and life expectancy has increased, as a result, the proportion of the population in older ages has increased markedly – from 5.5% to 8.4% at the age of 30-39 years, and the proportion aged 80 years and older is even greater – from 0.4% to 2%. Thus, the age distribution has approached its modern appearance in highly developed countries. This indicates a significant lifestyle change approaching them.

Two conclusions can be made. Firstly, in a country where the economy is developing, demographic development is also improving – the need for the birth of a large number of children, requiring survival in a poor life, is disappearing. Secondly, the improvement of the economy creates the possibility of its further growth and a change in mentality towards further development.

An example of the changes of economic development and age distribution is indicative of the development of part of developing countries, including some poorest. It is hoped that all they will continue to develop in this direction. Consequently, there are no restrictions for the advancement of developing countries to the noosphere here.

13. Conclusion and discussion

The author has analyzed the factors of possible potential achievement of V.I. Vernadsky's noosphere. Important areas of the analysis are the determination of the source of long–term energy, the development of the economy and the improvement of high tech progress, the stabilization of the Earth's population, the preservation of the natural environment. The study showed that these tasks are being solved and can be solved in the future by humanity. But there are other tasks – maintaining acceptable climatic conditions and ending wars. The solution of the problem with the climate, apparently, will move into the next century, and wars – their cessation necessarily requires an increase in the standard of living, accompanied by an increase in the standard of living and consciousness of people – changes should be expected here.

One of the main conclusions is that the long–term existence of mankind is possible only on the basis of the transition to nuclear power with partial use of alternative sources and with a maximum reduction in the use of fossil fuels that give atmospheric CO_2 emissions. Nuclear power is the most important element to reach the noosphere. The world cannot yet abandon the use of fossil fuels. The positive development of humanity will undoubtedly come to such an opportunity for all countries.

The world is moving towards population stabilization – developed countries are close to it. Economic development and an increase in living standards will lead to the stabilization of their population. They will be followed by developing countries, some of them are already moving towards stabilization.

The task of global, regional and local conservation of the natural environment is a direct task of creating the noosphere as a sphere worthy of a person according to V.I. Vernadsky. It is generally solved by developed countries, developing countries have to go through this difficult path.

There is a comparison of the development of human society with the effect of "fat growth" in plants. Conditions when plants in phytotrons or greenhouses are provided with excessively good conditions of high air temperature, illumination, humidity, leading to rapid growth, which in some cases lead to the fact that they cease to bear fruit. It is assumed that this is a universal phenomenon of life, in a number of developed countries, leading to a decrease in the birth rate, that is, that part of the population with a good life "misses" the genetically predisposed age of reproduction of offspring. The author believes that this is only a visible effect. Human life is accompanied by many phenomena, among which there are not only material conditions of life. One of them is the improvement of the living standards, which are connected with the level of cultural interests.

It may be objected that the conducted research on the formation of the noosphere could have been done without mentioning it, and finding the way for the positive development of mankind does not require the concept of the noosphere. However, this contradicts the main idea of V.I. Vernadsky that the noosphere is the way of human perfection. The results obtained here are based on this assumption. One can, for example, talk about the biosphere, but not know that, thanks to V.I. Vernadsky, we came to understand the activities of living organisms that have brought the atmosphere for several billion years from a state with a high content of CO_2 and low oxygen to the modern one. It will turn out like in Moliere's play in "A Philistine in the Nobility": his hero, Mr. Jourdain, lived his life and did not know that he was saying in prose.

The conclusions of this work on the use of the proposed factors for the formation of the noosphere express the author's reasonable belief. They are not wishes about their usefulness, they represent the necessary conditions for the possibility of the onset of the noosphere. They can be supplemented by other factors, it is possible to argue with them, but without the implementation of these conditions in real life, it is impossible to talk about the onset of the noosphere.

References:

1. Alexandrov G.A., Armand A.D., Svirezhev Yu.M., Tarko A.M., etc. Mathematical models of ecosystems. Ecological and demographic consequences of nuclear war. M., Nauka, 1986, 176 p.

2. Braudel F. Structures of everyday life. Possible and impossible. M.: Progress. vol. 1. 1986. 623 p.

3. Vernadsky V.I. Biosphere. Scientific Chemical and Technical Publishing House .N.X., Leningrad, 1926, p. 147.

4. Vernadsky V.I. Essays on geochemistry. M.-L.: Gosizdat, 1927. p. 368.

5. Vernadsky V.I. A few words about the noosphere. // Successes of modern biology. 1944, No. 18, issue 2, p. 113-120.

6. Lorenz K. The so-called evil. M.: publishing house "Cultural Revolution". 2008. p. 616.

7. Meadows D.H., Meadows D.L. Randers J., Behrens V.V. Limits of growth. – M., MSU, 1991, 207 p.

8. Meadows D.H., Meadows D.L. Randers Y. Beyond growth. – M., "Progress", 1994, 303 p.

9. Moiseev N.N. Modern rationalism. // M., Publishing House of MGVP COX, 1995, 376 p.

10. How much uranium will last in the Russian Federation. [electronic resource]. https://vsevolod30.livejournal.com/358988.html?ysclid=lf1ai43tzg348942605/. (date of address: 31.05.2023)

11. Nazaretyan A.P. Aggression, morality and crises in the development of world culture. (Synergetics of historical progress). M.: "Heritage". 1996. p. 184.

12. Operation Desert Shield. [electronic resource]. https://ru.wikipedia.org/w/index.php?title=%D0%9E%D0%BF%D0%B5%D1%80%D0%B0%D1%86%D0%B8%D1%8F_%C2%AB%D0%A9%D0%B8%D1%82_%D0%BF%D1%83%D1%81%D1%82%D1%8B%D0%BD%D0%B8%C2%BB&stable=1/. (accessed: 05/31/2023)

13. Paris Agreement. FCCC/CP/2015/L.9. [Electronic resource]. https://unfccc.int/resource/docs/2015/cop21/rus/l09r.pdf

14. Parkhomenko V.P. Modeling and forecasting of global climatic and biospheric processes. // IV All-Russian Scientific conference "Mathematical modeling of the developing economy and ecology" ECOMOD–2009, Collection of works. - Kirov, July 6-12, 2009 And: GO VPO "VyatGU", 2010, p. 277-295.

15. Portnoy M.Yu., Tarko A.M. Mathematical model of high technology development. – M., Computing A.A. Dorodnitsyn Center of the Russian Academy of Sciences, 2008. Messages on applied mathematics. 30 p.

16. Pospelov I.G. Mathematical model of economic mechanisms of capitalist economy // Methods of system analysis in the problems of rational use of resources. – M.: VC of the USSR Academy of Sciences, 1977. p.18-116.

17. Tarko A.M. Anthropogenic changes in global biospheric processes. Mathematical modeling. - Moscow: Fizmatlit, 2005, 232 p

. 18. Tarko A.M. Development of the countries of the world and Russia on the basis of modernization. Analysis and modeling. // Bulletin of Environmental Education in Russia. 2010, No. 3, p. 19-21, No. 4, p. 31-34.

19. Tarko A.M. On the approach of the noosphere. // Free Thought 2014. No. 4 (1646), p. 189-200.

20. Tarko A.M. The reverse side of growth. Modern structural economic crises and ways to overcome them. // Free thought. No. 5 (1653), p. 81-94. (2015).

21. Tarko A.M. On the present and future of Russia and the world. – Tula. Publishing house of Prompilot. – 2016. – 196 p.

22. Tarko A.M. Modeling the consequences of nuclear war as a strategic deterrent to potential aggressors. // Strategic priorities. International Scientific and Analytical journal. No. 4 (16), Moscow, 2017 p. 34-51.

23. Tarko A.M. Will the Paris Agreement stop global warming? // The Age of Globalization: Teacher Publishing House (Volgograd) No. 4, 2019 p. 71-85. ISSN: 1994-9065. DOI: 10.30884/vglob/2019.04.07

24. Tarko A.M. New understanding of biosphere stability and global warming. // Norwegian Journal of development of the International Science. Earth Sciences. No. 51, Vol. 2. 2020 p. 3-7. ISSN 3453-9875. DOI: 10.24412/3453-9875-2020-52-2-3-7

25. Tarko A.M., V.N. Novokhatsky. Modeling of world dynamics taking into account scientific and technological progress. // In the collection Modeling and optimization of socio-economic development of administrative-territorial complexes, CEMI of the USSR Academy of Sciences, 1988, p. 123-126.

26. Teilhard de Chardin P. Human phenomenon. — M. Nauka, 1987, p. 240.

27. Forrester J. World Dynamics. M., Nauka, 1978, 167 p

. 28. Chumakov A.N., Stychinsky M.S. Cultural and civilizational dialogue and its possibilities in the conditions of the global world // Century of Globalization. 2018, No. 1, p.3-13.

29. Expert. 2010, No. 1.Special issue.

30. Environmental Consequences of Nuclear War. Physical and Atmospheric Effects. SCOPE 28. – Eds.: Pittock A. B., Ackerman T. P., Crutzen P. J., MacCracken M. C., Shapiro C. S., Turco R. P. – Wiley, U.K. , 1985. – v. 1, 359 p.

31. Environmental Consequences of Nuclear War. Ecological and Agricultural Effects. SCOPE 28. – Eds.: Harwell M. A., Hutchinson T. C. – Wiley, U.K., 1985, v. 2, 523 p.

32. Rosling O. Gapminder. A non-profit foundation based in Stockholm. 2023. [Electronic resource] http://www.gapminder.org/data / (accessed: 05/31/2023).

33. Teilhard de Chardin, P. (1955/2015). The human phenomenon (Translation: Sarah Appleton [1] Weber). Brighton/Chicago/Toronto: Sussex Academic Press. https://ia600206.us.archive.org/20/items/ThePhenomenonOfMan/phenomenon-of-man-pierre-teilhard-de-chardin.pdf

34. Toon O.B., Bardeen C.G., Robock A., Xia L., Kristensen L., McKinzie M., Peterson R.J., Harrison C.S., Lovenduski N.S., Turco R.P. Rapid expansion of nuclear arsenals by Pakistan and India portends regional and global catastrophe. Sci. Adv. 5, eaay5478 (2019).

35. Vernadsky V. La geochimie. Paris: Alcan., 1924. 404 p.

36. World Bank Open Data. 2023. World Development Indicators. [Electronic resource] https://databank.worldbank.org/data/home.aspx (accessed: 03/11/2023)

37. Worldometer the American Library Association. [electronic resource]. https://www.worldometers.info/coronavirus/. (accessed: 03/11/2023)

38. Xia, L., Robock A., Scherrer K., Harrison C., Bodirsky B.L., Weindl I., Jägermeyr J., Bardeen C., Toon O.B., and Heneghan R., 2022: Global food insecurity and famine from reduced crop, marine fishery and livestock production due to climate disruption from nuclear war soot injection. Nat. Food, 3, no. 8, 586-596, doi:10.1038/s43016-022-00573-0.