Critical Assessment of Technological Progress

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Abstract

The modern technocratic tendencies are not a naive technological optimism of the beginning of the 20th century, but its roots may be traced back to that time. Russia had a diametrically opposed school of thought regarding the religious and cultural criticism of technology, which stood against the over-estimation of the role of technology in society. This is the school that could have laid the foundation of philosophy of technology as philosophy of environment, which differs from technocratic philosophy of technology based on so-called technological optimism. The present stage of scientific and technological development has clearly shown the limits beyond which science and technology are confronted or will be confronted with problems for which there is no solution or, to put it better, scientific and technological problems developed by science and technology themselves. The forthcoming stage of modern scientific and technological development is sometimes identified with an alternative differentiation of 'rigid' and 'elastic' natural science and technology. We are speaking about the elaboration of a practically new paradigm of scientific and technological development. Philosophy of technology is due to become not only a philosophic study of scientific and technological progress but also a new philosophy of environment and technological sustainable development.

Technocratic philosophy of technology and cultural criticism of technology

The technocratic illusion makes people believe that *everything is technologically possible*, at least in principle. This orientation towards a boundlessly positive scientific and technological progress was given a new lease of life in the 1970s when science was looked up to as a direct productive force. Science and technology were expected to fully satisfy an individual's requirements, to set him free from the burden of muscular and routine mental labour. High hopes were pinned on space and nuclear power

research and development. Scientific and technological policy brought about the setting up of some special institutions within the framework of various social and economic systems, which also showed that science and technology were becoming more and more important in the process of strengthening a country's defence potential. This bore the concept of *post-industrial society* developed in the West, and the idea of *scientific and technological revolution* worked out in the socialist countries.

At the same time both traditional engineering and scientific education were, and still are oriented to a significant degree towards technocratic objectives relating to people and the environment. By saying this we are by no means making an appeal to give up engineering activity, which would make the existence of modern civilisation impossible, but we do call for the fostering of a quest for new, more humane forms of this activity. We shall be able to do this if we re-orient scientific and technological thinking, first of all, by altering the system of engineers' education. Such conditions fertilise the technocratic tendencies to revive in society, especially if these technocratic illusions promise prompt enrichment to society and are backed by the technocratic lobby's propaganda. This is no longer the naive *technological optimism* of the early 20th century, but its roots may be traced back to that time.

Russia had a diametrically opposed school of thought regarding *religious and cultural criticism of technology*, which stood against overestimation of the role of technology in society. Unfortunately, the critical voices were not heard in the revelry of either rapid technological development in capitalism or post-revolutionary expectations and first successes of socialist reconstruction. This is the school that could have laid the foundation of philosophy of technology as *philosophy of environment*, which differs from the technocratic philosophy of technology based on so-called technological optimism.[1]

Nikolai Berdiaev shared this opinion, stating in his article 'The Man and the Machine' (Berdiaev 1949) that the domination of technology destroys personality and would inevitably lead to dehumanisation of man. Which is why he believed that fighting against the hegemony of technology was necessary to save the human image. The designer brings expediency into the mechanism from outside, and it depends on the

organiser. This is where, according to Berdiaev, the *mechanism* differs from the *organism* in which expediency is an inherent feature. The culture of 'making' wins in the contest with nature in the 20th century that can be hailed the triumph of technology. But this Pyrrhic victory shakes people's belief in the irreversible natural order of things. Everything can be made, changed, rebuilt, even the human psyche. This precise illusion dominated in the minds of many in the 1930s and was embodied in the unprecedented programme of remoulding of the people from the capitalist past in the camp forge of socialist reconstruction in the first five-year-plan periods (Gorokhov 1992).

Berdiaev sees the utmost danger of technology in its dehumanisation because it strikes a deathblow at the humanistic ideals of culture, because the machine is anti-human by its nature. But the humanistic ideals taking their roots in the culture of the Renaissance come into antagonism with the environment, which is destroyed by man using the highly developed technical means of this century. The main contradiction of modern technological civilisation, noticed by cultural criticism of technology, is that modern technology opens up some unprecedented opportunities for humanity to satisfy and even make up their own requirements on the one hand, and on the other hand it enables the destruction of the very basis of human existence.

Backed by modern technology, man begins to consider himself the demiurge, the designer of the world that he can rebuild in different ways according to his requirements. This fundamental illusion of modern technocracy-oriented society was bitterly stated by Sergey Bulgakov in his *Philosophy of Economy* (Bulgakov 1990) published in 1912. But man is not God, he is a part of nature and he cannot replace it with a totally man-made environment, though he tries to do it, but all in vain. As a result, nature revenges itself with more frequent disasters, global climate change and other irreversible changes that put at stake the very basis of man's existence as a species. Bulgakov believes that to overcome this misunderstanding of the world, we have to transform the machine into an organism, gradually and carefully transplanting the artificial into the natural, but not replacing the natural by the artificial.

Man gives up the illusion of his omnipotence and domination over nature only painfully even at minute swings of the climate. Then he physically feels his oneness with nature, which he no longer considers just an environment of man who stands in the centre of the world, but rather in accordance with the Parmenidian understanding of the world as an indivisible unit, the One that has no separate components. 'If we were able to design in principle some technological means to regulate the natural environment or create a man-made one, we could not produce them in convenient terms before the irreversible process of biosphere degradation begins. The only way for Homo sapiens to survive is thus to lessen the global man's impact on the biosphere and provide regeneration of regulative potential. Development under such conditions can be regarded as *sustainable*. From the numerous possible directions people should learn to choose those that do not have environmentally destructive effects'. It is the task of science in its highest, humanistic interpretation (Danilov-Danilian 1999: 81–82).

In order to make this transformation possible, however, we need to bring environmental consciousness to managers, engineers and scientists and change the present-day scientific and technological outlook. As Russia has vast territories, environmental problems do not seem to be so acute there, but this is an illusion. The total pollution of vast territories will affect not only the citizens of Russia but also the whole world since environmental problems do not acknowledge state borders. Moreover, to put the problem of waste utilisation onto the shoulders of the forthcoming generations is as immoral as to design insufficiently safe and undependable machinery for the present generation. In this point the problems of humanisation and *environmentalisation* of technology directly address ethical problems.[2]

Technology and ethics

In 1898 a Russian philosopher of technology, P.K. Engelmeier, raised a question in a polemic dialogue with Leo Tolstoy (Engelmeier 1898-1): Where is the point of contact between technology and ethics? He

answered the question himself: There where the goals of the good and of usefulness correspond with each other. Science investigates the requirements of nature while ethics sets requirements for society. The subject matter of technology is usefulness while art attains the goals of beauty. Together, however, they are the main factors of modern culture (Engelmeier 1900). At the same time the traditional technological activity as well as traditional engineering education always were and still are oriented towards man's technocratic directive relating to environment and other people. The situation has dramatically changed especially in the 20th century. The changed situation requires *new ethics*.

The result of technologically oriented science and the machinery based on this science[3] is, according to Berdiaev, that human society unexpectedly finds itself confronted with a new reality that is no longer a product of natural evolution but rather of man's creative activity, of the process of organisation. This is, as the philosopher believes, the core of technological civilisation because the domination of machines and technology manifests itself in transition from organic life to rationally organised being, from the dependence of human existence on nature to constructivism and rational organisation. So, as we can see, human beings—man the created—rises up against his Creator.

The machine makes man a machine, take the appearance of a machine: man's activity becomes mechanical and rational. But man cannot become a machine unless he destroys himself. Which is why he makes himself dependable on this technological, machine-made environment, without which he can no longer live. The paradox is that in the course of technological development human society has reached a situation in which it will not be able to exist because of the machine-made character of its environment, where the natural is almost totally replaced by the artificial.

According to Bulgakov, technology is also a system of all possible means to influence nature. The very possibility of its existence lies in the significant accessibility of nature for human activity. Which is why man, being an active and conscious part of the world's organism, becomes its centre, and potential domination of man over the world is realised through economic mechanisms. But man is not God: he cannot create everything he wishes out of nothing. Man can act freely and genuinely

if he finds a method to use his own nature. But he receives his own nature as well as his environment as given facts (Bulgakov 1990: 88–89).

Berdiaev defines *technology* as the *last love of modern people* and thinks the problem of technology as very sensitive and unsolved for the Christian conscience that has formed the dual attitude to machine and technology in general—neutrally indifferent and apocalyptic. The first attitude interprets technology as a personal matter of inventors and engineers that means keeping away from bearing responsibility for the results of human activity. The second attitude is manifested in the anathema of technology as the triumph of the reign of Antichrist. But these two responses to the question raised by history are not satisfactory.

Bulgakov in his article 'The Main Problems of Progress Theory' emphasises that the theory of technological progress was transformed in the 20th century into a kind of progress theology that foretold the achievable with the help of modern technology future of the happy, proud and free man. To bring happiness to as many people as possible was put forward as a goal of that super modern religion where human society equipped with technological knowledge played the role of God (Bulgakov 1990: 261–309). That interpretation of progress comes close to the philosophy of technology as seen by Fred Bon (German philosopher of technology), according to whom the question 'What should I do to be happy?' is the most important question of technology (Bon 1989). The first Russian philosopher of technology P.K. Engelmeier (Gorokhov 1997), who also came from the initial premise of Bon, made the significance of technology in modern culture have *eudemonic approach*: 'Man is the architect of his own fortune'. These words express the so called technological optimism of the first philosophers of technology. 'The extreme forms of technological optimism were characterised by specific euphoric expectations of the future' when humanity will be able to reach material but not a cultural heaven on Earth and even obtain cosmic power (Pot 1985: 141–142).

The most illuminating example of this technological optimism and at the same time of the restrictions that arose in the course of scientific and technological development is *nuclear power engineering*. One of the pioneers of nuclear theory, Frederik Soddi,[4] in the early 20th century

described in one of his lectures an almost Biblical picture of eternal abundance of wealth based on nuclear reforms. He believed that just as mythical history began with the discovery of fire, nuclear transmutation and domination of nuclear energy would lead to the achievement of the kingdom of heaven on Earth. Soddi considered the alchemical mythologeme philosopher's stone that creates the elixir of life by transmutation of elements, to be 'a very exact but not more than metaphorical expression of our present-day world outlook—like the Biblical myth about the Garden of Eden—the proof that pre-historic man admitted that one day he would acquire the ability to transform elements'. Then Soddi foretells us with admiration that 'a direct domination over nature' and realisation of heaven on Earth with the help of the new science achievements: 'a human society that would be able to transform the elements need not earn its living with blood and sweat {...} we can readily imagine that these people will be able to make desert continents green, melt down the ice on the poles and transform the whole globe of the Earth into the Garden of Eden' (Wagner 1970: 160). Is this better than the communist Utopia? Implementation of any of the two approaches shows that the promise of heaven on Earth is transformed into the rebuilding of hell on Earth, some features of which are well-known to us not only from our own social history, but also from the not less spectacular history of scientific and technological progress (fortunately, only in a separate region). The catastrophe of Chernobyl has already turned many fertile agricultural regions of Byelorussia, Ukraine and Russia into deserts. Is not our greatest fear that CO_2 discharge into the atmosphere increases man's impact on it, which may cause irreversible changes of the climate (the global warming), thus melt the ice of the Arctic and Antarctic regions and destroy vast territories vital to modern civilisation.

Speaking about the eudemonic ideal S. Bulgakov mentions that this ideal, if taken as a scale for historical development assessment, inevitably leads to immoral consequences. Technology begins to dominate over man, not to serve him, and makes him not happy (as, for example, Engelmeier thought) but miserable. The State, having taken responsibility to patronise science and technology, inevitably begins to demand they should be useful in the increasing of its economic and military might

and does not provide free research to multiply our knowledge for the welfare of the people. This forcible technological and social progress was anti-human and destructive to the environment. This false understanding of progress was dominating in the Soviet Union from the early 1930s through to the 1950s, this period being that of the virtual implementation of the Soviet idea.

According to Bulgakov, the eudemonia ideal first leads to idealisation of human requirements; secondly this idea treats sufferings of one generation of people as a bridge to happiness of the next generations. It makes no difference to the concept if these are the sufferings of the present generation to achieve happiness for their children and grandchildren,[5] as the communist ideas promised, or, on the contrary, happiness of the present generation is achieved at the expense of the destroyed life space for all generations to come, if we speak about squandering of natural resources and contamination of the environment. Dostoyevsky's remark that to build one's own happiness at the expense of the unhappiness of others is immoral may be recalled at this point.[6]

Technological progress as a moral value—a new paradigm of scientific and technological development

In the 17th to 19th centuries human society formed the understanding of scientific and technological progress as continuous improvement of society and nature on the basis of the growing capacity of scientific knowledge in the world. Up to the middle of the 20th century this illusion, and relating to it, cosmic, natural scientific and technological Utopias led to the blurring of the limits of human cognition and technological activity, to development of scientific and technological optimism concerning the chance to make human society happy with the help of more and more advanced achievements of science and technology.

This belief in continuous scientific and technological progress, the absolutisation of a value-free scientific research, the illusion of the actual 'createability' (*Machbarkeit*) of the world on the basis of obtained knowledge resulted in the emergence of a scientific religion, based mostly on the

belief in the power of scientific knowledge and the progressive character of technological activity grounded on this knowledge. There appeared an illusion that if technology has turned an animal into man, then, combined with science, it could turn man into God, the creator not only of artefacts but also of matter, nature as well as life. Scientific and technological progress is subconsciously taken as the way beyond the limits of the possible. Such notions come back to philosophy of science and philosophy of technology of the late 19th to early 20th centuries, but it was Francis Bacon who first mentioned this in his works in the 17th century.

Since that time science was regarded as a means to multiply human knowledge aimed at creating man-made conditions and equipment to facilitate man's life. Bacon's confidence in the fact that scientific and technological progress is a humanistic one was supported by a further idea of cultivating ethically neutral knowledge and moral responsibility for its application that could do people harm. The task of Bacon's programme of scientific development was to convince the great men of the world that financial and organisational support of science was necessary and useful for society and the state. This programme was aimed at 'arranging science as an intensive enterprise and institutionalising it socially so that its inventions could serve man's well-being' (Böhme 1992: 129). This is the main goal of *New Organon* and the social Utopia of *New Atlantis* by Francis Bacon.

If ancient society set science a task to cognise that man can cognise, then Bacon sets a task to achieve man's domination over nature. This domination means that humanity with the help of exact knowledge of natural causes can use nature for some personal ends. By doing this, humanity would like to enjoy the rights to utilise nature, which was given by God. Man's domination over the material world is based, as Bacon sees it, totally on science and art. The danger may arise, however, of scientific and artistic results being placed at the service of vice and luxury or something of the kind, but it does not seem to Bacon too perilous because it cannot inspire anyone. Moreover, he believes that unlike political activity that aims at improving the state of affairs practically through the use of force and injustice, inventive activity can bring happiness and wealth without doing anybody harm.

Distinguishing three types of ambition that science could serve: (1) to multiply personal power in your native country, (2) to multiply the might of your native country and to make it dominate over other peoples and (3) to broaden the domination of human society over nature as a whole; Frances Bacon stresses that the latter is undoubtedly the healthiest and the noblest.

Trusting professional ethics is not enough from the present-day point of view. However, he does not discuss the effects of such applications of scientific and technological achievements for personal and political ends that do people harm. In his social Utopia *New Atlantis*, he speaks on the contrary, about the necessity of keeping these achievements as national secrets. The strict antagonism between man and nature, rare before Bacon but well established after him, is also problematic.

Science is to investigate the forces hidden in nature and enlarge as much as possible man's power over nature that is interpreted as a giant workshop for human activity. *New Organon* subserves this task as it deals with the logic of invention, the methodology of inventive activity that fundamentally transforms the world, for example, the invention of gunpowder or the compass. The application of a single invention inspires many people to consider the inventor a superman. But Bacon believes the discovery of a method that could facilitate further inventions deserves even greater respect. This method should throw light on things as they are, without superstition and deception, errors and confusion, which is worth more than the fruits of inventive activity altogether. Thus, Bacon changes the very system of human knowledge that is no longer treated as a closed system, a canon, but as a constantly renewable open system, a result of collective cognition. Science should in the future become a science of activity while its methodology should be based on a combination of empirical and rational abilities of the spirit. The methodology of research is here not a means of knowledge organisation but the transference of collective experience into underdiscovered fields of science. From here comes Bacon's concept of *scientific and technological process as a scientific experience passed over from generation to generation* and obtained at every moment of time as a result of co-operation of separated labour of researchers.

For the first time Bacon considers science to be scientific research, organised into research laboratories according to application spheres, meeting some social needs, i.e. serving these social needs directly. However, these are the needs, above all, of the national state, including scientific and technological development in the military sphere (Böhme 1992: 130–132). As we can see, Francis Bacon's programme articulates and develops an aggressive approach towards the utilisation of natural resources for the ends of human society. The programme elaborated, being undoubtedly progressive at that time and having some underwater stones, was successfully implemented in the 19th–20th centuries, but at the end of the 20th century we have come to the conclusion that *this programme has exhausted itself completely* (Böhme 1993).

Multiplication of man's might, the establishment of man's domination over nature and all useful kinds of art, manufacture, mechanisms and machines with the help of experiment, paying no attention to theology, ethics, politics, metaphysics, grammar, rhetoric and logic—this was *the motto of the London Royal Society*. This separation of natural science research from all ethical and religious matters that had a progressive character at the time, is now coming into antagonism with modern social development because it blurs the limits of the possible for an individual and for humanity in general, placing the former alongside of God the Creator in producing a heaven on Earth with the help of industry, technology and science.

Such super optimism concerning science and technology was given its final shape in the 19th century. Even Renan, a deeply religious Christian scientist for example, says in one of his earliest books, *The Future of Science* (written in 1848–1849 under the impression of the French Revolution but not published until 1890), that scientific belief is a supreme derivation from Christian thinking and tradition (Wagner 1970: 98–101). From his point of view, science has the power of both revelation and creation. Since its task is to organise people and God Himself, it needs full autonomy and boundless freedom. In this case the researcher becomes an authority for himself, free from any control. Thanks to science man, who is also the embodiment of the Spirit, achieves domination over matter. Such domination, as Renan expects, can be

achieved as a result of scientific research, possibly, in a million years when human society perceives the laws of life and the atom and, by transforming elements and altering species, gains boundless power and control over the Universe. Scientific knowledge will become a real basis of 'intellectual elite' power that with the help of 'preventive terror' will save everything on the Earth from destruction and let the elite approach God, as they become super human. If the secrets of life can be discovered only at the sacrifice of humanity itself to build up a new world, it will mean that the predestination of human existence has already been achieved, i.e. (that is) man, grown up in the process of evolution from the animal kingdom, has mutated into the divine matter. Two decades later under the influence of the results of scientific and technological development, which can serve vice as well as virtue and whose consequences cannot be foreseen in the predictable future, Renan realised that by doing this man can break all possible limits. In the preface to his book Renan admitted that the expectations of boundless happiness which human society might achieve with the help of scientific and technological progress was purely an illusion.

In the same way P.K. Engelmeier, a Russian engineer and philosopher of technology, begins his booklet *Technological Results of the 19th Century* (Engelmeier 1898-2: 1) with the words full of optimism: 'Our 19th, technological, century is coming to an end, the century of steam and electricity, the century of unprecedented conquest of forces of nature'. Then, describing the achievements of technological progress, he writes: 'Technology has conquered for us space and time, matter and power, being the power itself that irrepressibly turns the wheel of progress' (Engelmeier 1898-2: 6). Giving a rather optimistic assessment of the achievements, Engelmeier believes that the technological outlook was dominating in the 19th century not because of wide development of manufacture, railways, steamers, telegraph and other formal signs of the technological century, but also because of an inward tendency of Western European culture to overcome actual obstacles with actual power. Summing up the results of technological progress, Engelmeier mentions that for many thousands of years technology has been acting as 'an unconscious power unconsciously coming into a single combat with

the elemental forces of nature. In the 18th century technology was recognised, called by its name and placed alongside other noble and free professions (Engelmeier 1898-2: 12–13). *The main scientific feature of technology in the 19th century was to conquer the power of nature*. The function of science is to predict facts while the function of technology is to influence nature, evoking by artificial methods the desirable facts and to retard the undesirable ones. The technological outlook regards the world as a game of the forces accessible for our understanding and our impact on them, in other words, it plaits the will of man into other natural forces that govern the order of phenomena. To put it in a short phrase, the technological outlook is the 'Man is the architect of his own fortune' formula (Engelmeier 1900: 79–80). Man has learned to guide life according to his own desires. Engelmeier calls this skill technology. The genius of humanity over the past two centuries has surrounded us with the man-made microcosm within the natural one, because man should have done something to have his requirements satisfied, this something being expedient reforms of his living conditions. Which is why Engelmeier grants the leading part in society to *engineers* who *should become the technological elite of society*, on whose purpose the system of engineers' training should be improved. The emergence of technocracy in the 20th century showed how 'efficient' this management of society can be. It was rather difficult for Engelmeier as well as for Renan to foresee to what uncontrolled consequences this boundless scientific and technological progress might lead, especially in the military sphere.

In 1812 Sergey Bulgakov in *Philosophy of Economy* exclaimed with bitterness and suspense: Our generation seized with this passion to a greater extent is losing all limits in its effort to define the possible. 'The world is plastic', it can be reconstructed and even reconstructed in various ways. We live under the impression of the ever increasing might of our economy that opens boundless vistas for 'cultural creativity' (Bulgakov 1990: 110). According to Bulgakov, the genuine aspiration of life is to conquer, dissolve all that is inanimate, mechanical.[7] This is Bulgakov's metaphysical way out to break the antagonism between economic activity based on scientific cognition of the mechanism of nature, and nature itself, (or) the organism which actually means gradual

'digestion' of the man-made into the natural, transformation of the mechanism into the organism in the process of human economic activity, that correlates with the concept of low-waste technology, environmentally friendly technology, etc. which have been put forward rather recently. But against the background of the triumphant march of technological civilisation this appeal remains the voice of one crying in the wilderness.

The present-day interpretation of scientific and technological progress, developed within the framework of theory of sustainable development, correlates to a greater extent with the ideas of Bulgakov than with the concepts current at the beginning or even in the middle of the 20th century. 'According to the environmental approach, *sustainable development* is a development that does not exclude the system from the limits of economic capacity of the biosphere. It does not evoke the process of destruction and degradation in the biosphere, which may result in emergence of conditions profoundly unacceptable to man' (Danilov-Danilian and Losev 1998: 42–43, 47).

It is through the connection between science, technology and the economy that the slogan *Knowledge is Power* can be realised. This connection, on the one hand, leads to capitalisation of knowledge, and on the other hand, to growing dependence of even 'pure' science on technology and the economy. Man is placed in the centre of the world, his economic activity being interpreted as 'a new force of nature, a new world-transforming factor that differs fundamentally from the other forces of nature'. According to Bulgakov, the very possibility of technology comes from the actual accessibility of nature for man's impact. Nature is treated as a passive source while man is an active, conscious source and in this sense he becomes the centre of the Universe, subordinating the rest of nature to himself. 'His potential world domain is partially and gradually realised through the economic process' (Bulgakov 1990: 88–89, 112). But man does not equal God, he 'does not have omnipotence, the ability to create everything he wants out of nothing'. *Man may act freely and originally only when he deals with the methods to use his own nature as well as the environment being given to him.*

Man's economic activity implies a theoretical orientation to the world surrounding him, which he in turn changes. This orientation not

only builds up logical models of reality but also devises the projects that influence this reality. But science cannot and does not provide exhaustive answers and knowledge. Scientific knowledge is not only a transient and changeable quantity that can be deepened and made more precise in the course of scientific and technological progress, but human knowledge is limited in its essence. This deals, above all, with natural science which 'cuts chunks of reality out of the living organism to both orient itself by them and to distinguish some mechanical regularities in them. After this it rebuilds nature using these chunks. Nature is sure to be dead'. In fact natural sciences study 'the corpse of nature' which is why they break the unity, integrity and continuity of natural life while laying claim, however, to 'making up an exhaustive inventory of the world being', at least in the ideal. This notion is an illusion supported by the belief that scientific reality and the reality of nature are identical. This illusion, the belief in the boundless power of science, is implanted into the minds of modern people from childhood on by the very system of 'scientific' education that in truth resembles more closely the mythological education of the past which developed a non-critical attitude to the results of scientific research. In this point magic and science are alike in their intentions to conquer nature: the former—with the help of invocations, witchcraft and sorcery, the latter—with calculations and measurement that put natural history and nature itself into mathematical formulas.[8]

In the 20th century technology obtains a cosmogonical significance since it possesses a gigantic power of realisation and for the first time makes man a king and lord of the world, 'demiurge'. But this conceals a great danger of technology for man and the environment, because mass technological organisation abolishes the individuality of both the outer and the inner emotional life of man (Berdiaev 1949: 20–23). Making reference to Renan, Berdiaev warns that technology can provide man, or a small group of people with a great destructive power.[9] Berdiaev saw the danger of the technologisation of the spirit and intellect in the spiritual enthusiasm for technological construction that seized communist Soviet Russia and was based on the Marxist teaching that Berdiaev took to be an ersatz of true religion.

Marxist theory of scientific socialism is a clear example of the theodicea of scientific and technological progress. Russian history in the seven decades after the October Revolution shows what consequences this theory of progress may have. Nikolay Berdiaev predicted this in *The Truth and Lie of Communism* (1931). He watched with great anxiety as contemporary youth became inspired with the idea that the world had become plastic and that they could easily model and reconstruct this world, each common person being involved in the gigantic rebuilding project. At the same time communism threw away without hesitation the burden of the past and its traditions, which were in the way of revolutionary development of the decaying West, calling for the creation of a completely new world. Communism inspired people with that idea of universal reconstruction, whereas in fact it created heaven on earth only for a bureaucracy that rationalised human life down to the most trivial details and deprived people of their spiritual essence, leaving the economy and technology as the only meaningful substance. Marxist teaching borrowed the Christian concept of man as the centre of the Universe, but instead of anthropocentrism it placed *sociocentrism* in the foreground, according to which a social group substitutes for God and man does not bear individual, but collective or group moral responsibility for actions done. This dissolves the moral responsibility of the individual into that of society in general and is thus transformed to irresponsibility. This is more evident in the design process of large-scale man-machine systems, designed by many qualified engineers, scientists, designers, and managers of all kinds. A single participant of this gigantic process of creation does not feel he is responsible for the result of the creative work in general, but only for a part of it. This in fact, does not release him from responsibility for the undependable functioning of the whole system, perilous for the people who operate it or harmful to the environ-ment, no matter what position this person occupies in the designing team.

However, the concept of *anthropocentrism* is no longer sufficient, especially if it gets a hue of egocentrism, which is often connected with the ideals of self-enrichment at the expense of other people, other countries or the environment. Our understanding of nature is, first of all, utilitarian

and based on the idea of supremacy. The opposite attitude to nature can be observed in ancient nations that regarded themselves as an integrative part of nature. Modern society has been pulled out of the biological world, and Nature is given to it so that it could utilise Nature.

Such stimuli of enhancement of personal living standards are originally laid in the mechanism of self-organisation in the functioning of the *market economy*. The task of society and the state is not to monopolise these prerogatives in favour of separate groups but to provide framework conditions for the functioning of a social market economy, stimulate environmental protection activities by industries and communities, elaborate strict terms for environmentally friendly industries, control the fulfilment of these terms and to punish offending industries.

It goes without saying that the *final goals of technology*, as stated by the first philosophers of technology, *is to serve man*. But an amendment should be introduced summing up the negative experience of the 20th century: the service of mankind referred to must not have harmful effects on the environment.

V.I. Danilov-Danilian and K.S. Losev today write in the book *Environmental Challenge and Sustainable Development*: 'Modern civilisation has long and totally changed over to unified technologies of more sophisticated destruction of ecosystems and natural communities of organisms, deformation and deliberate change of the environment. Scientific and technological processes whose rate is many times higher than the rate at which new technologies of the biosphere are created (new biological organisms) stimulate more and more powerful sources of agitation, while national economy, guided basically by market forces, puts into practice the environmentally destructive technologies created by man'. This is how the crisis of modern civilisation manifests itself accompanied by the spiritual crisis of humanity (Danilov-Danilian and Losev 1998: 68).

As we can see, one of the most important tasks of modern philosophy of technology is to change the outdated understanding of technological progress as a revolutionary, onward process, which has come into antagonism with the new reality. N. Marfenin says in his article 'Ecology and Humanism': We may no longer hope for the omnipotence of nature.

'The natural mechanisms are not sufficient at present to preserve the biosphere. New methods for regulations, based on the understanding of natural processes and to some degree also the management of such processes, are required. The anthropogenic regulation is the forecast of natural cataclysms and a punctual decrease in speed of the process. It is the choice between immediate profit and long-term revenues in the usage of natural resources' (Marfenin 2000: 8). Thus, man, eager to dominate nature, destroys all natural and social borders in the course of scientification and technologisation and, in combination with on-going economic growth, threatens not only human society but also the biosphere as a whole. In the end such a progress turns into regress, first of all, in the environmental sphere, leads to the destruction of the immune forces of the environment and the human body. The *alternative* of this technological activity becomes a new paradigm in science and technology that is based on an equal partnership of man and environment. The present stage of scientific and technological development has clearly shown the *limits* beyond which science and technology are confronted or will be confronted with problems for which there is no solution or, to put it better, scientific and technological problems developed by science and technology themselves. Let us consider the basic restrictions and paradoxes that emerged in modern science and technology in the course of their progressive development in last decades.

(1) The development of the notion of scientific and technological progress is connected with the idea of 'creatability' (*Machbarkeit*) of everything, i.e. a profound possibility or even necessity to realise, implement, produce what is planned, designed, projected in scientific drafts and what is undoubtedly presupposed to be common weal. It deals with the illusion that science will be able, sooner or later, with a certain accuracy, to forecast, foretell, foresee or, at least, minimise all negative effects of these scientific projects. This 'total' *designing of everything* everywhere has led to a 'boundless' widening of the subject matter of design activity that absurdly distorts the idea of design culture and that has finally led to marking-up of its limits (Grabowski 1997).

(2) It has been established that *human scientific knowledge is not able to foresee everything: it is possible to only forecast a certain level of risk in new technologies*. Simultaneously, experts began to develop the concept of *engineer's ethics* and the problem of the *scientist's moral responsibility* for his inventions and discoveries, especially after the A-bomb had been invented and tested. The experts broke the illusion for example that a creator of a single element in an intricate technological system has only limited responsibility for the whole system.

(3) As the natural scientific approach to *social and organisational design* as a creation of the *socio-technical system* (local and global social structures) spread, they came to believe, that the social and technological systems *cannot be designed* in the traditional way *but re-organised*: we have to rethink our understanding of the design (Bleichert 1972).

(4) The development of up-to-date *information technologies* has strengthened the theoretical assessment of technological and engineering activity, as though it has blurred the borders between design and research. This raised the following question: Can the information system bear moral responsibility, if knowledge becomes impersonal?

(5) An acute necessity to develop scientific and engineering ethics that would have a place in the framework of natural scientific and engineering research developed in *biotechnology* and genetic engineering. This revealed more clearly the *internal limits* of scientific and technological development natural for mankind.

(6) Development of *environmental technologies* and the working-out of a new philosophy of sustainable development made us aware of the *external limits* of human scientific and technological development in the biosphere.

All these restrictions imposed by modern society on research and development show that the traditional concept of the ethical neutrality of scientific research and *the boundless character of scientific and technological progress* does not meet modern requirements and that it is necessary to change the strategy of scientific and technological development (Stepin, 1998: 19–20).

The forthcoming stage of modern scientific and technological development is sometimes identified with an alternative differentiation of *rigid* ('hard') *and elastic* ('soft') *natural science and technology* (Gleich 1989: 103–131). 'Rigid' natural science and technology are oriented towards the ideas of scientific rationalism and technological activity which were worked out by the ideologists of classical natural science and are still working, though in an altered way, in the framework of non-classical science. In fact, the stage of transition from 'rigid' to 'elastic' technologies and natural science can be transferred to the stage of emergence of *post-non-classical science and technology*, as V.S. Stepin says in his new book *Theoretical Knowledge*.[10] We are speaking about the elaboration of a practically *new paradigm of scientific and technological development*: the production of scientific knowledge cannot be separated from its application, and these cannot be separated from the ethic responsibilities of the scientist or the engineer inevitably giving a social and ecological orientation to the new natural science. To crown it all, it should be remarked that we are witnessing the on-going process of reorientation of the scientific world outlook and the modern scientific landscape evoked by aggravating global environmental problems, the environmental crisis of civilisation and a newly developing, powerful complex of environmental sciences. At the same time, many traditional scientific subjects are changing their content and coming to include more and more environmental issues. We have the right to say that physics and biology are no longer the *leaders of modern natural science*. These are *environmental sciences* that greatly influence the scientific world outlook and even the content of scientific knowledge.

Notes

1 'In the 20th century the idea of modern technology being the reason that dehumanises, depersonalises machines became a common thesis of cultural criticism' (Pot 1985: 200).

2 'The current ecological ideas are the next step in the development of humanitarian ethics. Now we are talking not only about mutual respect between people, but also the prosperity of future generations, and about preservation of the

biosphere—'the community house' we inhabit together with millions of other species' (Marfenin 2000: 9).

3 The technology of the 19th–20th centuries is based on natural science, which studied not nature itself but technically modelled experimental situations that did not exist in nature.

4 'For the scientists who believe in progress he symbolises the pinnacle of eschatological scientific religion' (Wagner 1970: 159).

5 According to Dostoyevsky, to manure future harmony by personal sufferings.

6 'The first and the main task the theory of progress sets itself is to show that history has meaning and the historical process is not only evolution but progress as well.' This task is too much for empirical science to take on since it has a metaphysical character. The absolute law of virtue which should become the law of our life 'when applied to historical development tells us to mean well in history and do our best to promote the realisation of virtue, tells us, in other words, to mean progress. Progress is, from this point of view, a moral task, not existence, but the absolute imperative' (Bulgakov 1990: 284–285, 290).

7 'Which is why when disclosing this or that regularity of causes and consequences, this or that mechanism of nature, life becomes eager to acquire it, include it into its organism and which is why the spreading perception of nature as a mechanism is but a preparation to acquisition of nature as an organism. The organism is a perceived and acquired mechanism. The mechanism is still unorganised, although available for the organisation of nature' (Bulgakov 1990: 160).

8 'Thus people are creating and enhancing the prejudice that the scientific attitude to reality is the deepest and most authentic one, but they forget about the originally limited character of science' (Bulgakov 1990: 154–155).

9 'Soon peaceful scientists will be able to produce upheavals of a historic and cosmic character'. This permits power to be concentrated in the hands of those who possess technological secrets. The future of all humanity depends on this. In Berdiaev's opinion, 'the technological epoch', the epoch when technology dominates over human soul, will inevitably end in the victory of the human spirit, not in negation of technology, but in its subordination to the human spirit and spiritual values of life. Technological civilisation, the society of technology and machines want man to be part of them, deprived of personality. 'Technology is always merciless to the living stock, but it is mercy to all the living and existing stock that should restrict the power of technology in our life' (Berdiaev 1949: 54).

10 'The post-non-classical type of scientific rationality extends the field of reflection on activity. It is aware of the relation not only between the knowledge of an object

and the specific nature of the means and procedures of activity, but between this very knowledge and the structure of the goals and values of such activity as well. At the same time the relation between intrascientific and extrascientific goals is brought to light. In overall investigations of complex self-developing systems more frequently than ever becoming dominating objects in natural science and technology (including the objects of ecology, genetics and genetic engineering, 'man—machine—environment' technical complexes, modern information systems, etc.) the elucidation of the ties between intrascientific and social values is performed through the social expertise of respective investigation programs' (Stepin 2000: 724).

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