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INTELLECTUAL HERITAGE OF ACADEMICIAN VOLODYMYR VERNADSKY AND WORLD PHYSICAL AND ECONOMIC THOUGHT

On the occasion of the 160th anniversary of his birth and with the aim of honoring and rethinking the worldview significance of the scientific heritage of the outstanding Ukrainian scientist, co-founder and first President of the Ukrainian Academy of Sciences (now the National Academy of Sciences of Ukraine), Academician Volodymyr Vernadskyi on March 2, 2023, a roundtable meeting **"Intellectual Heritage of Academician Volodymyr Vernadskyi and World Physical and Economic Thought"** has been held, organized by the Serhii Podolynskyi Scientific Society, the Dovnar-Zapolskyi Scientific Library of the Kyiv Vadym Hetman National Economic University. Department of Economic History of the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine, Institute of Environmental Economics and Sustainable Development of the National Academy of Sciences of Ukraine, Department of Economic Theory of the Kyiv Vadym Hetman National Economic University.

The forum was attended by representatives of various institutions of the National Academy of Sciences of Ukraine, as well as leading experts in modeling and forecasting, macroeconomic analysis, and the history of economic thought from Ukrainian universities.

In his welcoming remarks, the Chairman of the Serhiy Podolynsky Scientific Society, Doctor of Economics, Professor Volodymyr Shevchuk, noted that the bloody war, whose goal Putin's Russia sees in the total extermination of Ukrainians, calls for an existential consideration and a fundamentally new interpretation of worldview values, which requires the latest approaches to thinking and acting that are consistent with the noospheric paradigm proposed by Academician Volodymyr Vernadskyi. Professor V. Shevchuk noted that the purpose of studying Vernadskyi's scientific heritage should be a deep understanding of his worldview ideas and the implementation of his intellectual heritage in the environment of economic and philosophical culture in its broadest sense, primarily in the field of world physical and economic thought, in particular, ecological economics as the newest segment of modern world economic science. Today, in the era of the noosphere, which is intended to become a lifesaver for

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humanity, the speaker emphasized, - The spiritual and intellectual component of humanity's existence comes to the fore: it is a prerequisite for the final Ukrainian victory.

The representatives of various institutions of the National Academy of Sciences of Ukraine made presentations at the forum, assessing the role and importance of Volodymyr Vernadskyi's worldview concepts for the development of scientific knowledge.

Viktoriia Nebrat, Head of the Department of Economic History at the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine, Doctor of Economic Sciences, noted in her speech that the 160th anniversary of Volodymyr Vernadskyi's birth came at a time of large-scale challenges and great trials for Ukraine, Europe, and the whole world. "These challenges actualize the need to turn to the ideas and scientific achievements of Ukrainian thinkers who formed the foundation of the national cultural heritage. Because the heritage of the Ukrainian nation - land and mineral resources, spiritual traditions, economic potential and scientific achievements - is our strategic arsenal in the fight against the enemy and the basis of the national perspective".

And Volodymyr Vernadskyi, as the speaker convincingly showed, occupies a prominent place not only among Ukrainian scientists, but also in the "immensity of the world's intellectual culture." According to Victoria Nebrat, Vernadskyi's mission "involves the realization of the unity of man with the world and human responsibility; the direction of science to protect and nurture the living shell of the Earth; the development of the sphere of the intelligent (noosphere), which means not only increasing information resources, but above all, increasing the knowledge and intellectual potential of the planet".

According to the speaker, "one of the defining features of the scientist's work was a consistent and holistic state position. Therefore, Vernadskyi, as the founder and first president of the Ukrainian Academy of Sciences, advocated the need to build an academic structure based on the state principle. Meeting national, state, and local requirements, the Academy of Sciences was to serve, as Vernadskyi emphasized, "to increase the productive forces of the country and the human being in Ukraine". "That is, - as the speaker emphasized, "from the very beginning, the creation of the Academy has been associated with the formation of the national economy and the construction of a promising model of state building, and the Ukrainian Academy of Sciences itself appeared as an institution of Ukrainian statehood".

As summarized by Doctor of Economic Sciences Victoria Nebrat, "modern public demands on the National Academy of Sciences are determined by practical needs in the context of war and the tasks of post-war reconstruction of

Ukraine, which actualizes the following tasks: first, strategizing the state science and technology policy by defining and ranking goals and objectives based on the vision of the model of the future economy; second, adjusting the priority areas of development of science, engineering and technology in Ukraine, in particular, taking into account the imperatives of strengthening state security, the desirability of expanding access to world markets for knowledge-intensive products and services, European integration requirements for Ukraine, the needs of post-war economic reconstruction and the socio-humanitarian space".

Head of the Department of Economic Theory at the National University of Kyiv-Mohyla Academy, Doctor of Economic sciences, Professor **Iurii Bazhal,** in his report "Vernadskyi's Noosphere as an Objective Natural Substance of Scientific Activity: Context of Ukraine's Economic Policy", noted the significance of the event in modern intellectual life. The speaker recalled the words of Volodymyr Vernadskyi that the rise of Ukraine and Ukrainian science is an irreversible process, emphasizing that this was said in 1920, when Ukraine was losing ground in the process of state-building. Volodymyr Vernadskyi's conviction was based on his theory of the noosphere, according to which development is a natural, and irreversible geological process, and individual events cannot stop the movement on the scale of millennia. Iurii Bazhal noted: "We must use the ideas of noospheric development in our practical activities, building an economic policy that will ensure the construction of the country we want". According to Vernadskyi, this will definitely happen, but under what condition? This will happen if we follow the principles and natural forces that determine the development of humanity as a whole and individual states, that is, if we develop the scientific and technological sphere, and at a significant and unabated pace.

Vernadskyi V. wrote many historical studies on the development of science, where he consistently justifies his position that the development of scientific activity is the basis for economic growth and social progress in general. Therefore, he paid considerable attention to the development of scientific institutions, including the Academy of Sciences in Ukraine. Vernadskyi was guided by his theory that in order to develop science, it is necessary to develop scientific institutions and shape their structure. This is an important ideological point for us - we need to develop science in order not to be backward. The figures on the increase in Ukraine’s spending on research and development in individual countries in the twenty-first century (from 2000 to 2018) are convincing: the world leader in absolute terms of research funding is Japan, with its spending on science in 2000-2018 increased by 1.7 times, in Germany - by 2.6 times, in South Korea - by 5.3 times, in Taiwan - by 4.4 times, in Spain - by 3.1 times, in the State of Israel – by 2.8 times, in Poland - by 5.6 times, in the Czech Republic - by 4.5 times, in Hungary - by 4.9 times, and in Slovenia - by 3.2 times. The figures

for comparing the amount of research funding in 2018 in our close neighbors, the post-socialist CEE countries, are also impressive: $15 billion in Poland (Ukraine had $0.5 billion at that time, and now it is even less), and $2 billion in Slovenia. "Therefore, by funding research and developing noosphere institutions, the world is following Vernadsky's lead. If we reduce funding and curtail the institutional infrastructure of scientific research - as a network of intellectual activity that develops the noosphere - we will be moving in the opposite direction. In order to take up the platform of Volodymyr Vernadsky, we must make a decisive turn towards overcoming these threatening trends," the speaker concluded.

In the report "Towards a Systematic Approach to the Program of Controlled Evolution" by **Oleksandr Palagin**, Doctor of Technical Sciences, Professor, Academician of the National Academy of Sciences of Ukraine, Honored Inventor of Ukraine, Deputy Director for Research of the Glushkov Institute of Cybernetics of the National Academy of Sciences of Ukraine (prepared jointly with Junior Researcher **Denys Symonov**), the problem of organizational support for the effective implementation of the strategy of sustainable development of mankind, which requires the introduction of a dynamic system of global processes management, was presented for discussion. As the speaker emphasized, "we are talking about creating a systemic infrastructure that takes into account the common interests of humanity and defines a set of measures that guarantee all the entities that make up the system the safety of life, and in general, the prosperity of the planet on the path of evolutionary development. To do this, the researchers believe it is necessary to build a global system that works like the UN, or with the use of modern intelligent information and analytical technologies and infrastructure for implementing the results of their work. This should be a single system of world order that solves all the problems of effective life on planet Earth, the complex of which is now well known and only needs to be clarified with a ranking of criteria and development of effective methods of solving these problematic situations on a scientific basis. One of the key tasks on this way is the problem of forming a life-giving collective consciousness, which is also solved on the basis of modern intellectual information technologies".

The authors' ideas for designing a world order system are based on the universally recognized noospheric theory of Academician Vernadskyi. In particular, on the principles of the noosphere theory, which justifies "the need to build a scientific foundation that takes into account all components of noosphere genesis in their entirety and unity." In essence, as the speaker noted, it is about "building a scientific picture of the world (SPW), which represents a general integrated knowledge of the laws of controlled evolution and can only be ensured through the transdisciplinary development of science as a global knowledge".

Despite the proclamation of a knowledge-oriented society, the speaker emphasized that today in the public discourse "there is no constructive formalized model of the world order that meets all the challenges of today's dangerous state of life on our planet in the entire unity of its components, such as the environment, human health, energy, industry, etc., life safety, and, finally, the targeted development of science itself".

The existence of such a system, according to the speaker, "requires the establishment of new institutions or reorganization of the existing ones, whose functional responsibilities will be to develop and implement a sustainable development program using a systematic approach, ensure the functioning of transparent monitoring and control systems, and promptly respond to deviations from standards and rules by all members of the international community".

The process of implementing such a dynamic system for managing world processes should be managed with the help of "a cybernetic model of management with a feedback, and a balanced system of current indicators and coordinated methods of responding to the growth of negative trends affecting human security".

Dmytro Klynovyi, PhD in Economics, Associate Professor, Senior Researcher, Leading Researcher at the Department of Sustainable Development Methodology of the Institute of Environmental Economics and Sustainable Development of the National Academy of Sciences of Ukraine, presented a report on the National Concept of Sustainable Management, prepared jointly with **Ihor Bystryakov**, PhD in Economics, Professor, Head of the Department of Sustainable Development Methodology of the same institute. Considering the need to develop a special concept of a national model of sustainable management for Ukraine, the speaker presented the position of the author's team, according to which such a concept should be developed on the basis of modern models of public administration, namely: "good governance", and "new public management" and on the basis of the recreational approach and the principles of robust management.

"The recreational approach should become the basis for the formation of self-organized, highly responsible and decentralized management structures that combine foresight methodology, green thinking, stakeholder approach, and a focus on creating "total value" with minimizing transaction costs and saving resources "for all for all", taking into account the needs of future generations, adaptability, parallel and consistent application of soft (self-regulation) and hard (directives) management methods, self-development according to the fractal scheme by implementing a set of sub-projects (portfolios) at lower management levels within large projects, etc.".

The main effects of the recreational approach, according to the authors of the study, should be "the sustainability of self-organized economic systems in the face of turbulence, complexity and interdependence, resource savings, etc."

In turn, the application of the principles of robust management involves "the formation of regulators of socio-economic processes in the form of communication platforms for interaction between government, business and communities, as well as the creation of sustainable financing within the organization (accumulation of resources in funds for sustainable development), which will ensure the sustainability and purposefulness of the self-development of such structures".

As emphasized by the authors of the study, the application of this management approach will make it possible to fulfill such urgent tasks of social development as: "ensuring a "green" technological transition in the face of threats and challenges of the 4th Industrial Revolution, effective and innovative, as well as consistent with the goals of sustainable development, reconstruction of the national economy in the war and post-war periods, ensuring sustainable economic growth and security, etc.".

According to the approach proposed by the authors, "the basic processes of sustainable development will include digitalization, ecologization and socialization of economic relations". At the same time, the restructuring of the existing economic system towards sustainable development, according to the researchers, should be carried out in three key stages, which include reorganization, recombination and revitalization of the economy.

Vasyl Horbachuk, Head of the Department of Intellectual Information Technologies, Doctor of Physical and Mathematical Sciences, Senior Researcher at the Glushkov Institute of Cybernetics of the National Academy of Sciences of Ukraine, presented the collective work "From Signals, Languages, Writing, Libraries, 2D Printing, Internet to Noosphere, Cloning, 3D Printing, CHATGPT, n-Computing and Technological Singularity" (co-authors - Masters, PhD students **Viktor Hodliuk** and **Dmytro Rybachok**). Tracing the genesis of the ways of fixing knowledge, the speaker referred to the scientific statements of Volodymyr Vernadskyi that it is human cognition and knowledge that affect the biosphere, developing the noosphere - the thinking sphere of the planet.

According to the speaker, modern means of recording knowledge (in particular, the Internet) can also be considered a support environment for the noosphere, which is actively developing along with tools and methods of digitalizing the knowledge space. At the same time, the speaker, referring to the hypothesis of technological singularity put forward by Vernor Vinge and Ray Kurzweil, argues that "the noosphere will become a natural environment in the future where human-machine superintelligence will emerge, reaching the point of

technological singularity". This, according to the authors of the study, requires "much more efficient Internet data centers in terms of hardware and power consumption. Hypothetical Nooscomputers (N-computers), focused on managing both information and knowledge, can be much more efficient in terms of energy consumption, than existing computers, and therefore can bring civilization closer to the point of technological singularity." Thus, the speaker emphasized the importance of developing "hardware and forms of energy consumption of Internet communications as a medium for the formation of the noosphere, capable of bringing civilization closer to the point of technological singularity".

Considering the tasks of post-war reconstruction of Ukraine, Doctor of Economic Sciences, Senior Researcher, Head of the Department of Ecosystem Assessment of Natural Resource Potential at the Institute of Environmental Economics and Sustainable Development of the National Academy of Sciences of Ukraine in her report "The Concept of Green Recovery in the Context of Vernadskyi's Teachings," **Mariia Ilina** raised the issue of improving the methodology for assessing environmental damage and losses as a result of Russia's armed aggression. According to the researcher, such an assessment should include not only the assessment of direct damage, but also take into account the damage caused to entire ecosystems, which, accordingly, requires the development of new methodological approaches. At the same time, as the researcher emphasized, "it is not only the loss of ecosystem resources that should be assessed, but also the loss of ecosystem services, in other words, losses from the deterioration of various ecosystem functions (soil purification, water balance regulation, biodiversity conservation, etc.)".

The main methodological approach to assessing the economic value of ecosystem services, according to the speaker, is to define the sum of the value of their use and non-use. The value of use is the sum of the values of direct, indirect use and deferred alternative use. "To define the value of non-use of resources, the very value of the existence and preservation of ecosystems is taken into account, primarily for the purpose of inheritance".

Doctor of Physical and Mathematical Sciences, Professor, Expert Consultant of the Scientific and Educational Center for Applied Informatics of the National Academy of Sciences of Ukraine **Valerii Dubko** in his report "Research of the paradigm of sustainable development of modern civilization", prepared jointly with PhD of Physical and Mathematical Sciences, Associate Professor **Vadym Semianovskyi** (Scientific and Educational Center for Applied Informatics of the National Academy of Sciences of Ukraine) and PhD of Physical and Mathematical Sciences, Associate Professor, Senior Researcher at Glushkov Institute of Cybernetics of the National Academy of Sciences of Ukraine **Viktor Raspopov**, expressed the opinion that in the face of growing

contradictions in the social development of the twenty-first century, a comprehensive approach to solving global problems of the modern technologically advanced civilization, which is being formed today under the influence of the worldview and philosophical ideas of Academician Volodymyr Vernadskyi about the need for a non-catastrophic impact of society on living and non-living nature, should be developed. In these conditions, the speaker noted, "there is an urgent problem of changing the paradigm of economic research, which directly affects the forms of economic education of young people and the use of big data by scientists using the methods of mathematical statistics, theories of probability and random processes, computer and mathematical modeling and forecasting. The development of economic knowledge, taking into account civilizational challenges and sustainable development tasks, requires further systematic digitalization of economic science and organization of relevant areas of education".

In the report "Digitalization in the field of renewable energy: energy microgrids as a tool for sustainable development" by **Volodymyr Lypov**, a leading researcher at the Digital economy sector of the Economic Theory Department of the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine, Doctor of Economic Sciences, Professor, it was noted that in the context of current trends in the active integration of information and communication technologies and digitalization of data processing, when human's negative impact on the environment is dramatically increasing and as the speaker emphasized, an important component of this doctrine "is the recognition of the depth of responsibility for the decisions that he makes itself or delegates to intelligent machines controlled by artificial intelligence". First and foremost, responsibility should relate to critical management decisions in the backbone industries of the economy, being the energy sector being a key one.

In this context, according to the researcher, "attention should be focused on the combination of opportunities created by the introduction of digital technologies using renewable energy sources and the construction of local energy microgrids", which, in turn, opens up new directions for the development of the national economy, such as: "increasing the power generation capacity; increasing the efficiency of the use of non-renewable resources; reducing negative environmental emissions; optimizing the activities of the entire complex of enterprises that provide generation, accumulation and distribution of electricity; overcoming the natural monopoly in the markets of production, transmission, distribution and retail trade of electricity; differentiation of wholesale and retail markets". At the same time, the speaker noted, there are prospects for transition from a hierarchically integrated organization to a two-sector model of a single

energy market in the country, in which the traditional structure is complemented by local microgrids.

The combination of digitalization with the increased use of renewable energy sources and the development of local energy microgrids on this basis, the speaker summarized, "serves to implement the paradigm of sustainable development and will contribute to solving the vital socio-economic problems facing Ukraine, which is especially important in the context of the military aggression by Russia".

In her speech, **Oleksandra Kurbet**, a researcher at the Department of Economic History at the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine, noted that Academician Vernadskyi's teachings are relevant in the context of today's Ukrainian realities, which put forward the task of rethinking the role of science in society as a whole, as well as its importance for post-war reconstruction and economic development.

Referring to the historical experience of post-war reconstruction of various national economies, the speaker showed that "rethinking the role of science, realizing the need for its development was important for the economic growth of many countries". According to the speaker, this historical experience is a significant argument that a plan for the post-war reconstruction of modern Ukraine should be developed now, while the war is still ongoing. At the same time, the speaker emphasized that the developers of recovery programs should be primarily professional economists, and first of all, Ukrainian specialists who have a deeper understanding of the specifics of the country's socio-cultural environment.

Representatives of leading Ukrainian universities also made presentations at the meeting. Thus, in her report "The Concept of Physical Macroeconomics in the Development of Vernadskyi's Teachings", Head of the Department of Economics of the Ivan Franko National University of Lviv, Doctor of Economics, Professor **Lidiia Hryniv**, noted that in view of the aggravation of global socio-economic contradictions caused by natural disasters and climate change, whose emergence Vernadskyi foresaw in the mid-20th century, "there is an urgent task to update the conceptual framework and methodological tools of economic science". Traditional neoclassical economic science, as the speaker noted, is still developing on the basis of the philosophy of reductionism, which does not take into account existing contexts, climate change, new scenarios of social development and abstracts from the laws of preservation of the "film of life" discovered by Vernadskyi. "It also does not take into account the role and value of energy and the work of the Earth's surface for making economic decisions that would prevent further destruction of the 'film of life' and climate change".

Therefore, according to the speaker, there is an urgent need to develop "a sophisticated system of macroeconomic analysis that would be based on the laws and realities of the physical world of the Earth's biosphere and explore the spatial and physical basis for the formation of primary value chains in the modern economy". According to the speaker, the methodology of macroeconomic analysis should be based on "the physical and economic approach developed by Vernadskyi, which involves the knowledge of the physical space of the biosphere, within which people's economic activity is carried out. Its development today gives the opportunity to develop non-market mechanisms for preserving the "film of life" and its biodiversity and to substantiate qualitatively new laws of value and money circulation".

Drawing attention to the fact that Vernadskyi's scientific achievements became an important methodological basis for the development of the modern economic science of sustainability, Lidiia Hryniv called for a deeper and more systematic "implementation of his scientific provisions in the modern physical and economic science, taking into account the laws of the biosphere, in particular the law of its spatial heterogeneity; the law of conservation of biomass of living matter; the doctrine of living matter as the basis for development of the biosphere; the concept of the noosphere; an approach to the study of the evolution of the biosphere as a single space, geological, biogenic and anthropogenic process, which is important for development of the physical and economic paradigm of sustainability science".

Pointing to the role of intellectual production and innovative thought in the formation of the noosphere, and emphasizing the limitations and complementarity of utilitarian and existential approaches to the utility of goods in the non-market dimension, Professor of the Department of Economics at Lviv University of Trade and Economics, Doctor of Economics **Bohdan Shevchyk**, in his report "Nooeconomics as a socio-cultural project of the noosphere" (co-authored with the Rector of Lviv University of Trade and Economics, Doctor of Economics Professor **Petro Kutsyk**) argued the regularity of the formation of the noo-economy, which, according to the authors, is "a socio-cultural system of intelligent creativity of the word, the use value of which is the ontological novelty of the expanded meanings of being, as well as a set of institutions of inclusiveness, movement and use of the word, where the principle of equivalence fits into the modus operandi of the length of sacred time".

According to the authors of the report, "the economy of impressions can be considered a transitional stage-link between the digital technologies of artificial intelligence of the fourth industrial revolution of the sixth technological mode of NBIC-technoconvergence and the noo-economy. The sensual content of the spectacle is the consumption and exchange value of the production and supply of

this type of service, which distinguishes it from the actual service economy, in which human resources are increasingly being replaced by the productive capacity of computer systems that are incommensurate with human capabilities in information processing. According to the speaker, the peculiarity of providing services in the experience economy is the synergistic effect of the diffusiveness of the good and the environment of its consumption, and sometimes even the emancipation of exchange value and its extrapolation into the content of the environment: one pays not so much for the cost of the service as for access to the place of its provision, which results in the formation of not just the scale of permanent demand, but also the consciousness of cultural identity along with the subjectivity of the market actor".

The scientific discourse on the significance and worldview mission of Volodymyr Vernadskyi's scientific heritage based on a broad interdisciplinary approach from the perspective of contemporary social challenges made it possible to reassess the contribution and prognostic potential of the scientist's ideas in relation to the development of knowledge about the role and nature of economic interaction in the context of the prospects for the development of civilization.

During the scientific discussion, the roundtable participants came to a common conclusion that in terms of its axiological and conceptual approaches - regarding the economical use of natural resources, reduction of the ecological footprint of humanity, and development of new forms of energy supply - the theory of the noosphere by Volodymyr Vernadskyi is in line with the paradigm of sustainable development. Both theoretical platforms are based on the principles of balancing economic, social and environmental goals of society as the basis for sustainable development of civilization, which simultaneously optimally addresses a set of issues related to meeting the most essential needs of humanity and preserving the environment.

The leitmotif of most of the reports was the idea that the ideological value of Volodymyr Vernadskyi's scientific ideas has significantly increased in the face of large-scale geopolitical challenges, which were most acutely manifested in Ukraine during the war unleashed by Russia. Today, Volodymyr Vernadskyi's call to scientists and all of humanity to create conditions for peaceful coexistence of nations and an end to wars around the world is more important than ever. According to Vernadskyi, the only possible way of conflict-free development of civilization is the development of the noosphere, which directly depends on the development of science and the state and quality of social organization of society, and national and cultural peculiarities of the social system. Therefore, it is science that is called upon to become an effective tool for solving many global

problems and finding scenarios for the harmonious and balanced progress of civilization.

At the roundtable discussion, the legacy of Academician Vernadskyi was presented not only as a globally recognized intellectual achievement of the Ukrainian nation, but also as a scientific basis for the future revival of Ukraine based on sustainable development and the knowledge based economy.