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ТЕОРИЯ И МЕТОДОЛОГИЯ НАУКИ И ТЕХНИКИ

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Ontological layers of modern technology

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The word “technology” in the modern understanding became the subject of wide discussion only at the second part of the XXth century. Today technology is considered as ontologically distinct, no longer a dependent process but a special phenomenon. It encompasses many meanings from different discourses, the word is used as self-evident, and is employed in a wide variety of contexts, sometimes with widely divergent implications. In order to reveal the ontological heterogeneity of this concept, we consider it in three layers or levels of being: the subject-object level where technology breaks up into many objects, practices and knowledge, presented phenomenologically and closely related to various areas of scientific activity; the social level where technology permeates society as a network, system and power, a web of influences and relationships that shape the technological environment in which people exist; and the metaphysical level where technology is seen as the fate of humankind. Technology turns out to be the cornerstone of modernity, entering into a dialectical contradiction with nature and culture, and is considered as the driving force of civilizational development.

Keywords: technology, philosophy of technology, technique, modern technology, definition of technology

Introduction

The term “technology” is one of the most widely used today. The rapid development of technology, strongly associated with social change, makes us take a fresh look at the modern understanding of technology. Despite its apparent clarity,

general availability and usability, the term combines heterogeneous ideas. In addition, it should be noted that technology in the modern sense is of relatively recent origin, but its modern understanding has an impact on the understanding of the past. As Eric Schatzberg writes, "technology" is "a term whose powerful present-day meanings hang like dead weight on our understanding of the past" [Schatzberg, 2006, p. 488].

Digital technologies, the Internet of things, augmented, virtual and mixed reality, artificial intelligence and robotics not only expand human capabilities, but also afford big influence on other people. Bio-nano-technologies put persons in a new position in relation to their very being, which is now subject to re-creation. All this, together with the need to rethink the precarious relationship of culture, technology and nature, requires a better understanding of the ontological status of modern technology, that is, of what "technology" is.

What is technology

The definition of "technology" and its associated terms is a challenge from many points of view: linguistic, historical, philosophical. Leo Marx states that "technology" lacks particularity and discreteness, "this elusive nonentity cannot be identified with any particular kind of artifact, or any particular social group, profession, or institution; nor does it represent any specifiable body of ideas, methods, or principles" [Marx, 2010, p. 983].

Also, problems arise in relation to different languages. Most continental European and Slavic languages use two distinct terms that in English are both commonly rendered as "technology," from Latin *technica* and *technologia*: Carl Mitcham and Eric Schatzberg state, "the cognates of 'technology' generally refer to the science of or discourse about the practical, material arts, while cognates of 'technique' are applied to the actual processes and methods of these activities" [Mitcham, Schatzberg, 2009]. The meanings of *Technik* consisted of two related strands: a narrower one referring to the material aspects of industrial production, and a broader one encompassing any rules, procedures, and skills for achieving a specific goal [Schatzberg, 2006]. In the Russian language there is also *technica and technologia.* In everyday language, *technica* is used to denote technical artifacts, and *technologia* for technological processes. At the same time, *technica* is often used in Russian to denote the procedural side of professional activity, for example, when one speaks of the technique of painting, the technique of a pianist, singer, carpenter, etc. More advanced and knowledge-intensive activities count as *technologia* (digital, bio, nano, space technologies), but "philosophy of technology" translates as "philosophy of technique."

In English, with no real equivalent to *technique*, *technology* and thus the *logos* or reason of *techne* is the only common noun for all things technical. Carl Mitcham and Eric Schatzberg claim that "through most of the 20th century, 'technique' was the dominant term; most philosophical discourse about technology in French, German, Dutch, Spanish, Portuguese, Italian and more is in fact a discourse about 'technique': la technique, die Technik, de techniek, la técnica" [Mitcham, Schatzberg, 2009] – but one should add to their observation that not all these

languages follow the German example of hypostasizing an abstract universal entity *die Technik* (like *die Sprache*) rather than referring without definite article to a generic manifold *technique* (like *langue*). For one example of how this plays out in translation consider Fernand Braudel's phrase about material culture: "*french phrase* (In a way, everything is technique)" [Salomon, 1984]. In translation this became "In a way everything is technology" even as the author means by *technique* not only inventions but also gradual improvements in processes and tools, as well as technical arts without tools or instruments such as the art of using the human body in walking, dancing, swimming, making love, or giving birth [Braudel, 1986]. This broad understanding of "technology" does not allow for a "*Frage nach der Technik*" or a question of what *die Technik* is. Instead it takes us back to the Greek *techne*[1] as "an art or craft, i.e. a set of rules, system of making or doing" [Liddell, Scott, 1940]. While the word τεχνολογια (*technologia*) occurs several times in Aristotle (and some other Hellenistic and Byzantine authors), this is only in the context of a treatise on [or terminology of] the arts of language, especially grammar and rhetoric. The term was used with approximately the same meaning in Latin during the Reformation. The word "technology" came into English in the XVIIth century, and means "a kind of learning, discourse, or treatise, concerned with the mechanic arts" [Marx, 2010, p. 966]. Johann Beckmann's *Anleitung zur Technologie* [Direction for Technology, 1777] served to found a discipline called "Technologie" at Göttingen University, extending Linnaeus' research to the rational study and classification of useful natural objects, also featuring manufactured things [Frison, 1998]. Referring to rational principles and the *logos* of technical matters, Beckmann claims that "Technology is the science which teaches how to treat (*Verarbeitung*) natural objects (*Naturalien*) or the knowledge of crafts (*Gewerbe*)" [Beckmann, 1780, p. 17]. Probably one of the earliest claims of technology as amalgamating theoretical science and industrial practice was made in the 1829 book *Elements of Technology* by Jacob Bigelow: "There has probably never been an age in which the practical applications of science have employed so large a portion of talent and enterprise… as in the present. To embody the various (aspects) of such an undertaking, I have adopted the general name of Technology, a word sufficiently expressive, which is found in some of the older dictionaries, and is beginning to be revived in the literature of practical men at the present day" [Bigelow, 1829]. He presented the understanding of technology as "principles, processes, and nomenclature of the more conspicuous arts, particularly those which involve applications of science, and which may be considered useful, by promoting the benefit of society, together with the emolument of those who pursue them" [Ibid.]. Bigelow's statement, however, received little to no development, except perhaps for naming a new institution – The Massachusetts Institute of Technology – in 1862. It was only around the beginning of the XXth century the word "technology" became closely associated with mechanical arts and industry.

[1] In popular classical literature *techne* and its Latin translation, *ars* (from which the English "art"), could refer as well to cleverness or deviousness in getting, making, or doing and to specific trades, crafts, and skills of many kinds [Mitcham, Schatzberg, 2009].

However, the term continued to be little used by scientists and specialists. Even in the second half of the 19th century, researchers such as Karl Marx and Arnold Toynbee almost did not use the word technology, but relied more on traditional concepts: factory mechanism, machinery, mechanical discoveries, improvements, inventions, etc. A deeper philosophical understanding of technology as *Technik* began in Germany at the end of the 19th century, primarily associated with industrial arts. On the American continent, the word "technology" was introduced by Thorstein Veblen and his followers who sought to continue German discussions about the social impact of *Technik*. Ignoring the subtleties of word usage, they linked "technology" firmly to the idea of progress, as did, for example, Charles A. Beard [Schatzberg, 2006].

And yet "technology" was not broadly established and discussed in English until the 1960s when it was used in reference to objects (mostly products and devices, less to structures), processes (from skills to systems or networks of production, transportation, and communication), and knowledge (of making and using) – with a bias toward products and processes [Mitcham, Schatzberg, 2009].

Leo Marx claims that the changes created a semantic void, that is, a set of social circumstances for which no adequate concept was yet available – a void that the new concept, technology, would fill eventually [Marx, 2010, p. 967]. The driving force or engine of social change was evidenced through the use of the concept of technology, and in the 20th century the picture was completed as *technology* acquired a pronounced scientific content [Layton, 1971]. Technology is seen not merely as the result of progress but also as the power that constructs or constitutes progress. As Vadim Rozin remarks, "gradually, technology began to mean a complex reality that functionally provides certain civilizational gains (i.e., it is a mechanism for innovation and development), and in essence is a sphere of purposeful efforts (politics, management, modernization, intellectual and resource security, etc.)" [as cited in Melnik, 2010].

It can be said that modern technology is ontologically distinct, no longer a dependent process but a special phenomenon. We can say that technology is implicated in all doing and making, that is, any human practice, if not a new form of human existence, then at least a way of being in the material world. Technology and social life have turned out to be so connected and interdependent that they gave rise to many different terms and metaphors such as "technosociety," "technopolitics" or "technoculture," "techno[music]" and, of course, "technoscience." However, as Jean-Jacques Salomon wrote "To limit the definition of the word only to those things which characterise the technology of our time, machinery and prime movers, would be to do violence to all that went before" [Salomon, 1984].

Today, the term "technology" is all-encompassing. It signifies and unifies numerous dramatic changes in human life that are associated not only with the "new digital world order" or with networking the world – industry 4.0, autonomous vehicles and robots, humanity 2.0 or climate engineering and frugal technology. Though the widespread use of the word "technology" in a global context allows us to analyze civilizational and global processes, the make-up and dynamics of the semantic field behind the term force us to separately consider layers of meaning in respect to modern technologies.

What technology is today

Having become a key concept signifying contemporary developments, the word "technology" is a moving target and remains difficult to define. Even though it encompasses many meanings from different discourses, the word is used as self-evident, and is employed in a wide variety of contexts, sometimes with widely divergent implications. According to Clive Lawson, technology can be seen as the archetypal black-box category [Lawson, 2008, p. 48]. Studying how the word "technology" is used, it becomes obvious that there is no single essence or definition of technology, but only a "family resemblance" in the sense of Ludwig Wittgenstein.

We propose to consider technology at different levels of being (fig. 1). Ontologically, technology appears from concrete objects and practices to "perfected metaphysics" (*vollendete Metaphysik*) (as described by Heidegger). Without trying to survey all available interpretations and theories of technology, we will consider different layers or levels of discourse at which technology effectively exists.

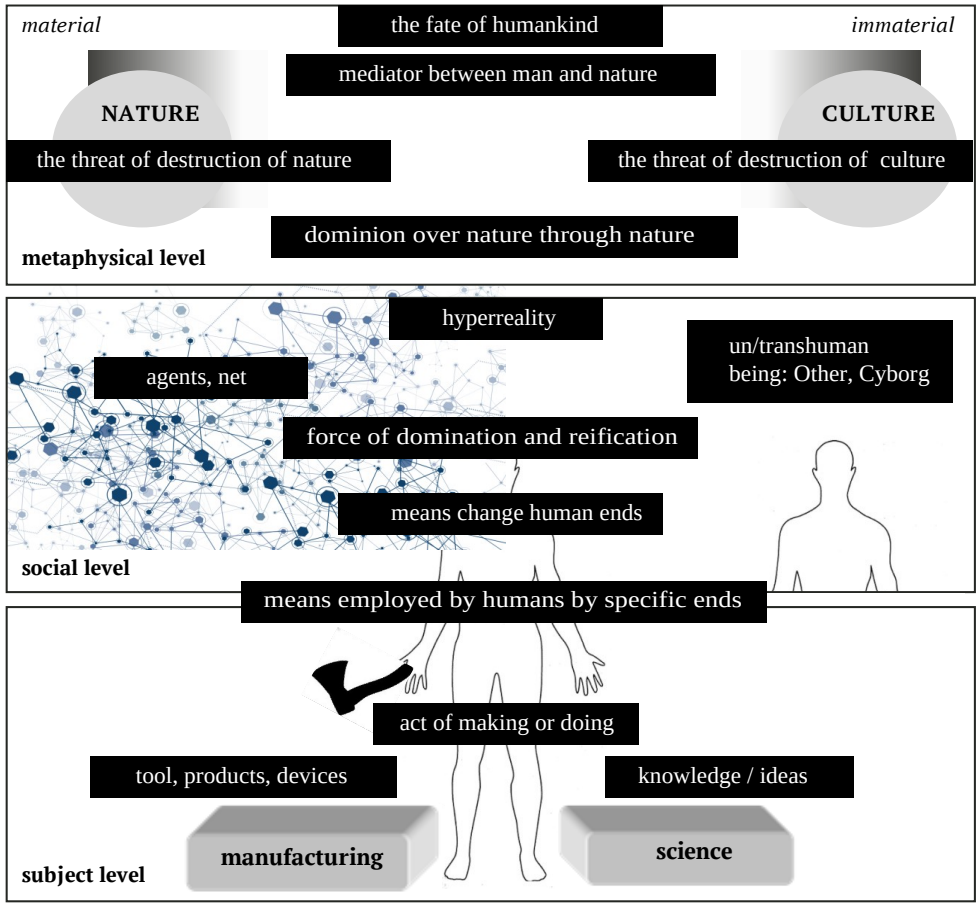

Fig. 1 Technology at different ontological levels

From the very beginning, *techne* amalgamated material objects and non-material ideas. In Plato's *Gorgias*, Socrates argued that every *techne* involves *logoi* bearing on the art involved [450b]. Aristotle argued a complementary understanding of *techne* as one in a spectrum of different forms of engagement with reality, moving from sensation through experience to theory [Metaphysics I [Aristotle, 1989]]. *Techne* was conceived as *episteme*, involving true consciousness of the world, capable of being taught or communicated [Metaphysics I, 1; 981b8–10]. However, its specificity is on changing rather than unchanging things [cf. Nicomachean Ethics VI, 6; 1141b] [Aristotle, 1934]. According to Friedrich Dessauer's definition of technology ideas and matter come together as follows: "Technology is the true essence of ideas as it represents the formation of final purpose and works through the inventory of nature" [Dessauer, 1958, p. 115]. The search for a unified definition of technology either considers artifacts as embodiments of ideas and procedures, or, ignoring the material component, focuses on processes. In an effort to show the relationship between material and social technology, Clive Lawson sees technology as the embodiment of the intangible: "technology is the site in which the social achieves a different mode of existence through its embodiment in material things" [Lawson, 2008, p. 55]. At the most generalized level of consideration of the ontological place of technology, the material and non-material appears as nature and culture. Technology appears as a transformation of nature through mind, agency, or spirit.

Technology combines a huge number of heterogeneous material objects, processes and knowledge. The ontological description of technology thus becomes a mosaic, created from the relevant categories as presented in the previous chapter. Since such diverse categories cannot be combined into a descriptive definition, common characteristics are sought that yield a conception of technology at a first level of ontological analysis. At this level, technique or technological practice turns out to be necessarily connected with a person. This is confirmed even by materialistic definitions of the human as *homo faber* and thus, by way of technology. Accordingly, Karl Marx cites Benjamin Franklin's definition: "The use and fabrication of instruments of labour, although existing in the germ among certain species of animals, is specifically characteristic of the human labour process, and Franklin therefore defines man as a tool-making animal" [Marx, Engels, 1996, p. 189].

The second level, which we call social, points to the role of technology as a formative force in modern society. Here, researchers pay attention to those technologies that are most likely to transform existing social practices. Technology is viewed primarily from the perspective of the population of users and not with a focus on makers and builders, scientists and engineers. At this level, the intersection of the material and the ideal presents itself differently, the latter including the goals and imaginaries of humans, but also the implications or meanings of technologies that emerge as independent agents, as Others etc.

One of the most common approaches to understanding technology in a social context is the instrumental one, which is based on the definition of global challenges, sustainable development goals, or societal interests. These unify technological development in the sense of orienting it. The presumed role of technology is to serve as a means towards specific humanly defined ends. The instrumental approach offers a broad definition that "it is based on the common sense idea that technologies are 'tools' standing ready to serve the purposes of users" [Feenberg, 1991]. A definition in terms of goal-directedness avoids the confusion that comes with the ontological heterogeneity of components. However, although formally true,

the statement that technology serves human goals sounds unconvincing in some contexts, not only when unintended consequences come to view. Technology itself can act as a normative factor that limits freedom of action and prevents the achievement of certain specific goals of use. Latour described the desk that does not allow him to leave three drawers open at the same time [Latour, Venn, 2002, p. 253], similarly, automatic transmissions do not allow drivers to accelerate to overtake. Also, the complexity of technological systems does not allow one to accurately assess all the agents included in the process and the goals they pursue. Moreover, Ellul and Winner argue that those who claim to control a technology that serves their purposes do not, in fact, have the ability to do so. Technological development appears to follow its own logic, and often enough, people take that for granted and merely adapt to it. Technology permeates all social processes in society, becoming an active part of them. Thus, at this second, social level, technology is considered in conjunction with social dynamics as a single, overarching process. The factors from the previous subject-level of defining technologies, such as the connection with scientific activity or dependence on manufacturing, can no longer be considered the most significant. Emerging properties of technologies turn out to be the subject of philosophical discourse, in particular, their systemic or network nature and seeming autonomy. Technological networks include not only people involved in technological processes, but also their users. The first large-scale and obvious example of a technology that has become a network and system is the railway. It marks the transition from separate discrete inventions of creative genius to a technological system of which a person is only a part. Although the railway is a completely material technical object from rails to steam locomotive, it already becomes clear here that the essence is not in individual material components, but in an aggregate that connects disparate and dispersed elements. Other networks are considerably less tangible, such as the telegraph, electric grid, and the internet as the triumph of networking. Borgmann points out that modern hard technology has been replaced by postmodern soft technology that is flexible and adaptive [Borgmann, 1992]. The transition from objects to services and then to information ultimately signifies the hyperreality of simulations that move beyond the limitations imposed by the real world. The metaverse is poised to create a new technogenic social reality, transhumanism announces a future in which humans will be technologically upgraded.

Friedrich Georg Jünger wrote “When a telephone or a radio is installed in my home, I not only get an object for my use, I am also hooked up to a circuit of power lines or a radio network” [Jünger, 2021]. Leo Marx sees the key feature of technical networks in “blurring of the boundary between the material-artifactual component [the mechanical equipment or hardware] and the rest: the cognitive, technical, or scientific components; the hierarchically organized work force; the financial apparatus; and the method of obtaining raw material” [Marx, 2010, p. 973]. Modern technologies are significant as part of a technological conglomerate, where all components are mutually dependent, where equipment withdrawn from the system becomes meaningless as it loses the ability to function like a fish thrown ashore. We can also note the increasingly complex nature of networks, and the ever deeper immersion of persons in them, which turns out to be just one of the elements of the system. Moreover, modern digital systems are acquiring an increasingly “powerful”

status, they serve as a tool for evaluating and regulating people's activities. Shoshana Zuboff views modernity as an era of surveillance capitalism, gathering digital data about people. Companies use it not only to predict human behavior, but also to modify it [Zuboff, 2019]. The most striking example of the implementation of digital control is the social rating system in China, where the technological system captures a person's activities in various aspects, assigns him a certain score, and in the absence of the necessary rating, a person can no longer buy transport tickets, rent a vehicle, and so on. Also, there are schemes for total video control and artificial intelligence predictions of criminal activity as means to prevent a "threat" to the state. In other countries as well, technological systems collect and analyze data about people, tracking online behavior, using surveillance cameras on the streets, obtaining information about a person's physical condition through wearable devices, etc. Thus, modern digital technology today turns out to be a tool of power and control, creating unprecedented opportunities and the need for tight regulation. Another recent dimension to the discourse about technology is its "independence" or "autonomy": "as if it existed independent of its human creators, and is capable of controlling them by virtue of an autonomy alien to them" [Winner, 1977]. When AI and robotic systems enter into social interaction with a person, they are called Others, quasi-Others [Coeckelbergh, 2022], sobject [Ullmann, 2022], etc. The ability for robots to act as moral agents, to have legal rights, and to marry humans are widely debated topics. Jacques Ellul also wrote that technologies can invade the whole horizon of ends by setting up their own laws, they become 'autonomous' and no longer merely automatic to the extent that humans cannot question them anymore but defer to their heteronomous rule. In this sense, people are forced to adapt to old as well as new technological systems and submit to already existing and emerging ways of technical dominance.

Bruno Latour's Actor-Network-Theory seeks to overcome this debate about autonomy and heteronomy simply by no longer separating human agency from material causality. He views technology in terms of a confluence of human and non-human agency. Latour writes about 'technological trajectories' [Latour, 2012, p. 219] to emphasize that tools, just like humans, never act alone [Conty, 2018, p. 82]. He thus rejects the claim that subjects constitute objects, for nothing "pertains to a subject that has not been given to it" [Latour, 2007, p. 213]. Wherein link transforms the actors that it connects and is not neutral. Actor-Network-Theory has been called "(an) ontological toolkit ready at hand for continuously, in each new empirical as well as philosophical inquiry, reopening the question of what there is and what is important" [Hämäläinen, Lehtonen, 2016, p. 33]. In metaphysical terms Harman argues that Latour stands in opposition to a "Copernican philosophy" (Husserl, Heidegger, Derrida, Russel, or Quine) that "reduces objects to our human access to them" [Harman, 2009, p. 25]. One of the developments of the theory is the construction of "flat" ontologies where the human and non-human are equalized through their position in the network. Flat ontologies conflate animate and inanimate materialities, refuse to take into account one-sided causal relationships and the impact of people on technology.

The discussion about the possibilities and limits of defining technology in terms of subjective work and social conditioning turns out to be connected with

the third and most general ontological level of technology existence: technology in modern society goes far beyond the scope of those objects, processes and elements of knowledge that are directly included in its composition. It permeates and determines not only human life, but also the civilizational path of humankind in its planetary setting. In philosophical discourse, technology is often framed in respect to nature and culture, but here, in particular, there is no general understanding of technology at this level of abstraction.

Technology as a spiritual form that shapes the world is interpreted differently by philosophers like Cassirer, Heidegger, and others. It can be conceived as a semiosis that combines ideas, rules and matter to create artificial environments, a so-called second or third nature [Nesterov, 2020]. Thanks to the development of technology, the relationship between humans and nature has changed. This can be seen as destructive or creative of nature and culture. If nature appears only as a resource, for example, then it will be exhausted, and non-technological ways of prehending the world are doomed. Nikolay Berdyaev wrote that "culture is impossible without technology, the very emergence of culture is connected with it, and the final victory of technology in culture, the entry into the technical era leads to the death of culture?" [Berdyaev, 1933]. Accordingly, technology is often seen as the cornerstone, a main force that determines the future of humanity. In a global sense, the ability of technology to serve the goals of mankind signifies the possibility of a technogenic formation of our habitat, possibly overcoming environmental and other crises. Technology would thus appear as the embodiment of the spiritual power of man. Cassirer understood technology as the "means by which man gives the outside world its determinate form" both physically and intellectually [Cassirer, 1925]. On technology are projected the dreams of the salvation and prosperity of mankind: "Technology… promises to bring the forces of nature and culture under control, to liberate us from misery and toil, and to enrich our lives" [Borgmann, 1984].

Others view the relationship differently, foregrounding the contrast between nature and technology. Spengler saw in technology the embodiment of the Faustian culture of domination, which sought to subjugate the power of nature, to build its own world: in the face of inevitable cultural decline, technology was a fate that we should embrace as a "tactics of life" [Spengler, 1918]. "Using the means of Faustian technology" it would be possible "to melt humankind into a whole" [Spengler, 1931]. For Heidegger, modern technology mirrors modern metaphysics according to which humans construct a world in which they are themselves only part of the picture as subjects of impersonal calculation and control. Technology is therefore the destiny of humans in the modern world. Heidegger seeks to establish a "free" relation to technology that does not allow it to "warp, confuse, and lay waste our nature" [Heidegger, 1966, p. 54]. According to Jaspers, technology provides dominance over nature through nature, but contributes to the alienation of humans from themselves and from the outside world. Speaking of "demonism," Jaspers pointed to the shadow part of the technology, which manifests itself in its unintentional creations which are opposed to humans and remain uncomprehended [Jaspers, 2021].

Quite another approach to the place of technology in the field of nature-culture was pursued by Simondon, who represented it as a mediator between humanity and

nature, seeing in the technical being "the embodiment of man's [sic] own natural foundation" [Simondon, 2017, p. 17]. Technology according to Simondon is not limited to its utilitarian function, it also provokes a transformation of the environment, which rebounds onto living species, including humans. "It goes beyond the very limits of the ends belonging to a present state of affairs, to needs that, to a certain extent, exhaust and surpass themselves" [Simondon, 2015, p. 19]. Along similar lines, Vadim Rozin argues that today humanity is gradually rebuilding itself on a new path of awareness and mastery of its own technical activities in order to stop the destruction [Rozin, 2017].

Summary and Conclusion

Technology today is a key concept around which revolve political, economic, social, philosophical discourses. At the same time, modern technologies are becoming more and more complex, increasingly intertwined with all aspects of life. In the modern sense, the term "technology" has become widely used only since the 1960s. The term closed a linguistic lacuna due to which key trends in the development of society remained unarticulated, in effect hidden and ontologically isolated or obscured. Now the term "technology" carries a heavy semantic burden and requires special understanding. In order to reveal the ontological heterogeneity of this concept, we considered it in three layers or levels of being: the subject-object level where technology breaks up into many objects, practices and knowledge; the social level where technology permeates society as a network, system and power, and the metaphysical level where technology is seen as the fate of mankind. At the first level, we see the compositional implementation and integration of technology with various objects and processes. Here the technology is ontologically heterogeneous, presented phenomenologically and closely related to various areas of scientific activity, which allows us to talk about bio- or nanotechnologies, high or plasma technologies. At the second or social level, technology is a system of influences and relationships that shape the technological environment in which people exist. Here, the significant implications of the development of technologies for public life come to the fore, networks, communication and power relations are analyzed, and human-made types of reality that are virtual, hyperreal, prepare for the metaverse. The most general level of consideration of technology brings it to the level of a significant category of being, a metaphysical reality. Technology turns out to be the cornerstone of modernity, entering into a dialectical contradiction with nature and culture, and is considered as the driving force of civilizational development.

Armin Grunwald once defined "technology" as that what we mean when we speak generally about technology. They thus define not a term that classifies and categorizes but a term that serves reflection about the modern world. Substituting "generally" by "philosophically" we arrive at the present situation: "Technology" writ large and as a singular nominative term is what we mean when we speak philosophically about technology as the manifold of our various and diverse relations to things. The three levels therefore tell us not only about the ways in which technology matters. They tell us also how philosophy is constituted today and how it layers or focuses considerations of significance between problems of agency, constitutions

of the social, and metaphysical reflections on self and world. If there are other ways to speak generally about technology, these will challenge the limits of philosophy as well as technology.

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Онтологические уровни современной технологии

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Слово «технология» в современном понимании стало предметом широкого обсуждения лишь во второй половине XX века. Сегодня технология рассматривается онтологически обособленно, уже не как зависимый процесс, а как особое явление. Она включает в себя множество значений из разных дискурсов, слово используется как само собой разумеющееся и в самых разных контекстах, иногда с противоположными значениями. С целью выявления онтологической неоднородности этого понятия мы рассматриваем его в трех слоях или уровнях бытия: субъектно-объектном уровне, где техника распадается на множество объектов, практик и знаний, представленных феноменологически и тесно связанных с различными областями научной деятельности; социальном уровене, на котором технология пронизывает общество как сеть, система и сила, паутина влияний и отношений, формирующих технологическую среду, в которой существуют люди; и метафизическом уровне, где технология рассматривается как судьба человечества. Техника оказывается краеугольным камнем современности, вступая в диалектическое противоречие с природой и культурой, она рассматривается как движущая сила цивилизационного развития.

Ключевые слова: технология, философия техники, техника, современные технологии, определение технологии