From the classical science ethos to the techno scientific one

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Abstract. Today, the problem of the science ethos is more relevant than ever and it is viewed from the perspective of the transformations, taking place in modern science and scientific knowledge. Norms and standards of the cognitive process are revised, Good and Truth understanding is being transformed, nature and value of fundamental and applied research is changing, problems of collective and personal responsibility of scientists, etc in the paradigm of post-nonclassical scientific rationality. The more innovative, progressive and new a product is in all aspects, the more valuable it is for consumer demand. However, due to the high rate of scientific activity results implementation, it is far from always possible to timely assess the consequences of the technological innovations’ application, to comprehend them from the standpoint of ethics, the technologies development is ahead of social expertise and the science ethics development. As a result, the relevance of studying the techno science ethos increases.

The purpose of this article is to analyze scientific ethics evolution, the emerging new scientific ethos - the ethos of techno science.

1. Introduction
Evolution of scientific ethics, analysis of a new scientific ethos formation - the ethos of techno science is examined in the article. The ethos of post-non-classical science is characterized as a techno scientific one. Its defining parameters are due to the influence of NBIC - technologies on the development of civilization as a whole and of each person separately. The innovative orientation of techno science actualizes research in the field of legal and ethical foundations of modern science. There is a need for philosophical reflection of the ethical norms’ emerging system and prohibitions as a new stage regulator of civilization development. It is shown that, in contrast to the ethos-classical science that regulates scientific activities within the scientific community, the ethos of post-non-classical science (techno science) is more complex and heterogeneous. The ethos complexity of post-nonclassical science or techno scientific ethos is determined primarily by the fact that now we are dealing with a transdisciplinary organization of scientific knowledge, with convergent technologies combining bio-, nano-, cognitive, information technologies, which result of such scientific ethics forms as bioethics, nanoethics, neuroethics, information ethics. In technoscience, knowledge is produced not only in the context of discovery and fundamental rationale, but also in the assessed consequences’ context of their application. The risks of technoscience led to the formation of such a new scientific discipline as the social assessment of technology, which is a form of post-non-classical science ethics. Both, the goals of scientific activity have been transformed and interaction within the scientific community. Ethics of technoscience unites not only nanoethics, bioethics, information ethics and neuroethics, but brings ethical research to a new level of conceptualization, integrating speculative studies of moral philosophy with humanitarian social practice.

In the ethical teachings of antiquity philosophers, the connection between moral component of knowledge and truth was fixed. So, Socrates identified knowledge with virtue, and ignorance with evil, the top of ideas hierarchy was the idea of Good for Plato. According to Aristotle, ethics was not
so much knowledge as actions, ethics was presented as a doctrine of "hygiene of life" in moral and mental terms, where the subject was morality, but the problem is Good and Evil identification and separation. Hence there is the ethical teachings division of Western philosophy into two main doctrines - the absolutist, coming from Socrates and Plato, where moral principles are understood as Absolute and utilitarian, so, the moral value of a behavior or action is determined by its usefulness. Today ethics is interpreted as an area of social and philosophical research, within which morality is studied, expressing a special sphere of supra-biological regulation of human relations and the highest values and obligation ideals associated with it. This means that ethics is at a kind of “meta-level” in assessing social events.

The scientific ethics focus is moral aspects of scientific activity. Throughout the entire process of science formation and development, its goal was the search for Truth. Scientific ethics, which task is to analyze and evaluate scientific activity and its results, took shape as a separate specialty of the science sociology in the 60s of the XX century. The most systemic is the concept of classical science ethos, formulated by R. Merton. This concept identifies four main principles on the basis of which, science should develop: universalism, universality, disinterest, organized skepticism. The ethos of classical science determined the behavior patterns in the professional scientific environment and, first of all, it was based on the rational behavior of the scientist [1].

However, despite the thoughtfulness and consistency of this concept, R. Merton himself recognized the impossibility of adherence to such principles in the scientific industry throughout its development history and the inevitability of changes, dictated by the situation. Already in 1965, a new understanding of the science ethos was formulated in the article "The Ambivalence of a Scientist", where he showed that a scientist's behavior was determined not only by rational motives, but also by various socio-psychological factors, designated by him as "the pathology of science." The consent with this point of view was expressed by the sociologist I. Mitroff in his article "The Subjective Side of Science"(in 1974), where he described the scientist's behavior as a fluctuation between norm and counter-norm. Thus, we see the following trend, characterizing the transformation of the scientific ethos. The ethos of classical science was based on the rules and laws of a moral and ethical order, which had no legal force, but determined the vector of activity corresponding to the set of rules, governing relations within the scientific community. Like H. Longino, Modern researchers consider scientific activity to be a process, conditioned by a multitude of extracognitive ideas and prejudices, as well as subject to the powerful influence of external factors, for example, the state, private business, and so on [2].

According to the modern philosophy of science, the science development is due to the influence of both internal, cognitive factors and external socio-cultural. V.S. Stepin identified three paradigms of scientific rationality, characterizing the dynamics of science in Western culture: classical, non-classical and post-non-classical [3]. Each of these scientific paradigms corresponds to the ethos of science and underlying legal and ethical foundations. Contradictions arise between the old, but already formed, and new, not formed yet, imperatives of scientific activity in the course of the science development. The scientific community is faced with a choice of norms and rules to rely on in his activities, is it worth adhering to some guidelines in a free scientist? One of this article’s objectives is to analyze this problem.

2. Results
The legal and ethical aspects of scientific activity correlate with various aspects of social life, in turn, the moral and value orientations of modern society have a serious impact on the ethos of modern science. Changes in science and nature of scientific knowledge at the present stage are enormous. Classical science was presented as an "ivory tower", a special world, where both processes taking place and their results are available only to a certain category of people - scientists. Today science is inseparable from society, as B. Latour noted, if earlier society surrounded autonomous science, but remained a stranger in relation to the principles and methods of scientific rationality functioning, now
science and the things we use traditionally in a term, call society, are intervened in each other [4, P. 209].

This change in the science place in society and the method of obtaining knowledge was expressed in the appearance of such a phenomenon as "techno science", which was the subject of close study [5,6]. "The peculiarity of techno science is that its objects are not objective reality in the Cartesian dualistic picture of the world, but the so-called human-sized objects. The main feature of techno science is its high social and practical orientation. Techno science is not a technical one, but a new form of science organization, integrating many aspects of both natural science and technology, and humanitarian knowledge"[7, p. 12]. Researchers pay attention to new relationships between fundamental and applied scientific knowledge in characterizing techno science. So, V.A. Lektorsky notes that “the study of reality and production of new technologies are increasingly intertwined with each other” [8, P. 35]. The rigid separation of fundamental and applied research is removed, as a result of human innovation; reality itself is transformed, since the border between natural and artificial is erased.

In our opinion, the most important aspects in the characterization of techno science were identified by V.S. Shvyrev. He correlated techno science with the postnonclassical paradigm of scientific rationality cognition is not a simulation of a “natural” reality existing outside of a person in both cases. The picture of the world with its business-technical science is not objective, but affects the human world. It goes beyond the narrow technologism (construction of engineering and technical structures), since it causes a change in the associated design and constructive consciousness. Unlike classical and nonclassical, “postnonclassical rationality is not a purely cognitive rationality that claims to model reality“ as it is “, it acts as a form of social and humanitarian design and constructive rationality” [9, P. 45].

In the work an article author, it is shown that NBIC technologies are an example of technoscience [10]. Special programs of social development, based on NBIC technologies, have been adopted in America and Europe. NBIC technologies are not just another scientific and technical improvement. They are today the main factor of social dynamics, influencing the development of civilization as a whole and each person individually. However, it is not clear whether and how the corresponding system of ethical norms and prohibitions will be fixed as regulators of the new stage of civilizational development.

One of the most important characteristics of post-non-classical science is the extremely rapid introduction of scientific results and technological progress into our life. Innovations are becoming the main value. Yesterday's laboratory research may already be a new technological achievement available to humans today. And this is not only smartphones or game consoles, but, stem cell-based medical technologies. For example, clinical trials involving volunteers can be considered both medical care and scientific experiment, but what norms should be used when assessing their legitimacy and humanity? For cancer patients, helping-hand participation can be both, the last chance for recovery and an additional threat to their life and health. Such situations actualize the problem of safety for a person of the scientific achievements results, which become available to him so quickly. If fundamentalism and universalism were the fundamental principles of classical science, then innovations ones become for the post-non-classical science. In practice, this manifests itself as the absence of a time interval between the development and implementation of the scientific achievements results.

The ethos of post-non-classical science has its own unique characteristics. As Kiyashchenko noted, the norms of scientific activity acquired a dynamic character, they "were formed in the horizon of interaction between scientific picture of world and life world, clearly demonstrating dependence on the goals set by this or that scientific community and on the internal norms adopted by it" [11, P. 48]. In techno science, knowledge is produced not only in the context of discovery and fundamental justification, but also in the context of their application estimated consequences. In the transdisciplinary research of post-non-classical science, the axiological aspect of the techno science philosophical foundations is particular importance. Risks of techno science, socio-ecological
consequences of technological disasters, need to introduce social and humanitarian expertise as a special type of activity, have led to the formation of such a new scientific discipline and social practice as the social assessment of technology, which is a form of ethics in post-non-classical science.

In the post-industrial society, the conditions for acquiring knowledge have changed, and, as noted above, the goals of scientific activity have been transformed. Interaction takes on a disintegrating or integrating character, depending on the circumstances within the scientific community, as well as between teams. Scientific communities can be formed for the solution of a specific problem and function not on a permanent basis, but a limited time period necessary to achieve the set goal, for example, invisible colleges as a form of non-institutionalized scientific activity. All this has an impact on the existing scientific ethos, which becomes more complex in such conditions. Researchers note that the formation of a modern society, a new style, based on the Fourth Technological Revolution achievements, is directly related to a change in value paradigms, ethical principles of science, and ultimately the subject itself [12]. Thus, profound changes in the field of science entail radical changes in the scientific ethos. The ethos of post-non-classical science (techno science) is being formed.

3. Discussion
It should be noted, characterizing the ethos of post-non-classical science, that in contrast to Merton's ethos of science, regulating scientific activity within the scientific community, the ethos of post-non-classical science is more complex and heterogeneous. The internal and external contours of science are distinguished. According to B.G. Yudin, the inner contour is based on the diverse connections between science and technology. The external contour is complemented by such connections as business financing the development of new technologies, human relations as a consumer of scientific developments, a society with all interconnections between the blocks of this contour are carried out [13].

Is the ethics of techno science an applied ethics that exists in addition to the internal ethics of science in the form of the ethical content of NBIC technologies’ various components nanoethics, bioethics, information ethics, neuroethics? Or is the ethics of techno science an integral meaning-making system, where applied, theoretical and socio-humanitarian, hermeneutic aspects are convergently connected? In order to answer these questions, one should refer to the analysis and assessment of the techno science ethics’ components.

Bioethics has been developing since the late sixties of the XX century. Initially, the subject of bioethics was the discussion and evaluation of new biomedical practices, but many ethical, anthropological, ontological problems arose with the development of biotechnology, in the search for answers which subject space of bioethics was formed to. The most significant change in the situation in the field of bioethics is due to the fact that a person is not only a consumer of various technology products' kinds, but also he becomes the target of these influences at the present stage of the science development. There was no question of changing human nature within the framework of human improvement programs, aimed at improving the quality of life, but today convergent technologies allow transforming the biological nature of a person and thereby undermining the basis of human identity. This path of human development is discussed by transhumanism supporters. Bioethics with its task to help predict the possible consequences of the biomedical technologies use is not only a scientific discipline, but also a social practice, aimed at preserving a person and his values.

Additional clarification of human nature problem is shed by research, called cultural neuroscience and neuroethics. Neuroethics is interpreted not only as an applied ethics that defines the medical intervention boundaries in the brain study, but also as a complication of philosophical ethics, since the ontological foundation of morality itself is called into question. Modern technologies and neuroscience make it possible to see which parts of the brain are activated during certain actions and experiences. The development of neuroscience and technologies for three-dimensional brain mapping, contributed to the formation of neuroethics, however, the essence of morality characterizes not as a person only, but in his desire to be ideal one. A person's actions are not always explainable as causal or utilitarian.
The philosophical context of neuroethics is associated with the need for a moral assessment of the cognitive technologies impact and neuroscience on humans.

Information ethics is the field of ethics aimed at studying the moral and ethical problems of information technologies development, as well as the ethical and legal aspects of electronic culture development in the information society. Its formation and development is associated with the spread of the Internet. Information ethics is not only a component of information philosophy, but a discipline that opens a new practical dimension and carries out the moral regulation of the infosphere, according to Oxford University Professor, one of the leading specialists in the philosophy of information technology L. Floridi [14].

Nanoethics is another form of ethics of techno science that carries out ethical reflection on nanotechnology. In the problematic field of nanoethics, there are issues of influence at the level of atoms and molecules on materials used in all areas of technology on the one hand, the problems of a moral, ethical and anthropological orientation on the other. The task of nanoethics is to design all aspects of the harm and benefits of introducing the most complex convergent technologies into social life.

All forms of techno scientific ethos are both a scientific discipline and, at the same time, a social practice, this is transdisciplinary knowledge. Transdisciplinarity is a modern type of knowledge, which is a hybrid of fundamental research, focused on the knowledge of truth and socially distributed production of knowledge.

However, not only the deep penetration of scientific and technological progress into the social life distinguishes the modern stage of science development. Science has a strong impact on all spheres of social life, as well as on a person, both as a social institution and as a system of knowledge. We can say that the interaction of science and humans occurs according to the principles of synergetics, considering the multifaceted nature of scientific research and the rapid implementation of practical results in society: nonequilibrium, unstable, in a regime of dynamic chaos. This social system instability has both positive and negative aspects. A person is exposed to risks, as an object of modern research and a field for testing their results. Today, even the biological component of human nature, which throughout the history of human evolution was the basis of human identity, can be transformed, and the prospects for a post-human future are seriously discussed. The achievements of modern science and technology also exacerbate the problem of social inequality. There are contradictions with the international code, which plays a protective function in the matter of maintaining universal equality, good and justice.

Modern scientific research is not only a matter of an armchair mind, it requires serious financial costs, and the result and its receipt are associated with both economic risks and predicting risks the dynamics of complex self-developing systems - objects of post-non-classical science. Another social consequences aspect of the techno science development is possible growth social stratification of society due to the inaccessibility for every one’s advantage of high technologies’ achievements. But even if they are available, is there a guarantee of their positive impact on the human body as a whole? Who will be responsible for applying the latest biomedical technologies in case of negative consequences? It is necessary to develop legal and ethical norms, aimed at preserving the essence and dignity of a person to prevent possible negative consequences of the modern technologies use.

4. Conclusion
Thus, the complexity of the ethos of postnonclassical science or techno scientific ethos is determined primarily by the fact of a transdisciplinary organization of scientific knowledge.

In transdisciplinary research, the horizon of object parameters, described by reductionist methodology, crosses a new vertical dimension, which takes from the plane of object reductionist connections into the sphere a person not only as a subject, but also in the sphere of his life, practice, social and cultural values. Transdisciplinarity presupposes the convergent penetration of the natural sciences and the humanities, as a deeper level of integration. The multidisciplinary approach combines the complexity of the world with the human knowledge complexity. Convergent technologies unite not
only bio-, nano-, cognitive, information technologies, but also social technologies. As a result, issues of science ethics and technology began to acquire decisive importance in philosophy, such forms of scientific ethics as bioethics, nanoethics, neuroethics, information ethics have emerged. The introduction of complex technical systems, precisely because of their increasing complexity, is characterized by unpredictability of undesirable side effects, arising during their creation and functioning. The techno science ethics is designed to contribute to the mechanisms creation of self-restraint and self-control in uncertainty conditions. At the next stage of the philosophical analysis of the science ethos, we will show that the ethics of techno science brings not only unites nanoethics, bioethics, information ethics and neuroethics, but ethical research to a new level of conceptualization, integrating speculative studies of moral philosophy with humanitarian social practice.

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References
[1] Mirskaya E Z, 2005 Merton and the Ethos of Classical Science, Philosophy of Science. Issue 11: Ethos of Science at the Turn of the Century. Moscow: IP RAN, pp 11-29
[2] Longino H 1990 Science as Social Knowledge. Values and Objectivity in Scientific Inquiry, Princeton, p 280
[3] Stepin V S 1989 Scientific knowledge and values of technogenic civilization, Problems of Philosophy, 10, pp 3–18
[4] B. Latour B 1998 From the world of science to that of research? Science magazine, Vol. 280, 5361, pp 208-209
[5] Gorokhov V G 2014 Technoscience - a new stage in the development of modern science and technology, Higher education in Russia, 11, pp 37-45
[6] Grunwald A 2010 Technology and society: Western European experience in researching the social consequences of scientific and technological development, Moscow, Logos, p 158
[7] Chernikova I V 2015 Technoscience in the system of scientific knowledge, Technoscience and social assessment of technology (philosophical and methodological analysis): - Tomsk, pp 8-26
[8] Lektorsky V A 2011 Rationality social technologies and human destiny, Epistemology and philosophy of science, XXIX, 3, pp 35–48
[9] Shvyrev V S 2008 On the relationship between cognitive and projective-constructive functions in classical and modern science, Knowledge, understanding, design. Moscow: IP RAS, pp 30-48
[10] Chernikova I V 2013 Interrelation of fundamental knowledge and technological projects of science, Epistemology and philosophy of science, T.38, 4, pp 177-189
[11] Kiyashchenko L P 2005 Ethos of post-nonclassical science (to the problem statement), Philosophy of Science, Issue 11, Moscow, IP RAN, pp. 29-54.
[12] Baeva L V 2011 Ethics and axiology of innovative science, Information Society, Issue 2, pp. 43-49
[13] Yudin B G 2016 Technoscience and "improvement" of man, Epistemology and philosophy of science, XLVIII, 2, pp 18–27
[14] Floridi L 2010 Information: A Very Short Introduction. Oxford, pp 108–111
[15] Kurzweil R 2006 The Singularity Is Near, Penguin Books, p 672