

**RECENT DEVELOPMENTS IN CYBERNETICS,
A THEORY FOR UNDERSTANDING SOCIAL SYSTEMS**

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ПОСЛЕДНИЕ ТЕНДЕНЦИИ В КИБЕРНЕТИКЕ, ТЕОРИЯ ДЛЯ ПОНИМАНИЯ СОЦИАЛЬНЫХ СИСТЕМ

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Аннотация. Эта статья состоит из трех частей. В первой части кратко представлены история развития науки «кибернетика» и усилия, предпринятые группой ученых в США и Европе в последние годы для расширения концепции науки с тем, чтобы она более успешно охватывала социальные науки. Цель состоит в том, чтобы способствовать коммуникации между дисциплинами и улучшить нашу способность управлять социальными системами. Вторая часть статьи представляет собой попытку, предпринятую в России, развить теорию рефлексивности в общую теорию целенаправленных саморазвивающихся систем для углубления нашего знания о социальных системах и управления ими. Понимание различий между западными и восточными научными подходами к кибернетике затруднено из-за очень разных истории и интеллектуальных традиций в России и США. Статья заканчивается сопоставлением двух подходов к кибернетике, сравнивающим их особенности. Представленные различия демонстрируют огромный потенциал развития кибернетики на Западе и Востоке на основе ее обогащения идеями российских и западных ученых.

Ключевые слова: расширение концепции науки; кибернетика; кибернетика второго порядка; кибернетика третьего порядка; социальные системы; интеллектуальные традиции.

**RECENT DEVELOPMENTS IN CYBERNETICS,
A THEORY FOR UNDERSTANDING SOCIAL SYSTEMS**

Poslednie tendentsii v kibernetike, teoriya dlya ponimaniya sotsialnyh sistem

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Abstract. This article consists of three parts. In the first part we describe a short history of cybernetics and an effort, which has been undertaken by a group of scientists in the United States and Europe in recent years, to expand the conception of science so that it more successfully encompasses the social sciences. The intent is to aid communication among disciplines and improve our ability to manage social systems. The second part of the article presents an effort in Russia to develop reflexivity theory into a general theory of purposeful, self-developing systems, thus improving our understanding and management of social systems. Understanding Western and Eastern approaches to cybernetics can be difficult because of the very different histories and intellectual traditions of cybernetics in the United States and Russia. The article ends with a comparison of the two approaches to cybernetics comparing their features side by side. The differences suggest a great potential for ideas from Russian and Western scientists to enrich the further development of cybernetics and science in East and West.

Key words: expanding science; cybernetics; second-order cybernetics; third-order cybernetics; social systems; intellectual traditions.

Expanding the Conception of Science

The field of cybernetics emerged in the late 1940s during a series of conferences in New York City sponsored by the Josiah Macy Jr. Foundation. During World War II many scientists had worked on applied projects. After the war they wanted to talk about what they had learned. Ten conferences on the theme of “Circular Causal and Feedback Mechanisms in Biological and Social Systems” were held between 1946 and 1953. They were chaired by Warren McCulloch, a philosopher at MIT [Abraham, 2016]. Participants included Gregory Bateson, Margaret Mead, Norbert Wiener, John von Neumann, Heinz von Foerster, Ross Ashby, Kurt Lewin and others [Pias, 2003]. After Wiener published his 1948 book, *Cybernetics, or Control and Communication in the Animal and the Machine*, the meetings were called the Macy Conferences on Cybernetics.

McCulloch was a philosopher who wanted to understand cognition. He decided to test existing theories of knowledge from philosophy using experiments in neurophysiology. McCulloch [1965], Humberto Maturana [1975], Heinz von Foerster [2003] and others asked, “How does the brain work?” They concluded that observations independent of observers are not physically possible. Building on the empirical work, von Foerster sought to include the observer within science. In 1974 he invented the term “second order cybernetics,” in an effort to shift the focus of attention in cybernetics from technical applications to the study of cognition [Foerster, 2003].

Several definitions of first and second order cybernetics have been given. See Table 1 [Umpleby, 2016]. A group of people in the American Society for Cybernetics thought this was important work and wanted to advance second order cybernetics as a scientific revolution within the field of cybernetics [Umpleby, 1974]. Beginning in the late 1970s this group began giving tutorials about the history and fundamentals of cybernetics at conferences in the U.S. and Europe. Tutorials were necessary because of the lack of university courses and degree programs in cybernetics. After presenting papers and tutorials at conferences for several years, they asked, “How does a scientific revolution end? How does one know the revolution has succeeded?” Thomas Kuhn had said there were periods of normal science and periods of revolutionary science [Kuhn, 1962]. He emphasized the transition from normal science to a revolutionary period due to “incommensurable definitions.” A revolutionary period ends, Kuhn believed, when the younger generation was persuaded to adopt the new point of view. But could there be a more definitive sign? Perhaps the Correspondence Principle would help.

The Correspondence Principle was proposed by Niels Bohr [1920] when developing the quantum theory. It says, “Any new theory should reduce to the old theory to which it corresponds for those cases in which the old theory is known to hold.” Wladyslaw Krajewski in a book on the Correspondence Principle [1977] expressed the view that a more general theory is not sufficient. There should also be a new dimension that was previously not noticed or had been thought to be insignificant. So, how could the role of the observer be formulated as a new dimension?

Table 1 – Definitions of First and Second Order Cybernetics

Author	First Order Cybernetics	Second Order Cybernetics
Von Foerster	The cybernetics of observed systems	The cybernetics of observing systems
Pask	The purpose of a model	The purpose of the modeler
Varela	Controlled systems	Autonomous systems
Umpleby	Interaction among the variables in a system	Interaction between observer and observed
Umpleby	Theories of social systems	Theories of the interaction between ideas and society

Source: [Umpleby, 2016]

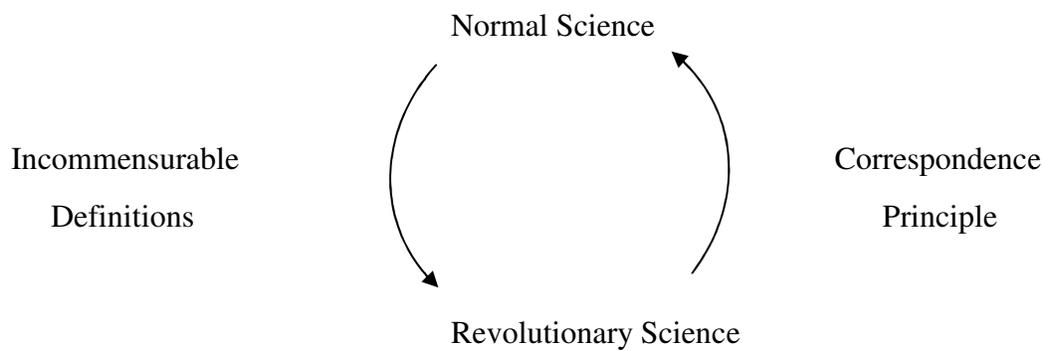


Figure 1. How science advances

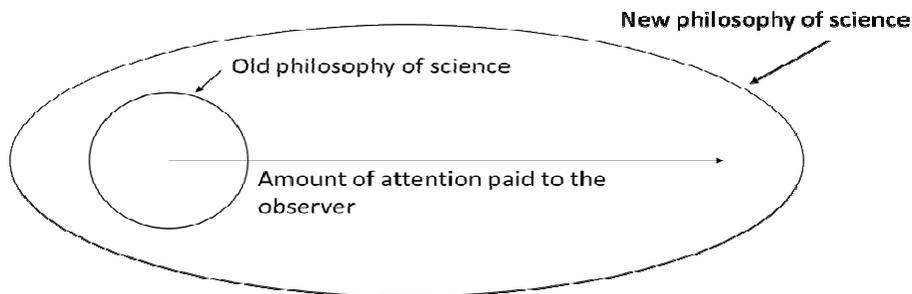


Figure 2. Expanding science in accord with the Correspondence Principle

The new dimension would be something that was not previously considered (e.g., the speed of light in relativity theory) or was assumed to be insignificant (e.g., the diameter of molecules in the gas laws). See Figure 2 [Umpleby, 2001]. All the data that supported the old theory (i.e., small circle) would also support the new theory (i.e., large oval). But now many more experiments could be conducted to investigate the region created by the new dimension (the area inside the large oval).

As more social scientists were attracted to the field of cybernetics, more thought was given to social systems. One way to describe the development of cybernetics is to say that it has progressed through three stages – engineering cybernetics, biological cybernetics and social cybernetics. See Table 2 [Umpleby, 2014]. These three approaches to cybernetics can be arranged in a triangle using Karl Popper's three worlds [Popper, 1978]. In Figure 3 the left side of the triangle would be the positivist approach to science. Scientists create descriptions of the world. The observer is explicitly excluded due to a desire to be objective. Biological cybernetics is concerned with how the brain creates descriptions of the world. Little attention is paid to the world since it already is included in the perceptions of the observer. Social cybernetics is concerned with how people act in the world. Theories or descriptions are thought to be less important than appropriate actions. Hence, each side of the triangle emphasizes two vertices and deemphasizes the third. Second order cybernetics was first a theory of knowledge (bottom of the triangle) and later also a description of how knowledge is used (right side of the triangle). With this triangle second order cybernetics became not a competing epistemology to positivism but a theory of epistemologies [Umpleby, 2016].

For many decades social scientists have tried to imitate the physical sciences. Physics was regarded as an example of how to do science. More recently the idea is to expand science so the physical sciences become a special case of a larger view of science. The new view includes purposeful systems. Inanimate objects (e.g., in physics) are a special case [Umpleby, 2017].

Second Order Cybernetics

In recent years there has been a transition from speaking about second order cybernetics to describing also second order science [Riegler & Mueller, 2014, Mueller, 2011, Kauffman, 2014]. This is possible because cybernetics is a general theory of control and communication. It is a theory of information and regulation. Physics, in contrast, is a general theory of matter and energy.

Table 2 - Three versions of cybernetics

	Engineering Cybernetics	Biological Cybernetics	Social Cybernetics
The view of epistemology	A realist view of epistemology: knowledge is a “picture” of reality	A biological view of epistemology: how the brain functions	A pragmatic view of epistemology: knowledge is constructed to achieve human purposes
A key distinction	Reality vs. Scientific Theories	Realism vs. Constructivism	The biology of cognition vs. the observer as a social participant
The puzzle to be solved	Construct theories which explain observed phenomena	Include the observer within the domain of science	Explain the relationship between the natural and the social sciences
What must be explained	How the world works	How an individual constructs a “reality”	How people create, maintain, and change social systems through language and ideas
A key assumption	Natural processes can be explained by scientific theories	Ideas about knowledge should be rooted in neurophysiology	Ideas are accepted if they serve the observer’s purposes as a social participant
An important consequence	Scientific knowledge can be used to modify natural processes to benefit people	If people accept constructivism, they will be more tolerant	By transforming conceptual systems (through persuasion, not coercion), we can change society

Source: [Umpleby, 2014]

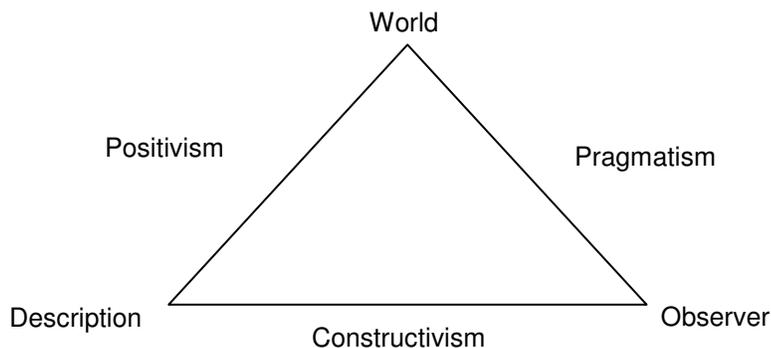


Figure 3. Three epistemologies

Whereas the physical sciences describe the material world, cybernetics is concerned with purpose, meaning, regulation, understanding and ways of knowing, including science. Hence, cybernetics aspires to provide a general theory of management, government, the interaction between ideas and society, and perhaps even the history and philosophy of science. The result has been an attempt to expand the conception of science so that it more adequately encompasses social systems. Social systems are reflexive. They observe, reflect and act. And they are composed of elements (e.g., individuals and organizations) that are also reflexive [Lefebvre, 1982; Soros, 1987; Umpleby, 2017]. Trying to describe social systems using tools taken from the physical sciences is very limiting. An alternative is to begin with an understanding of the phenomenon of interest.

Recent work in cybernetics has suggested that three dimensions can be added to our conception of science, not just to cybernetics.

1. The observer should be included in descriptions. We need to understand not only how to conduct an experiment but also the background of the scientist – history and culture, field of study, perhaps religion and political perspectives – any conceptions of the world that shape the context and the purpose of an inquiry.
2. In the physical sciences theories do not alter the way the world works, except to some extent in quantum mechanics. But in the social sciences there is a dialogue between theories and practice. A social theory typically describes how a social system operates and is used to suggest actions that might improve its performance. The evolution of economic thought provides an example. Theories by Adam Smith, Karl Marx, John Maynard Keynes, and Milton Friedman not only describe economic systems but also influence the way people behave in social systems [Umpleby, 2014].
3. The history of science is a self-organizing system, similar to biological evolution. There are two processes – the creation of new variety (e.g., the creation of a new theory) and the selection of appropriate variety. Some ideas are adopted and used. Some ideas are discarded. In the philosophy of science emphasis is placed on testing ideas. How ideas originate, or where they come from, is not necessarily described. New ideas are thought to arise from intuition, imagination, or inspiration. However in recent years schools of design have been created on several campuses. They are usually in schools of art or architecture. But machines, software, management procedures and government programs are also designed. There are now methods for teaching design. Hence there are now methods for creating hypotheses as well as methods for testing them.

These three additions to science – including attention to the observer or scientist, considering the effect that theories have on the phenomenon described, and methods for creating new hypotheses – are significant additions to our conception of science. They are consistent with earlier scientific work and they expand the possibilities for science in the future. Hence, they are consistent with the Correspondence Principle. In the new conception of science physics is not an example for all of science but rather a special case of a larger conception. The new conception will aid the unification of the sciences, both natural sciences and social sciences.

Third order cybernetics

Vladimir Lepskiy and his colleagues at the Institute of Philosophy of the Russian Academy of Sciences (RAS) have been meeting every two years for about 20 years to discuss Reflexive Processes and Control. They now call their work “third order cybernetics.” [Lepskiy, 2017].

The idea of third order cybernetics is based on the idea that philosophy of science is passing through three stages: classical, non-classical, and post-non-classical. [Stepin, 2005]. Each of the three development stages of science are associated with the dominance of one of three types of scientific rationality - classical, non-classical and post-non-classical rationalities. The scientific rationalities are not alternatives. Each subsequent rationality has its own specifics but includes also the previous types of rationality. Post-non-classical scientific rationality integrates all three types of scientific rationality.

The classical type of scientific rationality concentrates attention on the object and, in theoretical descriptions and explanations, tends to eliminate everything, which refers to the subject, or the means and operations of the activity. This elimination is regarded as a necessary condition for obtaining objectively true knowledge of the world. The goals and values of science, the determining strategies of investigation and the methods of analyzing the world, at this stage, as well as at all other stages, are determined by the worldview attitudes and value orientations dominant in the culture. But classical science does not comprehend these determinations.

The non-classical type of scientific rationality takes into account connections between the knowledge of objects and the means and operations of activity. Explication of these connections is regarded as necessary for objectively true descriptions and explanations of the world. But connections between science and social values and goals are still not an object of scientific reflection, though implicitly they determine the character of knowledge. They determine what and how we distinguish and comprehend in the world.

The post-non-classical type of scientific rationality broadens the field of reflection over activity. It takes into account the correlation of obtained knowledge of the object not only the specificity of means and operations of activity, but also the value-goal structures. Here we explicate the connection between intra-science goals and extra-scientific social values and goals. The requirement of explication of values not only does not contradict the way for obtaining objectively true knowledge of the world, but also is a premise for realization of this attitude.

The analysis of cybernetics evolution and the evolution of scientific rationality allows the hypothesis of their correlation. The first-order cybernetics "*cybernetics of observed systems*" (Norbert Wiener) developed in classical scientific rationality, the second-order cybernetics "*cybernetics of observing systems*" [Foerster, 1974] developed in non-classical scientific rationality. Post-non-classical scientific rationality can become a basis for formation of post-non-classical "*cybernetics of self-developing environments*" which can be considered as the third-order of cybernetics. The results of the first steps on the way of formation of the third-order cybernetics are presented in Table 4.

Table 4 - The generalized results of the philosophical and methodological analysis of the evolution of cybernetics (philosophical, methodological and theoretical levels)

PHILOSOPHICAL LEVEL		METHODOLOGICAL LEVEL			THEORETICAL LEVEL
Type of scientific rationality	Philosophical approach	Paradigms or model	Objects of control, dominant types of activity	Scientific approach	Areas of knowledge
Classical	Positivism	Subject - Object	Complex system Activity in activity	Activity approach Monodisciplinary approach	Cybernetics
Non - classical	Philosophical constructivism	Subject - Subject	Active systems Communicative activity	Subject-activity approach Interdisciplinary approach	Second order cybernetics
Post - non - classical	Humanistic interpretation of philosophical constructivism	Subject - Meta-Subject Self-developing reflexive-active environment	Self-developing environments Reflexive activity	Subject-focused approach Transdisciplinary approach	Third order cybernetics (post-non-classical cybernetics of self-developing reflexive-active environments)

Source: [Lepskiy, 2017]

The formation of scientifically ensured control and cybernetics in the context of post-non-classical rationality has begun [Lepskiy, 2015]. In our opinion, the formation of post-non-classical third-order cybernetics is realized. Thus, the main thesis would be *from “observed systems” to “observing systems” to “self-developing reflexive-active environments”*. From the paradigm *“subject - object”* to the paradigm *“subject - subject”* and further to the paradigm *“subject - metasubject”*.

A transition in control to the paradigm *“subject – metasubject”* led to the formation of new types of control. Control through self-developing environments becomes dominant. Control of *“the soft force”*, control of chaos, control of complexity, control via *“mechanisms of functioning of the environment”*, control *“via mechanisms of assembly of subjects”* and many other types of control. Control through self-developing environments also begins to be used in control of economic systems. For example, the 2007 Nobel Prize in Economics was awarded to Leonid Hurwicz, Eric Maskin, and Roger Myerson, for their contributions to mechanism design theory.

Their research is focused on the paradigm "subject - polysubject environment" in the control of economic systems.

Including the person in dynamic models of social systems becomes a basic approach. This trend is observed also in the economy. For example, the 2002 Nobel Prize in Economics was awarded to Vernon L. Smith "for having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market mechanisms".

Knowledge in third-order cybernetics

Let us consider several aspects of knowledge representation in post-non-classical scientific rationality:

- knowledge and a problem of subjectivity loss in the realities of "the digital world";
- the principle of the double subject in a self-developing reflexive-active environment; a problem of active knowledge in a self-developing reflexive-active environment;
- integration of knowledge in a self-developing reflexive-active environment.

Knowledge and a problem of subjectivity loss in the nature of "the digital world". In our opinion, the solution is to look for an adequate organization of interaction of the subject with the self-developing reflexive-active environment which should include various reflections of the acts and texts and should have some attributes of subjectivity itself. Communication of the subject with the metasubject becomes the basis for assembling the whole. The metasubject should contain mechanisms of support for assembling the subjects included.

The principle of the double subject in a self-developing reflexive-active environment [Lepskiy, 1998]. This principle defines the most important technological procedures of the self-developing reflexive-active environment and the organization of knowledge:

- a procedure for reflexive decomposition of subjects (identification of subject positions);
- a procedure for identifying a virtual subject; a procedure for generating virtual active elements;
- a procedure for discharging formalized types of activity from subjects;
- a procedure for reflexive synthesis (creation of activity models, models of activity subjects, personal models, etc.).

The principle of the double subject can be interpreted as the dynamic transformation of subjects into a virtual group subject.

The problem of active knowledge in a self-developing reflexive-active environment. The ocean of knowledge becomes less visible and available in traditional forms of access to knowledge. The traditional system of navigation of knowledge became hopelessly outdated, search engines essentially have not changed for the last fifty years. It is necessary to replace the paradigm of approach to the knowledge organization and navigation in the space of knowledge, on the basis of creation of environments of active knowledge inseparably linked with creators of knowledge including virtual creators. The solution of this problem is possible in a self-developing reflexive-active environment in which the exteriorization of various forms of subjects activity is included (activity, communicative, reflexive). These environments permit combinations and interactions of the subjects in various forms of natural and artificial intelligence. The environments of active

knowledge will allow satisfying not only property of relevance (compliance to the obtained information, to the inquiry formulated by the user), but also a pertinence (compliance of knowledge gained by the user to his/her requirements). Creation of the environments of active knowledge assumes participation of the environments in the solution of the problem of implicit (personal) knowledge identification.

Integration of knowledge in a self-developing reflexive-active environment. These environments create conditions for integration of knowledge on the basis of the system of special ontologies [Lepskiy, 1998].

Ethics in third-order cybernetics

The dominant concern in third-order cybernetics is ethical treatment of the subjects included in any meta-subject (a family, group, organization, country, etc.), the scientist's identification of himself/herself with this meta-subject and regulating interaction while taking into account his/her influence on the meta-subject [Lefebvre, 1982; Lepskiy, 2016].

Creating a Reflexive Philosophy of Government: An American interpretation of third order cybernetics as it has developed in Russia

The idea of third order cybernetics is rooted in the development of philosophical thinking in Russia in recent years [Lepskiy, 2015]. Whereas second order cybernetics emphasized self-reference and a scientist's reflection on his or her understanding, third order cybernetics is the study of social systems or the study of how a system composed of reflexive systems can itself be reflexive. An example is the relationship between a society and its government. The role of government is to enable a society to achieve its purposes, at a minimum survival and ideally prosperity and thriving. Achieving these objectives requires that the government control at least some aspects of society and that the society control the government, primarily by limiting the power that the government has over its citizens. Limits take the form of laws and institutions, such as a legislature and courts.

An important concept in third order cybernetics in Russia is the idea of a meta subject. The meta subject can be thought of on three levels. At the micro level the meta subject would be the family or the work group. At the meso level the meta subject would be a company or a city. At the macro level the meta subject would be a country or the world.

At the micro level the fields of psychology, therapy, and sociology have been influenced by cybernetics. Key authors are Gregory Bateson [1972], Donald Jackson, Paul Watzlawick [1974, 1983] and John Weakland.

At the level of the firm or organization the fields of management and public administration have also been influenced by cybernetics and systems science, for example Stafford Beer (1972), Russell Ackoff [1981], Peter Checkland [1999], and Markus Schwaninger [2008].

At the macro level to find the key authors one must go farther back in time. In the 17th century people in Europe were trying to create self-governing societies. The task was to build a reflexive society, one in which people were both rulers and ruled. Eventually the goal became to go beyond both the King and the Pope. Both still exist, but they are not as powerful as before.

The macro level is the most reflexive level. There are many feedback loops in a large social system. There are many challenges – how to resolve internal conflicts, how to defend the society against interference from outside, how to create an innovative society and how to achieve steady social progress in terms of standard of living and civil liberties.

Here are a few of the key steps in the development of government institutions in Europe. Charlemagne was crowned Holy Roman Emperor by the Pope in 800. His reign advanced the spread of Christianity in Europe. In 1215 the Magna Carta was the first agreement to limit the power of a king. Martin Luther (1483-1546) initiated the Protestant Reformation, thus limiting the power of the Pope. In the thirty years war (1618 – 1648) about 1/3 of the people in Europe were killed in wars between Protestants and Catholics.

During the 30 years war many people moved from Europe to N. America to escape the religious conflicts. The Peace of Westphalia, that ended the 30 years war, supported the idea of religious freedom and largely created the conception of the nation state. Each country could choose its own religion. Each person could worship as he or she chose. Individuals and nations became self-governing.

The underlying problem in Europe was aristocracy and a class system. A political/ religious hierarchy was the idea that supported the aristocracy. There were two solutions. One could move to America and create a new society on the frontier. Or one could think one's way out of the box by inventing ideas like individual rights, a social contract, and the rule of law. Ideas developed in Europe were tested in N. America. Leading theorists were Thomas Hobbes (1588-1679) and John Locke (1632-1704) in England, Voltaire (1694-1778) and Jean-Jacques Rousseau (1712-1778) in France and Edmund Burke (1729-1797) in Ireland.

According to Acemoglu and Robinson [2012] there are two challenges in developing a government: first, assembling enough power to achieve social purposes and second, limiting the power of the executive so that the rights of individuals are not abused. Over time several institutional arrangements have been developed, including (1) a federal system with local, state and national governments and (2) legislative, executive and judicial branches at each level. The branches were independent and each could check the power of the others. Other institutions were universities, a free press, business organizations, labor unions, and non-governmental organizations.

Several principles or values became accepted over time: majority rule and minority rights, a right to private property, trial by jury, the right of an accused person to have a lawyer, religious liberty, freedom of speech. Gradually secular authority replaced religious authority. The state – the citizenry as a whole through a constitutional system – developed the power to regulate both religion and the economy.

The type of government in a society is influenced by geography [Diamond, 2005]. A country with strong borders (e.g., UK and US) worries less about what people say and do. A country with no clearly defined borders (e.g., on the Central European Plane) must keep control of the population in order to repel invaders.

During the Cold War there were basically two points of view – capitalism and communism. These ideologies gave meaning and purpose to life and provided organizing principles. An alternative, more general point of view is what Karl Popper [1957] called “piecemeal social

engineering” and what Donald T. Campbell [1988] called an “experimenting society.” If third order cybernetics is seen as a theory of experimentation and reform in social systems, it will connect work in cybernetics with political reform and the evolution of society. This is an important addition to cybernetics and to the unification of science.

Some conclusions: Comparison of Russian and American approaches to cybernetics from the perspective of intellectual traditions

Understanding the differences in intellectual traditions leads us to a deeper understanding of the theories of cybernetics. Western scholars single out cybernetics of the first and second orders. Cybernetics of the second order includes a biological and social version. It arose from "experimental epistemology." The goal was to understand the processes of cognition on the basis of neurophysiological experiments, as a result of which cyberneticians came to the conclusion that the observer can not be excluded from science.

The Russian interpretation of second-order cybernetics is different from the Western conception. Table 5 presents a description of Lepskiy's theory using Umpleby's criteria.

The development of the conception of third-order cybernetics is based on Russian ideas: the activity approach, the typology of scientific rationality, the inclusion of the moral component, and acceptance of irrationality etc., are not well known in the West, which leads to some misunderstanding of concepts.

Briefly, the main differences between American and Russian approaches to cybernetics are the following:

- the American vision of second order cybernetics includes biological and social versions; the development of cybernetics takes place within the framework of the paradigms of classical and non-classical rationality (using Russian terms);
- the Russian vision of the second order cybernetics excludes from consideration the biological version, in fact, reducing second order cybernetics to the cybernetics of the individual subject (observer) and, indirectly, his / her values (through the choice of methods and means of studying an object), in contrast to the third-order cybernetics concept with its focus on the social (meta subject);
- Western scholars do not consider third-order cybernetics to be necessary, since the inclusion of an observer (subject) in the field of science, from their point of view, solves the problem of taking social values and goals into consideration [Medvedeva, Umpleby, 2003];
- V. Lepskiy's theory of third-order of cybernetics develops in the direction of typically Russian ideas: "noosphere", "collective consciousness", "co-evolution", etc., i.e. it is not just social cybernetics, but cybernetics of environments, and probably one can say cybernetics of nature.

Table 5 – Description of V.E. Lepskiy's theory using S.A. Umpleby's criteria

	1st order cybernetics	2d order cybernetics	3d order cybernetics
Leading scientific paradigm	Subject – Object	Subject – Subject	Subject – Meta Subject
The dominant approach	Activity approach	Subject-activity approach	The subject-oriented approach
Type of scientific rationality	Classical type of scientific rationality	Non-classical type of scientific rationality	Post-non-classical type of scientific rationality
The view of epistemology	A realist view of epistemology: knowledge is a “picture” of reality	Knowledge depends on the methods and means that the subject (observer) of the activity uses	Knowledge depends on the meta subject and its values, goals (meta-observer: family, group, organization, country, etc.)
A key distinction	Reality vs. Scientific Theories	Positivism vs. philosophical constructivism	Positivism vs. Humanistic constructivism; Emphasis on communication processes
The puzzle to be solved	Construct theories which explain observed phenomena	Include the observer within the domain of science	Reconcile intrascientific and social values and goals with the value orientations of the subject (observer) of scientific activity
What must be explained	How the world works	Reflection as a new dimension	How the self-developing reflexive active environment works
A key assumption	Natural processes can be explained by scientific theories	The subject's goals and values are included through the choice of methods and means of studying the object	Freedom as acceptance
An important consequence	Scientific knowledge can be used to modify natural processes to benefit people	Scientific knowledge can influence the phenomenon being studied	Scientific knowledge can be used to implement the idea of co-evolution: the coordinated evolution of nature and humanity as equal partners

Source: [Medvedeva, 2017]

The presented differences demonstrate the great potential for ideas from Russian and Western scientists to enrich the further development of cybernetics and science in East and West. Such cooperation is increasing. In September, 2020 the Institute of Philosophy of Russian Academy of Sciences plans to hold the World Congress on Systems Research and Cybernetics (WOSC2020).

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