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The Possibilities of the Kondratieff Long Wave Theory in Forecasting of a New Technological Revolution*

COMMEMORATIVE MEDAL FOR YOUNG RESEARCHERS

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Dear colleagues! I am deeply honoured to speak on the occasion of the award of N. D. Kondratieff Medal. First of all, I would like to express appreciation to the President and Director, as well as the International Kondratieff Foundation for this prestigious award.

The name of our conference is 'Nikolai D. Kondratieff's Scientific Heritage and the Modernity'. Therefore, I would like to devote my speech to the role of Kondratieff's scientific heritage and, first of all, to the long wave theory in forecasting of the development of new technologies.

There are many different forecasts about future technologies. For example, Francis Fukuyama predicts the imminent bio-technological revolution and discusses its possible consequences (Fukuyama 2004). Along with technology optimists such as Raymond Kurzweil, there are also technology pessimists. But very few scholars build their forecasts on a reliable scientific theory. Alvin Toffler, for instance, was the exception, but most of his forecasts were made long ago.

For a long time Kondratieff's theory of long cycles has been one of the most effective concepts that allows making scientifically sound forecasts. This is particularly important because it is safe to say that now we are on the threshold of technological revolution. Indeed, a number of circumstances and trends suggest that the global technological transformation will begin in the 2030s and 2040s.

The importance of the Kondratieff theory is that, without losing its integrity, it can be effectively combined with other theories, especially with those that are related to such cycles of different duration both shorter (*e.g.*, the Kuznets cycles and the Juglar cycles), and, on the contrary, longer cycles (*e.g.*, cycles of political hegemony or distinguished by us the cycles of chang-

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ing production principles which are formed as a result of production revolutions) (Grinin 2006).

It is commonly known that on the basis of Kondratieff's theory and ideas of Schumpeter there was formulated the theory of technological modes (or paradigms) according to which each long wave causes the change of the technological mode and allows making assumptions about the leading technologies in the near future with a high probability of their implementation. It already today provides guiding principles on the development and implementation of the strategy of techno-economic development (*Ibid.* 2013; Dator 2006; Grinin *et al.* 2017; Nefiodow L. and Nefiodow S. 2014).

Let me now summarize how the long wave theory and the theory of technological modes are used in our own forecasts.

First of all, we managed to establish links between the technological modes and superlong cycles of changing production principles (*i.e.*, the entire system of productive forces and the organization of production within the World System). In particular, we have established an important correlation between the phase of the Industrial production principle and the phase of the Scientific-Cybernetic production principle, on the one hand, and the duration of Kondratieff waves, on the other hand. That is, ***on average, one K-wave corresponds to one phase of the production principle*** (Grinin 2013).

Further, according to our theory, the production (technological) revolution, which is called Cybernetic, began in the 1950s. But this revolution is still developing. And now we expect the beginning of its most active (final) phase. According to our forecasts, the final phase of the Cybernetic Revolution will begin in the 2030s or 2040s and will last till the 2060s–2070s.

One should mention that the final phase of the Cybernetic Revolution will merge with the anticipated sixth Kondratieff Wave which, according to a number of forecasts, will begin in the 2020s and 2030s.

We have conducted an analysis of the development of new technologies, such as patent applications, research and development expenditures (R&D), publications analysis, stock market indexes, *etc.* as a result of which we came to the conclusion that the sixth technological mode will be characterized primarily by a breakthroughs in medical technologies, which will be capable to combine many other technologies into a single complex of MANBRIC-technologies (medico-additive-nano-bio-roboto-info-cognitive technologies) (Grinin L. and Grinin A. 2015, 2013; Grinin A. and Grinin L. 2015). Thus, we assume that the sixth technological mode will represent a broader system of innovative technologies, than it is usually considered; in particular, broader than NBIC convergence.

The idea of the importance of medicine in the sixth technological mode is well combined with the results of the study of population projection. Due to an

increasing global population ageing and average life expectancy more and more technologies will be aimed at maintaining and improving health.

We believe that during the sixth technological mode various self-regulating systems may become particularly widespread. Due to the development of self-regulation there will be created the technologies of constant health control of organism including those based on biotechnologies. And continuously evolving miniaturization of technical devices will allow implanting biochips directly into the human organism.

During the Cybernetic Revolution bionics, neurointerfaces, transplantation (including 3D organ printing) as well as gene engineering will rapidly develop. Robotics will also become one of the leading directions. Robots will be able to solve the problem of labor shortage. It goes without saying that the development of artificial intelligence will become one of the main directions which will lead to a significant increase in the number and the level of complexity of 'smart' systems.

However, one should emphasize that during the Cybernetic Revolution and the sixth technological mode, according to our forecasts, the increasing opportunity to change and modify the biology of the human body will become especially important (Gurdon and Colman 1999; Mallouk and Ayusman 2009).

This, in turn, requires deep philosophical and ethical comprehension of the consequences of this technological revolution.

In conclusion, I would like to quote N. D. Kondratieff, 'Foresight in social and economic life is possible, although its limits are rather restricted' (Kondratieff 2002: 566). At the same time, according to him, the limits of foresight 'are expanding along with the growth of scientific knowledge.'

He proved it by his own theory due to which today one can try to expand the horizons of foresight and forecasts.

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