# Introduction.
# On Nikolai Kondratieff's Anniversaries and Legacy

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There are researchers whose works and theories remain relevant for a long time after their death. Of course, Nikolai Dmitriyevich Kondratieff, an outstanding Russian economist is among them. He is one of those whose name is well-known abroad. On the occasion of the 130th anniversary of Kondratieff's birth it is also important to note the relevance of his ideas. In addition, the year 2022 also marks the centenary of the publication of his monograph *The World Economy and Its Conjunctures during and after War* (Kondratieff 2002 [1922], 2002 [1926], 2002 [1928], 2002, 2004) where he first formulated the idea of long cycles. Until that time the economic literature hardly knew any other cycles than ones with a characteristic period between seven and eleven years, which were called industrial, commercial, *etc.* Kondratieff quite logically called them 'short cycles' (*Idem.*: 2002 [1922]: 323, *etc.*). However, already in 1925, in his work *Long Cycles of Economic Conjuncture* (*Idem.*: 1993 [1925]: 25, 26), he began to call them as 'medium cycles'. Why? The fact is that in those years there were discovered some cycles with a characteristic period between three and four years manifested in fluctuations in inventories that could be denoted as truly 'short cycles' (Kitchin 1923). Later, these cycles became known as 'Kitchin cycles'. Due to the fact that the medium-term cycles often had internal ups and downs, a group of researchers from Harvard School headed by Wesley Mitchell started to consider cycles statistically (not by their logic, but

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by the presence of recessions, from a recession to another recession, regardless of the fact that they may be significantly different as regards their strength and nature). As a result, there were also identified some cycles with a period between three and four years, which to a certain extent coincided with Kitchin cycles. Some years later, Simon Kuznets discovered construction cycles lasting from 17 to 30 years (Kuznets 1930). Thus, in the 1920s–1930s one could observe the formation of the idea of the system of economic cycles in economic science. Kondratieff himself made a significant contribution to the study of this system.[1] It is important to emphasize that N. D. Kondratieff developed the theory of long waves not only of economic, but also social dynamics as a whole. Thus, in his article 'To the Question of Long Cycles of Conjuncture' (Kondratieff 1926) he wrote, 'Wars and revolutions originate from real, especially economic, circumstances... from the accelerating pace and the increased tension of economic life, the heightened economic struggle for markets and raw materials... Social shocks happen most easily under the pressure of new economic forces'. These ideas are still very relevant. It is no coincidence that the articles of the first section of this Yearbook ('Processes and Cycles') are devoted to various aspects of long-wave dynamics. This section includes four contributions. Most of them are devoted to long cycles. The largest paper of this section is about the forthcoming technological wave, named Cybernetic Revolution, its influence on the future including a new form of state (E-state), as well as correlation of this revolution with Covid-19.

The biography and some aspects of Kondratieff's work have been extensively discussed in the previous issues of this Yearbook (see, *e.g.,* Grinin *et al.* 2012; Bondarenko 2017). Nevertheless, on the occasion of his anniversary one should mention some facts about his life.

As a peasant's son, Nikolai Kondratieff managed to realize his abilities and in his young years he became a professor of economics. In one of his Suzdal letters from prison (May 2, 1938) summing up the results of his activity he

[1] N. D. Kondratieff, in particular, noted, 'The nature of the phase of the large cycle during which one can observe these medium-term cycles cannot but affect the course of the medium-term cycles. Indeed, if we take medium-term cycles, it becomes obvious that all the upward phases of the elements participating in medium-term cycles will be weakened, and all the downward phases will be strengthened by the general downward wave of the large cycle. On the contrary, if we take medium-term cycles during the upward phase of the large cycle, we will observe the opposite situation. Hence, medium-term cycles during the downward phase of a large cycle should be characterized by specific duration and depth of depressions, short periods and weak rises. Medium-term cycles during the upward phase of the large cycle should be characterized by the opposite features' (Kondratieff 2002: 380–381). This is true, but with the only significant correction that it is not the medium-term J-cycles that depend on the nature of the K-wave phase, as Kondratieff believed, but, on the contrary, the nature of the J-cycle cluster largely determines the nature of the K-wave phase (for more details see Grinin and Korotayev 2014c).

wrote, '... I did not get any education like most peasant children. Therefore, my character was shaped spontaneously in the hard school of life that I had to go through in my time. But without my character, I would never have made my way from a plow to the professor's lecturing desk' (Kondratieff 1991 [1931]: 559).

Nikolai Kondratieff made a significant contribution to various fields of economic science. He founded and headed the Conjuncture Institute, developed the theory of economic planning. During his lifetime he gained fame abroad. In Suzdal prison, Kondratieff wrote an outstanding work *The Basic Problems of Economic Statics and Dynamics*. Therefore, the assessment of the researcher's merits, made for his centenary, remains true, 'After six decades most of his works have not lost their significance and serve as a basis for the most relevant research. One should particularly mention the exceptional scientific rigor of his analysis, which places him on a par with the outstanding economists and is a model for researchers in the field of social sciences' (Fontvielle 1992).

As has been already mentioned, Kondratieff made a significant contribution to various fields of economic science.[2] Among all significant contributions to a number of areas of economic science Kondratieff's theory of long cycles (waves) brought him the greatest popularity. But there is a misconception that Kondratieff discovered long cycles (waves) of conjuncture. Long-term price fluctuations (with a characteristic period of about 60 years) were known even before Kondratieff's birth (see Jevons 1884; Chuprov 1889; for more details see Grinin and Korotayev 2014a, 2014b). His merit was that he made the long-wave economic and social dynamics a subject of special analysis and for the first time created a logical theory supported by numerous empirical data and their conceptual explanations. In other words, Kondratieff was not a discoverer of long waves in economic and social dynamics, but the founder of the first scientific theory of these waves, which had already become long cycles in this theory (Kondratieff 2002 [1922]; 1988 [1923]; 1993 [1925]; 2002 [1926]; 2002 [1928]). Therefore, they are quite deservedly called 'Kondratieff waves' (see Grinin and Korotayev 2014a, 2014b). Thus, one can refer N. D. Kondratieff to a special type of researchers who, on the basis of already known facts, phenomena and strange things that had not been explained by science before, created a new theory that changed the understanding of the nature and patterns of phenomena in some or other area and opened wide horizons for further research.

Despite the fact that the economic situation in the world is changing, the theory of long waves proves useful when analyzing various situations. For example, it takes on special significance and serves as an important tool both for

[2] Thus, he rightfully said, when he wrote from Suzdal prison, 'I believe that some of the ideas I have proposed and the predictions based on them have tested by reality and, apparently, have become part of the fund of recognized regulations' (Kondratieff 1993: 512).

an adequate understanding of current World-System processes and for their forecasting. It is important to note the fundamental difference in the functioning of global and national economies that is not always taken into account. The fact is that there is no powerful and well-adjusted mechanism with the use of monetary and non-monetary measures in the modern world economy at the global level, similar to regulation at the national level. Therefore, mostly the undistorted economic laws apply at the supranational level, manifesting themselves, as in former times, in the form of successive short or long economic cycles in the national market economy. This resulted and continue to result in the upswings and downswings of medium-term Juglar cycles (see, *e.g.*, Juglar 1889 [1862]; Tugan-Baranovsky 1894, 2008 [1913]; Schumpeter 1939; Grinin and Korotayev 2010, 2012; Grinin *et al.* 2010a, 2010b, 2011; Grinin *et al.* 2010), as well as in the form of upward and downward phases of long Kondratieff cycles.

To understand the impact of long waves on long-term economic dynamics, it is very important to see the relationship between long waves and waves of basic innovations, because the history of long cycles is closely related to the emergence, development and change of the so-called technological modes or paradigms, which are a system of leading at that time technologies and ways of their application. The third section of this Yearbook is devoted to this aspect.

It is also worth mentioning the organization that supports the K-wave research in different ways. The International N. D. Kondratieff Foundation was established on March 19, 1992 at the International Scientific Conference devoted to the centenary of the outstanding Russian scientist's birth. The International Foundation was named after Nikolai Kondratieff by the Government Decree of Moscow No 527 of July 21, 1992. Nowadays the Foundation is a scientific and public organization for assistance of studying and promotion the scientific heritage of N. D. Kondratieff, retaining the right to its former logo.

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| IKF<br>МФК | **INTERNATIONAL**<br>**KONDRATIEFF FOUNDATION**<br>Interregional Social Organization for Assistance of Studying and Promotion the Scientific Heritage of N. D. Kondratieff<br>Institute of Economics Russian Academy of Sciences<br>Nakhimovsky pros. 32, Moscow, 117218, Russia |

The International N. D. Kondratieff Foundation is accredited by the Department of Social Sciences of the Russian Academy of Sciences. The Board of the International N. D. Kondratieff Foundation includes well-known Russian and foreign scientists. For 30 years the Foundation has been actively promoting the ideas of Kondratieff and his followers, together with domestic and foreign

research and educational organizations, as well as with all involved institutions it has been implementing the projects in the field of economic, scientific and technological development of Russia, problems of forecasting the future from the future, the researches on the theory of cycles and crises, scientific and technological progress and innovation, dynamics of world and local civilizations, formation of the development strategy of the 'digital economy' in Russia and worldwide on the basis of the identified patterns in the development of the human system, *etc.*

In 1993, the International N. D. Kondratieff Foundation and the Russian Academy of Sciences established gold, silver and bronze medals in honor of N. D. Kondratieff, which are awarded every three years according to the results of the international competition to three Russian and three foreign scientists for their contribution to the development of social sciences.

The winners of the competition are also awarded diplomas with the nominees' names, indicating the merit of the medals they have received. Medal recipients make presentations, which are then published. The second section of this Yearbook presents six articles of N. D. Kondratieff Medal 2020 Winners.

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The sixth issue of the Yearbook 'Kondratieff Waves' has the subtitle 'Processes, Cycles, Triggers, and Technological Paradigms'. Its paper cover some interesting aspects of long-wave dynamics both in historical trends and theoretical researches. The Yearbook consists of three sections.

***Section I (Processes and Cycles)*** includes four contributions. Most of them are devoted to long cycles.

In the article by **David J. LePoire** 'Long-Term Dynamics of Ruling Structures in the West, China, and Russia' national periodic dynamics are explored based on government types or dynasties in the West, China, and Russia in the post-Roman/Han era. The period of these cycles is approximately 375 years with some substructure. This analysis first reviews shorter periodic national dynamics from the time scales of political cycles (16 years) and government cycles (72 years) within the United States. Then, the distinct features of long-term periodic dynamics in the West, China, and Russia are explored. The West and China developed relatively independently until the 18$^{th}$ century. During the period of the Roman and Han empires, China has evolved in a rather stable location in contrast to the moving center of Western leadership. In contrast, Russia was influenced by both the East (through nomadic tribes) and the West (through trade and wars). While the average period of about 375 years is seen in all, there is substructure, especially in Russian history that suggests the simultaneous overlap of two frequencies (an additional 450-year cycle). This time frame is consistent with the predator-prey model of two interacting human groups with birth and death rates derived from the expected human lifetime.

According to **Edward Lewis** in his article 'The Paradigm Shift Cycle as the Cause of the Kondratieff Wave' paradigm shifts in physics happen at 80-year intervals due to two constraints on physics and technology development that constrained the duration of paradigm development to average 80 years. These two constraints cause three generations to produce a physics paradigm and begin the industrialization during an industrial revolution. During each industrial revolution, there is a depressionary era due to the low productivity growth of the dying industries and the transition of the economy to new industries. Another depressionary era begins about 30 years after the end of the depressionary period of the industrial revolution. These depressions are times of high productivity growth when the industries reach the mature stage. The switch of emphasis from product innovation to process innovation causes depressionary eras during which the high corporate and consumer debt, product satiation, oligopoly formation, and increased automation that reduces the demand for labor cause depressions. The duration of the Kondratieff waves varies from about 40 to about 53 years depending on how quickly a paradigm is accepted.

**Marc Widdowson** in his article 'Discovery Processes and the Kondratieff Cycle: Mathematical Principles' supposes that 'discovery processes' are hypothesised as processes in which there is an inter-play between innovation activity and exploitation activity. Both require societal resources, in a zero sum game, so that, while innovation is needed to make exploitation possible, exploitation takes effort away from innovation, inhibiting the maintenance let alone expansion of exploitation. Such negative feedbacks, which propagate through the economy with a certain lag, give rise to oscillatory behaviour. Hence economic expansion proceeds in cycles. The cycle duration is linked to the human ageing process, since it is those entering adulthood who are best placed to respond to changed economic opportunities, while older adults are more committed to existing occupations. Since innovation activity is always positive (things are seldom de-invented), the cumulative activity (total inventions) manifests as quasi-logistic pulses, where growth is flatter when society's focus has shifted towards exploitation and steeper when society's focus has shifted back towards innovation. 'Complex' discovery processes extend the logic of these 'simple' discovery processes with an additional dynamic whereby high value exploitation processes stimulate competition, which reduces their value, while innovation restores their value. The coupled cycles of innovation, exploitation and competition produce a fluctuation in all three activities, whose phase relationships correspond to those of the Kondratieff cycle and whose duration, given some assumptions about the turnover of generations, can be shown to match the Kondratieff period. The ideas discussed in the paper are applied to manned space exploration and are used to estimate the growth of the human presence in orbit over the next half-century.

**Leonid E. Grinin, Anton L. Grinin**, and **Andrey V. Korotayev** in their article 'Does Covid-19 Accelerate the Cybernetic Revolution and Transition from E-Government to E-State?' argue that the forthcoming sixth K-wave will merge with the final phase of the Cybernetic Revolution (the 2030s – the 2070s). Thus, the technological and economic tide will be more powerful than in the fifth K-wave. So any factors that may change the time or way of the Cybernetic Revolution will also affect the sixth K-wave. In this article the authors analyze one of such factors. Among many influences that the pandemic has and will have on society and the World System as a whole, one of the most important is the acceleration of the start of a new technological wave and a new technological paradigm in the near future. This impact is determined by the growing need for the development of a number of areas in medicine, bio- and nanotechnology, artificial intelligence and others, which we denote as 'MAN-BRIC-convergence'. It is shown that the experience of dealing with the COVID-19 pandemic has confirmed that the final phase of the Cybernetic Revolution will begin in the 2030s at the intersection of a number of medical, bio-, digital and several other technologies, with medical needs as an integrating link. Among the multitude of self-regulating systems in the economy and life (which, in their opinion, will flourish during the Cybernetic Revolution) socio-technical self-regulating systems (SSSs) will play a special role. Thus, COVID-19 becomes a powerful impetus not only in terms of accelerating technological development and approaching the final phase of the Cybernetic Revolution, but also in changing socio-political (and socio-administrative) relations in the forthcoming decades.

***Section II (Kondratieff Medal 2020: Winners' Speeches)*** presents six articles of N. D. Kondratieff medal laureates.

This section is devoted to the speeches of Kondratieff Medal laureates of 2020: **Zhan T. Toshchenko** (Gold medal), **Fedor A. Smirnov** (Silver medal), **Tatyana Yu. Yakovets** (Bronze medal), **Stanislav E. Bilyuga** (Commemorative medal for young researchers), **Konstantin A. Kudryavtsev** (Commemorative medal for young researchers), **Marina G. Treyman** (Commemorative medal for young researchers).

***Section III (Essays and Reviews)*** includes four articles by **Leonid E. Grinin** devoted to the first, second, and third technological paradigms interrelated with the first, second, and third Kondratieff waves. The paper 'The Concept of Technological Modes/Paradigms: Introduction' presents some ideas about the interconnection between K-waves and techno-economic paradigms. According to **Leonid E. Grinin,** in his article 'The First Technological Paradigm: Textile Industry' the first technological paradigm (of textile industry) was formed during the final phase of the Industrial revolution and finally took

shape around the 1820s – the 1830s and reached maturity in the 1840s. Thus, it developed within the framework of the first long Kondratieff wave (the 1780s – the end of the 1840s). Breakthrough innovations in the textile industry which led to its almost complete mechanization became the basis of the first technological paradigm. At that period there was created a number of highly productive machines which became much more complex than in earlier periods and more advanced, replacing human labor and skills. It is very important that a system of mechanized production was formed in a sector that was growing almost continuously. This growth led to major social changes in society. For a long time a large number of artisans coexisted with machine production by creating a kind of symbiosis of old and new technologies. But the new paradigm gradually became more distinct. Thus, by the mid-1840s there were already only 60,000 hand weavers and 150,000 machine weavers, and 15 years later hand weaving in England almost completely disappeared. This period was marked by the introduction of the universal engine. However, contrary to popular belief, steam power, which was actively introduced into the British economy, was not an absolutely necessary element for the completion of the Industrial Revolution and the formation of the first technological paradigm. For a long time, these processes were based on water power, which by the end of the Industrial Revolution, even in Britain, provided half the textile capacity.

In another article 'The Second Technological Paradigm: Railway Lines, Coal, Steel' **Leonid E. Grinin** argues that the second technological paradigm (of railway lines, coal, steel) developed during the second Kondratieff wave (*i.e.,* in the 1840s – early 1890s). This is the period of the complete victory of machine production and its powerful spread. By the end of the industrial revolution (*i.e.,* in the 1830s), and even in the late 1840s, the main technologies and structures of the second technological paradigm (development of railway lines, rapid growth of coal mining, iron and steel production) had already formed within the first technological paradigm. During the development of the second paradigm, revolutionary changes took place in steelmaking. Machines spread everywhere. At the same time, one could observe the transition from light engineering (weaving spinning and other machines for the textile industry) to heavy engineering (rolling mills, transport machinery, *etc.*) which provided the basis for the development of the third paradigm.

In the article 'The Third Technological Paradigm: Electricity, Chemical Industry and Heavy Engineering' **Leonid E. Grinin** points out that the third technological paradigm was associated with the third Kondratieff wave which dated back to the 1890s – the late 1940s. It is known as the period of electricity, chemical industry and heavy engineering because these directions formed its basis. But, of course, many other technologies were also developing at that

time, including those that later provided the basis of the fourth technological paradigm (automobile manufacturing, oil production and others). By the time the third paradigm formed, many of its basic technologies and structures had already taken shape; in particular, the chemical industry, heavy engineering and electric power generation were growing, telegraph and telephone started to connect territories, and even tramway appeared. But a number of technologies developed during the third paradigm. The spread of electric and internal combustion engines led to the appearance of machines capable of operating autonomously, which fundamentally changed the organization of production in particular functioning of factories and plants, transportation and daily life. Since the beginning of the 20th century, but especially since the 1920s, due to the appearance of diesel engines the machines began to perform the main operations in agriculture.

It also contains **George Lawson's** review of *Handbook of New Waves of Revolutions in the 21st Century: The New Waves of Revolutions, and the Causes and Effects of Disruptive Political Change* published by Springer International Publishing.

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