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NIKOLAI KIBALCHICH IN THE HISTORY OF WORLD ROCKET-SPACE TECHNICS: DISCUSSION QUESTIONS OF DOMESTIC AND WORLD HISTORIOGRAPHY

The article deals with the history of rocket and space technology and controversial issues regarding the role of Nikolai I. Kibalchich in the formation of the rocket-dynamic principle of motion.

In 1881, Nikolai I. Kibalchich, while in prison for participating in the assassination attempt on the Russian Tsar Alexander II, developed the project of an "aeronautic device" ("flying machine"). As the basis of this device, he put a rocket dynamics principle. His project has been considering one of the first, if not the first, project of rocket technology, which opened up the opportunity of flying in airless space. However, as our study indicates, this point of view is not shared by everyone who is involved in the history of space exploration and rocket technology research.

We discuss opinions given in various bibliography sources on the N. I. Kibalchich' role for uprising of the engineer thought in rocket technology. The appreciations of this role are given by researchers from Ukraine, Russia, and the former Soviet Union as well as from the European countries and USA. A critical analysis of various points of view has revealed several factors that have had and have up to now a negative sign on the evaluation of his "flying machine" project: revolutionary activity, participation in the killing of the Tsar, interpretation of its technical design as inapplicable to rocket and space technology, etc. Our study is aimed to minimize such judgments and to testify that "flying machine" proposed by N.I. Kibalchich using the rocket-dynamic principle of motion conceptually outstripped the engineering idea of the time when the inventor lived.

Keywords: *rocket and space technology, history of rocket techniques, outstanding personalities: Nikolai Kibalchich.*

INTRODUCTION

The origins of rocket science, the establishment of its basic theoretical principles of the period of initial professionalization of this scientific-technical and engineering field of knowledge are one of the significant problems in the history of science and technology. It is indisputable that researchers of this problem need to appeal to those individuals who laid the foundations of the space science and technology.

The statement by the outstanding physicist and physicist-historian S. I. Vavilov has become an aphorism, according to which "*the history of science cannot be limited to the development of ideas — equally, it should relate to human beings, with their characteristics, talents, depending on the social conditions of the country and the era. In the development of culture, individuals have had and continue to retain an incomparably greater importance than in the general socio-economic and political history of mankind. Therefore, it is clear that the life and work of advanced people are a very important factor in the development of science, and*

their biography is a necessary part of the history of science..." [38, p. 4].

Undoubtedly, these words also refer to the pioneer of the rocket and space industry, an extremely interesting and gifted person, who is Nikolai Ivanovich Kibalchich (October 19 [31], 1853, the city of Korop, Chernigiv Governorate (present Ukraine) – April 3 [15], 1881, St. Petersburg (present Russia)). It is no coincidence that his name has entered the memorial anthology of outstanding Ukrainian personalities [19], the world rocketry industry's outstanding personalities [15], and "Pioneers of Space Exploration Book Collection" (see, for example, [6]).The complexity of studying his technical work lies primarily in the fact that almost all researchers in his analysis are forced to rely on the only work of N. I. Kibalchich on this issue, namely, on the one that he wrote in the short time between arrest and execution on the attempted assassination of Tsar Alexander II. Nikolai I. Kibalchich died at the age of 27 and practically did not leave behind himself the printed works with descriptions of his inventions and technical ideas. By this reason, the analysis of his contribution to the development of rocket and space technology is difficult. In this context, an important role is played by the memoirs of N. I. Kibalchich of his contemporaries, those who spoke with him, as well as other personal sources used in this study [9, 21, 22].

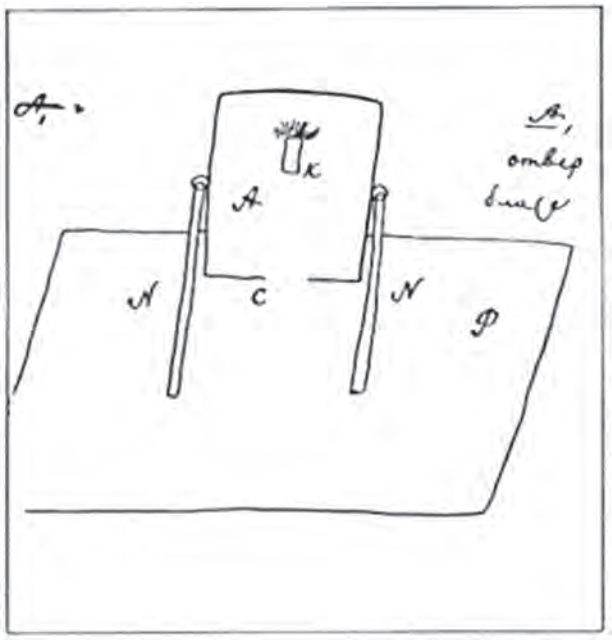
The political activity of N. I. Kibalchich also obscures the significance of his priority work. For domestic researchers, his revolutionary activity (especially for researchers of the Soviet period) was a factor that contributed to a positive perception of the figure of N. I. Kibalchich in the eyes of the Soviet community, supported by a powerful ideology. But for the world community, his political activity often prevailed over scientific and technical and became an occasion for discussion. For example, Thomas Andrew, a political observer and science fiction writer, whose interests are focused on the problems of space exploration by Russia, China, and India, wrote in his study, "*The revolutionary bomb-maker and anarchist – some would now say terrorist – Nikolai Kibalchich (1853–1881), acted within debates both revolutionary and cosmic*" [1].

The aim of our work is to conduct a critical analysis of sources (both domestic and foreign) that considers the contribution of N. I. Kibalchich to the fundamentals of rocket and space technology in a wide range of opinions about it, including in a different way than in domestic publications on space exploration history. The subject of the research is the views on the role of N. I. Kibalchich in the rocket-space technology history presented in various sources.

Nikolai I. Kibalchich (19 October 1853 – April 3, 1881) – one of the outstanding rocketry pioneers in the world

N. I. KIBALCHICH AND HIS PLACE IN THE HISTORY OF ROCKET AND SPACE TECHNOLOGY IN THE ASSESSMENT OF UKRAINIAN AND RUSSIAN RESEARCHERS

One of the first inventions of N. I. Kibalchich was the design of a "propelling projectile" he created for use for terrorist purposes. The design of the "propelling projectile" was described by the inventor in his testimony, from which follows a significant search and design work by N. I. Kibalchich: "*I had to use a lot of time and labor to prepare them before I collected the necessary technical information and invented this projectile device. It should be noted that among my party, I was the first to take nitroglycerin. In order to get acquainted with the subject, I re-read everything that I could find in literature in Russian, French, and German. But in order, firstly, to produce dynamite using our own means and, secondly, to arrange a propelling projectile with dynamite that was quite satisfactory,*



Sketch of the "flying machine" proposed by N. I. Kibalchich based on the rocket-dynamic principle of motion [26]

I had to come up with a lot of new devices that were not used anywhere. I offered several types of propelling projectile, differing from each other in the device for receiving fire, which reports an explosion of dynamite, and only recently I came up with this form of projectile" [9]. According to the description of the "propelling projectile" design made by N. I. Kibalchich, both the "propelling projectile" itself and some of its structural elements (for example, "Kibalchich fuse") were reconstructed in our time [11]. Experts highly appreciated the design activity of N. I. Kibalchich in the development of the bomb. In this case, we are dealing with a specific design, which, apparently, could be claimed as an invention.

We also draw attention to the fact that N. I. Kibalchich invented a number of "new devices that were not used anywhere", that is, he worked at the inventive level in the course of work on the "propelling projectile".

As for the technical project developed by N. I. Kibalchich a few days before the execution, the manuscript and its key points are now well known and published in various sources since 1918 [34].

The Figure shows a page from the manuscript of N. I. Kibalchich with his sketch of the "aeronautical device". Let us briefly recall some of the main provisions of this manuscript. Nikolai I. Kibalchich proposed to use slowly burning compressed gunpowder, the burning rate of which can be regulated, as fuel for creating a "driving force" (traction force). According to N. I. Kibalchich, the change in the burning rate or the mass of the supplied fuel should lead to the possibility of controlling the traction force of the "device". He also noted that other explosives could be used to create a "driving force" (traction force). In order to establish and replace fuel, according to the inventor, "special automatic mechanisms should be invented" [23, 34].

We especially note the idea of installing a mobile cylinder with a fuel (rocket engine) on the proposed device so that "*it could be tilted in a vertical plane, and now could have a cone-shaped rotation. Both maintaining the apparatus in the air and moving in the horizontal direction are achieved simultaneously by tilting the cylinder*" [23, 34].

Nikolai I. Kibalchich also considered the placement of fuel, providing the movement of the "aeronautical device". Furthermore, he proposed a layout of cylinders (engines) that control the movement of the structure in horizontal and vertical planes. He did not bypass the problem of stability of the "aeronautical device" arising from its movement. At the same time, he expressed the idea that "*for stability, some kind of motion controllers in the form of wings, etc., can be devised*" [23, 34].

These and other ideas set forth by N. I. Kibalchich in his project subsequently received a real constructive solution under the new technical and technological capabilities. A modern reading of these ideas is given, for example, in [13]. As it is known, the rocket-dynamic principle used by N. I. Kibalchich is the basis of modern rocket and space technology.

Nevertheless, an analysis of the contribution of N. I. Kibalchich to the development of rocketry due to the lack of a detailed constructive description in his project leads to a discrepancy between the interpretations of the meaning of his manuscript and the description of the "flying machine". Cosmism's researchers are especially "guilty" of this as they do not often focus on the "aeronautical apparatus" designed by N. I. Kibalchich in the context of the development of modern rocket technology.

As for the personality of N. I. Kibalchich, the Russian historiography of his life and work traces the approach associated with attempts to establish in the minds of both scientists and ordinary readers the idea that N. I. Kibalchich was an outstanding *"Russian"* engineer (see, for example, [14, 18]). In order not to look unfounded, we give an example from the article by Il. Poltavskii, published back in 1929. It begins with the words: "*The most typical and brightest figure of the Russian inventor-revolutionary in the tsarist days is represented by N. I. Kibalchich, one of those whom the Narodnaya Volya Executive Committee together with Zhelyabov and Perovskaya sent to the case on March 1, 1881*" [25].

Apparently, it would be more correct to write literally "of Russia" by belonging to that State (Russian Empire – *Auth.*) of which he was a citizen. From an ethnic point of view, he was not the Russian. To be more precise, as proved by the researchers of his life, the ancestors of N. I. Kibalchich were immigrants from Serbia. They moved to Ukraine and were assimilated into its environment. This seemingly not very significant moment receives a value when you see how often Russian authors identify the iconic personalities of Ukrainians in the history of the Russian Empire or the USSR as the Russian ones.

The tendency to represent N. I. Kibalchich as a "Russian scientist" continues today. What is the situation, and what kind of genealogy does N. I. Kibalchich have? Now, it is already well known about its Balkan (Serbian) track. Enough evidence for this version is presented, for example, in the book by Ivashchenko and Kravets [10]. This idea is confirmed both in the studies of Serbian scientists and in the search work of Ukrainian researchers. So, Professor Radmila Tonkovich (Serbia) in her report [32] in 2011 noted that the ancestor of the Ukrainian branch of Kibalchichi (priest Gregor Kibalchich) at the beginning of the 18th century was headed by one of the Serbian detachments (couple) of gayduks ? who fought for the overthrow of the Turkish yoke.Fleeing from the Turks, he with his wife and young son "found refuge in the Reuben hermitage of the Chernigov Governorate" [7, p. 166]. Now, the Reuben (Sosnitsky) monastery no longer exists. We also note that, apparently, the choice of residence was not accidental, since the founder of the Reuben hermitage (a monastery near the city of Sosnitsa in the Chernigov Governorate) is considered to be the Serbian bishop of Reuben [7, p. 166]. So, the Kibalchichs appeared in Ukraine in the 18th century. Since Gregor Kibalchich was ordained an Orthodox priest, he later became a priest at the Starodub Cathedral of the Chernigov Diocese.This happened in 1709, when (according to the book [10]) he was appointed to this post by the Chernigov bishop John (Maximovich). The latter is known for the fact that in 1700, he founded a collegium in Chernigov (a Slavic-Latin school), which was supposed to be the preparatory stage of training for further mastery of the sciences at Kyiv-Mohyla Academy. Subsequently, almost all representatives of several generations of the Kibalchich's family were priests in different cities and settlements of Ukraine. An interesting testimony of R. Tonkovich about those cities in the Chernigov Governorate in which representatives of the Gregor Kibalchich clan lived and worked mainly as priests. It is interesting the testimony of R. Tonkovich about those cities in the Chernigov Governorate in which representatives of the Gregor Kibalchich family lived and worked mainly as priests.A. Geida also notes that "*by the middle of the 19th century, most of the representatives of the Kibalchich family belonged to the clergy and held the posts of priests in the Starodub, Pogarsky, Mglinsky, Krolevets uyezds of the Chernigov Governorate*" [7, p. 78]. That is, this genus was mainly associated with Ukraine. Not single evidence, complementing each other, is important and, undoubtedly, confirms the assimilation of this family in Ukraine and the inextricable relationship of the family of Nikolai Kibalchich (and himself) with Ukraine. Already after finishing a secondary school, Nikolai Kibalchich went to Russia, where he studied medicine and later engineering at the Saint Petersburg Engineering College as well as started his experiments into pulsed (jet) rocket propulsion [4].

The second point in a number of Russian publications that we want to recall is a negative attitude to the personality of N. I. Kibalchich by the Russian monarchists. On the Internet, on the website of the Society for the Development of Russian Historical Education "Double-headed eagle" in a paragraph by A. Goncharov, "The Persons of Revolutionary Terror: Nikolai Kibalchich", it is noted, "*The brutal*

murder of the Emperor put an end to the life of Kibalchich. Arrested by the authorities and legally convicted, like other "Pervomartovtsy" killers, Nikolai Kibalchich was hanged in 1881. Shortly before his death, Kibalchich invented the original flying spacecraft..." And further the author, focusing on the fact that the streets of many cities of Russia bear the name of N. I. Kibalchich, claims, *"It is clearly not the inventor that is glorified, but the revolutionary terrorist, the killer of the head of the Russian Empire*" [8]. A similar, but somewhat milder interpretation, is presented in the book of essays [2], which refers to the fact that "*a promising inventor took the side of the terrorists and shared responsibility with them for the evil that brought terror to Russia*" [2]. Without touching on the moral and ethical issues of the act of terrorism by members of Narodnaya Volya, let us pay attention to the fact that it is the murder of the Emperor that causes condemnation.

In this context we would like to cite reminiscences of his contemporaries, who characterize Nikolai Kibalchich and his state before death. First of all, it's opinion of his lawyer V.N Gerard to whom Kibalchich handed over his last notes on the project: «"*When his men came to see Kibalchich as his appointed counsel for the defense*," said V. N. Gerard in his statement to the special committee of the senate, "*I was surprised above all by the fact that his mind was occupied with completely different things with no bearing on the present trial. He seems to be immersed in research on some aeronautic missile; he thirsted for a possibility to write down his mathematical calculations involved in the discovery*."» [3, 7]. One more description we find in the book by Diedov issued in 1906: "*To his liking, to his abilities, he was more a cabinet scientist than a revolutionary practitioner. Books, laboratory studies are his areas of interest. He was a man quite independent and more intelligent than many, but for his endless kindness, gentleness and impracticality. he could not lead people behind him at all, he was respected by everyone, everyone considered his opinion when it came to the purely scientific field ... with his ability to merge his whole soul with a favorite idea, he was certainly able to look calmly in the eyes of death, even more calmly than most other people. And on the eve of his death, he is known to be concerned only with the fate of his aeronautical project, as Archimedes is the fate of his circles*" [22].

But in our opinion, the more discussable are the negatives that come to light when considering the work of N. I. Kibalchich and relate primarily to his scientific-technical activities, in particular, the "aeronautical device" project.

What was the significance of the invention by N. I. Kibalchich? Did it have an impact on the development of rocket and space technology? Would this device fly if the project was implemented? Can this project be considered the first rocket technology project aimed at using for flights in outer space? These and many other questions arise not only with the modern reader. They were relevant even at the time when the project by N. I. Kibalchich was first published in the *Byloye* historic magazine in 1918 [34].

In order to evaluate the project, we turn to the two publications. Their peculiarity lies in the fact that, firstly, they were examined by specialists in rocket and space technology, and, secondly, they are spaced in time for almost half a century.

The first of these is N. I. Rynin, "a Soviet scientist in the field of aviation and descriptive geometry. The author of a number of works on jet technology, interplanetary communications, and the development of the stratosphere" [26].

The conclusion of N. I. Rynin, presented by him to the draft invention by N. I. Kibalchich in 1918, was critical from the point of view of the technical capabilities of the proposed apparatus in its practical implementation at that time [27]. He confirmed his opinion in 1929 in the book *Interplanetary Communications*, on the pages of which he noted that "*when approaching the Kibalchich's project with a strict test of the possibility of raising the apparatus and controlling it in flight, of course, the project does not stand up to criticism. The speed of the powder gases and their energy are not enough to lift the device that the author foresees*" [28].

At the same time, back in 1918, N. I. Rynin expressed a fundamentally very important opinion about the conceptual foundations of the invention of N. I. Kibalchich, "*For N. I. Kibalchich, priority should be set in the idea of using jet engines for aeronautics, in principle, though not yet practically realized, but right in the basis and giving attractive prospects in the future, especially if you dream about interplanetary communications...*" [27].

Almost half a century has passed. The rocket and space industry has developed rapidly around the world. Design thought has reached new heights. How do experts evaluate the invention of N. I. Kibalchich and his conceptual provisions now? V. N. Sokol'skii, an expert in aviation technology, Head of the History of Aviation and Cosmonautics Department at the Institute of the History of Natural Sciences and Technology of the Russian Academy of Sciences, a scientist under whose guidance a historical and technical school in the field of aviation and rocket and space technology was formed in the USSR, evaluated the invention of N. I. Kibalchich in 1963: "*When assessing the Kibalchich's project from a modern point of view, of course, one can find many shortcomings and even fundamentally wrong decisions in it. Moreover, a detailed analysis of the project proves that, as Kibalchich described it, a flying machine could not be created at all. But one cannot help but admire the courage of a man who developed his project, which was amazing for that time, on death row a few days before execution, and do not give credit to the talent of the scientist-inventor, who provided for such technical issues as ensuring flight stability, the use of multi-chamber devices, and the program mode of combustion, gunpowder inhibiting, etc. Therefore, we can rightfully consider N. I. Kibalchich one of the pioneers of rocket technology*" [30, p. 127].

Most of the academic scientists have the same opinion. One of the evidences of such a position is the publication of project by Kibalchich altogether with papers by Tsiolkovsky, Zander, Kondratyuk in collections of selected works of the "pioneers of missile technology", issued in 1964 by the Academy of Sciences of the USSR [23]. The analysis of bibliographic sources, gathered among publications of the Ukrainian authors, says that they have a balances approach and separate the activity of Nikolai Kibalchich as "*the scientist-inventor*" and "*the revolutionary-narodovolets*". Previously, the authors of this paper already addressed the personality of N. I. Kibalchich in our publications [29, 39] and emphasized objectively (altogether with another authors, see, for example, [5, 10, 13, 19, 24, 36] and papers in scientific encyclopedias such as "Encyclopedia of Modern Ukraine", "Encyclopedia of History of Ukraine", encyclopedias of cosmonautics) his contribution in the basic principles of further development of rocketry industry. The last but not the latter is to note briefly a cultural aspect: in 1960 the Memorial Museum of N. I. Kibalchich was established at the renovated Kibalchichi's family house [1] in Korop, Chernigiv region; expositions dedicated to life and "flying machine" of N. I. Kibalchich are in the Zhytomyr Museum of Cosmonautics named after S. P. Korolev [2].

THE ROLE OF N. I. KIBALCHICH IN THE HISTORY OF ROCKET AND SPACE TECHNOLOGY IN THE ASSESSMENT OF FOREIGN (OUTSIDE THE FORMER USSR) HISTORIOGRAPHY

The image of N. I. Kibalchich and the awareness of his contribution to the development of rocket and space technology outside our country are formed in the mass consciousness in different ways. One of the directions is the use of museum expositions devoted to the history of the development of world rocket and space technology. In this context, we point out the exposition of the International Space Hall of Fame at the "New Mexico Museum of Space History", which displays a stand about N. I. Kibalchich, starting with the heading "Conceived the first design of a manned rocket airplane" [3]. And further, it is reported that "Nikolai Ivanovich Kibalchich was a Russian revolutionary who developed the world's first design of a manned rocket-propelled craft. The design incorporated a gimbaled rocket engine, flight control, programmed burning of propellant and other unique features". The presence of N. I. Kibalchich in such exhibitions is undoubtedly evidence of the recognition of his merits in the history of the development of rocket and space technology.

The engineering design of N. I. Kibalchich is interpreted in foreign literature (excluding Russian, discussed in the previous subsection) is quite diverse. The first publications relating to N. I. Kibalchich appeared in Europe in the 1880s [21]. But until the description of N. I. Kibalchich's invention (1918) was made public, it was impossible to evaluate it.

[1] The Memorial Museum of N. I. Kibalchich in Korop. Available: http://museum.cult.gov.ua/memorialnyj-muzej-mykoly-kybalchycha-viddil-koropskoho-rehionalnoho-istoryko-arheolohichnoho-muzeyu/

[2] The Museum of Cosmonautics named after S. P. Korolev in Zhytomyr. Available: http://cosmosmuseum.info

[3] The New Mexico Museum of Space History. Available: http://www.nmspacemuseum.org/content.php?id=16

All works in which we are talking about N. I. Kibalchich can be classified as works devoted to the history of the Russian Empire as a whole, the history of the revolutionary movement in it, and works that deliberately consider the development of rocket and space technology in the world, and in this regard, in the Russian Empire and the former USSR.

The works of the first direction are not so interesting for this study since the scientific-technical side of N. I. Kibalchich's activity is fragmented in them (in connection with the technical support of terrorist acts of members of Narodna Volya). Therefore, questions of evaluating N. I. Kibalchich's rocket project are practically not considered, although there are references to it.

In this context, the publication of Werrett Simon, in which he, analyzing the evolution of weapons used by terrorists in the 19th century, draws attention to their ingenuity, turning into scientific innovation, is important. In particular, he concludes that "*Terrorists may have been revolutionary in their attitude to politics, but conformed to the scientific culture of their time. Nevertheless, while terrorists acted and saw themselves as consumers of innovative science, they could also contribute to innovations. The line between the skills of improvising radicals and those of legitimate scientists and inventors was not always clearly drawn*" [40, p. 23]. In our opinion, this conclusion is very important for understanding N. I. Kibalchich's activities, during which the boundary between the use of his innovative projects for terrorist purposes and for the development of science and technology disappeared. Kibalchich's dynamite, manufactured outside the factory, a "propelling projectile" (bomb) with an original acid fuse, the idea of using different methods of burning gunpowder to create a rocket engine — all these and other innovative ideas arose in the process of his "technical and terrorist" activities.

Therefore, much more important for understanding the contribution of N. I. Kibalchich in the development of rocket technology is the work of foreign researchers, devoted either directly to his life and activities with an emphasis on its technical side or the history of the development of rocket and space technology. Practically, all foreign researchers of the history of rocket and space technology in relation to N. I. Kibalchich are divided (as a careful analysis of sources showed) into two large groups: researchers who positively assess the role of N. I. Kibalchich in the history of rocket and space technology and those who evaluate this role rather skeptical.

Foreign researchers in the field of the history of rocket and space technology are also trying to answer those important questions that were identified by us in the previous subsection and, first of all, the question whether N. I.Kibalchich was the first.

Thus, Radmila Tonkovich, a Professor from Serbia, calls N. I. Kibalchich "*an ideological pioneer and theorist of space exploration*" [35] and believes that he is "*the forefather of rocket technology and astronautics*" [Ibid.]. Considering the invention of the Pervomartovets-inventor, R. Tonkovich puts forward an important thesis: "*The fact that his scheme was not known for a long time (the archives of the Department of Internal Affairs were published only in 1918 by the Byloye magazine) does not change the most fundamental — in the intellectual space in which human civilization lives, something was added*" [Ibid.].

Encyclopedia of Science by David Darling provides a brief essay on N. I. Kibalchich, in which, in particular, there are such lines: "*Nikolai Kibalchich was a Russian medical student, journalist, and revolutionary who may have been the first person in history to propose using rocket power as a means of transport in space. Kibalchich wrote a remarkable paper illustrating the principle of space propulsion. In it, he describes a means of propelling a platform by igniting gunpowder cartridges in a rocket chamber. Changing the direction of the rocket's axis, he realized, would alter the vehicle's flight path*" [12]. And further, the author describes the "flying platform" of N. I. Kibalchich: "*The device that Kibalchich described consisted of a platform with a hole in the center, above which was mounted a breech-loaded rocket motor. The motor was fed, machine-gun fashion, with charges of compressed powder, the thrust being varied either by altering the size of the cartridges or the speed at which they were fed into the chamber. Take-off was vertical, with the chamber firing through the hole. As soon as sufficient altitude was reached the chamber would be rotated through 90 degrees for horizontal flight. The propulsion arrangement of this unusual craft foreshadowed some of the vertical take-off aircraft which began to be developed in the second half of the twentieth century*" [12].

The complex, controversial image of a revolutionary terrorist and, at the same time, an inventor is presented in the book of Lee Croft, a Professor at the University of Arizona, which was first published in English in 2006 [4].

In the annotation of the book Lee Croft describes the personality of N. I. Kibalchich as follows, "*Kibalchich conceived and drew the design of the first rocket-powered human-carrying flying device, thus qualifying himself in History as a "terrorist rocket pioneer. On the other hand, there is Kibalchich's conception and design of a rocket-powered device, cited as seminal to the subsequent development of rocket by numerous later prominent figures in the world effort to advancehumanity into the outer reaches of our atmosphere and intospace itself. Rocket scientists like K. Tsiolkovsky and Werner von Braun acknowledged the antecedence of Kibalchich's rudimentary 1881 conception*" [4, p. 7]. Paying tribute to N. I. Kibalchich, Lee Croft, however, is quite critical of some statements by Soviet historians of space exploration. So, in his opinion, "*Soviet scholars concocted a direct influence of Kibalchich upon their cold-war-era space leader Sergei Korolev*" [4]. This question is not as simple as it seems at first glance and requires careful study.

A brief description of the innovative idea of N. I. Kibalchich is also given in a book by John Parsons dedicated to the American rocket scientists [33]. Gainor Chris in his famous book "To a distant day: the Rocket Pioneers" gives a balanced description of the tragedy of a young rocket scientist, whose political activity led to early death: "*Although Europe was relatively free of war between the fall of Napoleon in 1815 and the start of World War I in 1914, the new political movements challenged those in power, notably during a series of foiled revolutions in 1848. In the late nineteenth century many revolutionary currents had responded to the changes taking place in Russia, and on March 1, 1881, members of a group called Narodnaya Volya (The People's Will) assassinated Tsar Alexander II by throwing a bomb into his carriage in St. Petersburg. The bombers hoped to end autocracy in Russia and replace it with democracy and socialism, but in the short term they succeeded only in replacing Alexander with a more reactionary and repressive czar, Alexander III. The maker of the bomb, a twenty- seven-year-old scientist named Nikolai Kibalchich, was arrested and thrown into a tiny cell in the Fortress of Peter and Paul. Knowing that he would be put to death, he set to work on designing an aircraft using reactive devices to move it. Before he was hanged on April 3, Kibalchich wrote a memorandum on his craft, which used a solid rocket to propel a platform through the air. «I believe in the feasibility of my idea, and this faith supports me in my terrible situation», he wrote in his cell. «If learned specialists find my idea realistic I shall be happy to be able to render service to my country and mankind. I shall meet death calmly then, knowing that my idea will not perish with me». He begged authorities to share his memorandum with other scientists, but after his execution the memorandum was hidden in the government archives for decades until the revolution he had hoped for enabled his work to be published"* [6]. And emphasizes": Although his device would not have worked as hoped, it did point the way to the use of rockets as a means of moving humans through the atmosphere and beyond (bold italic – Auth.). *And Kibalchich became the first of many rocket enthusiasts to be entangled in Russia's knotty revolutionary politics. Few would be as willing*" [6].

Ron Miller, a specialist in research on the history of rocket science, "*explores the history of rocketry, from the first development of rockets as toys over one thousand years ago to their modern uses in war and space exploration*", is known for his books in this area. Without denying the merits of N. I. Kibalchich in the history of the development of rocket and space technology, he poses a very important question about its priority, cites a number of inventors whose activities in those years, in his opinion, can claim priority in the history of the development of rocket technology. In particular, he writes, "*Was Nikolai Kibalchich the first to suggest the idea of rocket-propelled space flight in 1881? Most Russians would say "yes", but whatever the answer, the story is tragic enough for a Russian novel and Kibalchich's ideas certainly were ahead of their time*" [7]. In our opinion, a special study should be devoted to such issues, which is beyond the scope of this paper.

At the same time, there is a direction in foreign literature that is based on the idea that the project of N. I. Kibalchich in the history of rocket and space technology does not deserve attention, and its significance is hyperbolized.

A number of modern foreign historians and sociologists who deal with the history of rocket-space tech-

nology in various contexts (in particular, in the context of the emergence and development of Russian cosmism?) do not give a positive assessment (at least, in those works that we had to get to know) to the invention of N. I. Kibalchich. So, in a monograph edited by S. J. Dick and R. D. Launius (NASA, 2007), which addresses the social impact of space travel, regarding N. I. Kibalchich's invention, it is stated that "*Kibalchich was a member of the People's Will terrorist organization which assassinated Tsar AleksandrII. Before his execution in 1881,Kibalchich devised a plan for a rocket-propelled vehicle that later Soviet historians* absurdly (bold italics – Auth.) *claimed was an early design for a spaceship*" [32, p. 533].

The most distinctly critical view of the role of N. I. Kibalchich in the history of rocketry was manifested in the well-known study *From Cosmic Enthusiasm to Nostalgia for the Future. A Tale of Soviet Space Culture*. It reports on his invention as follows: "*Kibalchich, a certified engineer, deserves some prominence in Russian history but not for any contribution to astronautics*" [31, p. 291]. Considering the assessment of the invention provided by N. I. Rynin, the author of the section on N. I. Kibalcich believes that it was filed "*in an uncharacteristic lapse of hyperbole*" [31, p. 292].

And further, the author describes the project of N.I. Kibalchich as follows: "*In his exposition, Kibalchich did not mention the cosmos or even the upper atmosphere; because his calculations omitted the effects of air, post facto interpreters assumed that he might have been thinking of a rocket working in vacuum. Although Kibalchich's exposition had nothing to do with space, Rynin's original statement stuck. Eventually, the former revolutionary achieved an iconic status in the canon of Soviet space history that hardly distinguished between Kibalchich's political and (alleged) scientific work. His dramatic, tragic and ultimately heroic story was retold dozens of times in speeches, articles, and books through the 1960s until it achieved a momentum that was divorced from the original events of the case. Kibalchich's story had obvious metaphoric value in the context of space, since his tale gave the new cosmic movement a hero who had given his life for both liberations from oppression and liberation from gravity*" [31, p. 292].

The main message of A. Siddiqi's reasoning boils down to the fact that N. I. Kibalchich was needed by the Soviet system to create a "usable past" for the space program. In this context, according to A. Siddiqi, he was even preferable to K. E. Tsiolkovsky: *"...Kibalchich was a much better candidate for a revolutionary figure in the field of space exploration; with a relatively minor contribution to aeronautics, he was elevated to remarkable prominence from the 1960s. His story, often likened by Soviet commentators to that of Icarus, remains extant in the post- Soviet era; historians in both the East and West continue to trump up this lost figure as a contemporary of Tsiolkovskii, Fridrikh Tsander and other major Soviet theoreticians*" [31, p. 291].

The author of the publication concludes that "*in untangling the myths associated with Kibalchich, one might argue that his effective contribution to the science of spaceflight is unimportant because he served a purpose that transcended questions of* '**scientific value**' (bold italics – Auth.).*The conclusions that both Russian and Western historians have come to regarding Kibalchich's role in the history – such as Michael Holquist's claim that he represents the nihilist impulse in Soviet space history – are not necessarily untrue, but obscure a deeper and perhaps more important process of myth-making [33]. The Kibalchich myth is instructive precisely because it shows how the Soviet space community was willing to subvert its own tenets of scientific truth to bolster its case*" [31, p. 293].

But then the question arises, why, even before the start of the Soviet space program and its ideologization, the famous Austrian inventor, pioneer of rocket technology, one of the founders of the German society of interplanetary communications, Max Valeir in his book *Flying into the World Space as a Technical Opportunity* (which withstood several reprints in the 1920s) considered the invention of N. I. Kibalchich as a priority. He characterized the personality of N. I. Kibalchich as follows, "*A convinced revolutionary in politics who gave his life in the struggle against the autocracy, N. I. Kibalchich turned out to be the largest revolutionary in science and technology*" [37].

Nevertheless, with regard to myth-making in relation to N. I. Kibalchich, certain elements of it did indeed existed, especially in the 1960s, and they had a corresponding political background.

It should also be taken into account that the statement about N. I. Kibalchich's dreams of outer space

and flights to planets, as well as a certain mythologization of his project, replicated without justification and necessary comments by many Ukrainian and Russian journalists and writers, gave some historians some skepticism about the attitude to the ideas of N. I. Kibalchich and his technical design of a "flying machine".

In foreign literature, this situation is reflected, in particular, in this way: "*Embellishments to the story began to appear almost immediately, perhaps the most enduring being that Kibalchich had feverishly and hurriedly drawn up the plans the night before his execution when in fact, he had done so eleven days before – a small detail perhaps, but one which made the story even more compelling. In many imagined representations of Kibalchich's flying machine, artists exaggerated his original representations to depict spaceships flying over the moon, which its original author would have hardly recognized. In the 1960s, these images proliferated as Kibalchich's story was brought to the forefront of Soviet space history, uncomplicated by appeals to evidence*" [31, p. 292]. A. Siddiqi is right about the fantasies of artists, but this is not an argument that reduces the importance of N. I. Kibalchich's original technical ideas.

Commending the thorough research carried out in this work, we note that, unfortunately, it does not have a comparative consideration of the technical ideas embodied in the project of N. I. Kibalchich in the context of the further development of rocket and space technology. Its author, specializing in the social and cultural history of technology and modern history of Russia, paid more attention to the social component of research on the Soviet space rocket project. Such an approach when considering the contribution of N. I. Kibalchich is also characteristic of some other foreign researchers.

However, if we discard ideological layers, the basic conclusion of the author of the study cited above regarding the contribution of N. I. Kibalchich to science seems incorrect. The social, revolutionary component of the inventor's life again outweighed the scientific and technical component of his activity. And this is the birth of a new myth, the manifestation of a different type of myth-making in relation to N. I. Kibalchich, which are promoted by some foreign scientists.

It is not at all a fact that N. I. Kibalchich did not dream about space flights. There are grounds for such a statement. And among them, in particular, a letter from N. I. Kibalchich, from which it follows that the idea of flying to the stars using rocket technology was inherent in him. In the paper by N. I. Nevedomskii, there is the evidence, taken from the letter of N. I. Kibalchich. The letter was written by him to his friend a few days before the fatal arrest. In this letter, the inventor said, "*...If I survive, I'll take care of the* rocket (bold italics – Auth.) *aeronautical apparatus that I spoke with Morozov... My motto is: "The road to the stars begins in Russia!*" [20, p. 1007]. We draw attention to the fact that even before his arrest, he was absorbed in this idea. And therefore, those researchers who claim that N. I. Kibalchich in prison only framed in the form of a project those ideas that he hatched for a long time are many times right.

And there is one more important moment. Indeed, we do not find the words "planet", "space", "airless space" in a small (six pages) work of N. I. Kibalchich. But what do experts in the field of rocket and space technology say? The fact that although N. I. Kibalchich called his apparatus "aeronautical", the possibilities of using it for flights in airless space also came from the rocket-dynamic principle of motion that he proposed. And in the fundamental moments of his invention contained the main features of modern rocket aircraft for flights in space. In particular, it is the rocket-dynamic principle of motion in outer space.

In this context, let us return to the letter of N. I. Kibalchich cited above and draw the reader's attention to the phrase used by the author of the project: "*aeronautical apparatus*".This term indicates a clear understanding of the rocket-dynamic principle implemented in the project.

There is another debatable question in assessing the role of N. I. Kibalchich in the history of rocket and space technology. This is evidenced, in particular, by a rather important thesis, which was put forward in [31]. According to it, "*Kibalchich's idea to use a powder rocket attached to a platform to propel it was not new. Other Russian scientists had advanced similar plans far more sophisticated around the same time that Kibalchich had*" [31, p. 292].

In a note to the expressed thought, the author cites the name of S. S. Nezhdanovsky, referring to the famous work of V. N. Sokol'skii [30]. However, V. N. Sokol'skii in this publication, considering the ideas of

S. S. Nezhdanovsky, does not encroach on the priority of N. I. Kibalchich. A detailed consideration in the comparative context of the projects of S. S. Nezhdanovsky and N. I. Kibalchich would make it possible to more accurately formulate a critical remark by A. Siddiqi regarding the priority of N. I. Kibalchich. Possible priority works are also discussed in the study of John Miller already mentioned, which cites a number of names of inventors who, in his opinion, could apply for such priority projects [17].

We note also that in 1891 similar ideas were developed independently by the German engineer Hermann Ganswindt. It is interesting that invention projects by H. Ganswindt (the dirigible, the helicopter, the internal combustion engine, and the two-stage vehicle driven by a series of dynamite explosions) were also ahead of his time [15].

More lately, in 1946, Stanislaw Ulam, the famous American scientist of Polish origin, developed these ideas at the more advanced technological level: he proposed to harness small nuclear explosions for propulsion of rockets. He was more fortunate: his idea was implemented in the Project Orion on "a study of a spacecraft intended to be directly propelled by a series of explosions of atomic bombs behind the craft" [4] and till now it is a main conceptual basis for a spacecraft design to be used for a rapid destination and following destruction of a celestial body that poses a threat to the Earth.

CONCLUSION

The personality of N. I. Kibalchich is undoubtedly significant in the context of the development of not only rocket and space technology, but also the intellectual history of mankind as a whole [5]. The automatic transfer of the assessment of the formation process of Soviet space culture and its ideological components to the assessment of the real contribution of N. I. Kibalchich to the development of the scientific-technical thought of mankind cannot be considered as a criterion of the significance of the latter. The ideological components when considering the invention of N. I. Kibalchich should be separated from his real contribution to the development of world space rocket industry and technical thought. Undoubtedly, there is a need for further studying the life and work of N. I. Kibalchich in the contexts considered in the paper, since there are discrepancies in their assessment, in particular in the works of domestic and a number of foreign historians of science and technology.

At the same time, an important component of further study is also the search and critical analysis of works (including contemporaries of N. I. Kibalchich), which could be considered priorities in the history of rocket and space technology. It is obviously the paper by N. I. Kibalchich [26], published in 1918 (37 years after his execution), was familiar to those whom we undoubtedly call the pioneers of rocket techno-logy, — K. E. Tsiolkovsky, F. A. Tsander, V. von Braun, S. P. Korolev. Further solving the discussion questions identified in the paper should be based on an analytical and synthetic study of a significant array of historiographic sources, a new reading of the work of N. I. Kibalchich, a study of sources on the history of the development of rocket and space technology, a comparative analysis of N. I. Kibalchich's ideas and those ideas which are implemented in modern rocket and space technology.

We hope that we were convincing as our research testifies in favor of the fact that the design of the "flying machine" proposed by N. I. Kibalchich using the rocket-dynamic principle of motion conceptually outstripped the engineering idea of the time when the inventor lived.

[4] https://en.wikipedia.org/wiki/Project_Orion_(nuclear_propulsion)

[5] A large impact crater in the equatorial region of the far side of the Moon is named after N. I. Kibal'chich (lat. Kibal'chich). The name was approved by the International Astronomical Union in 1970. Selenographic coordinates of the center of the crater are 2°43′ N 147°11′ W, diameter 91.7 km, depth 2.8 km [16].

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МИКОЛА КИБАЛЬЧИЧ В ІСТОРІЇ СВІТОВОЇ РАКЕТНО-КОСМІЧНОЇ ТЕХНІКИ: ДИСКУСІЙНІ ПИТАННЯ ВІТЧИЗНЯНОЇ І СВІТОВОЇ ІСТОРІОГРАФІЇ

Стаття присвячена історії ракетно-космічної техніки та дискусійним питанням щодо ролі Миколи І. Кибальчича в формуванні принципів створення космічних літальних апаратів. Народоволець Микола І. Кибальчич, перебуваючи перед стратою в тюремному ув'язненні за участь у замаху на царя Олександра II, розробив проект «повітроплавного приладу». В основу цього проекту він поклав ракетодинамічний принцип. Його проект вважається одним з перших, якщо не першим проектом ракетної техніки, що відкриває можливість польотів у космічному просторі. Однак, як показало наше дослідження, така точка зору поділяється не всіма, хто вивчає історію освоєння космосу і ракетно-космічної техніки. У статті розглянуті підходи і погляди, представлені в різних джерелах, на роль М. І. Кибальчича в історії ракетно-космічної техніки. Наведено оцінки цієї ролі дослідниками України, Росії, колишнього Радянського Союзу. Проаналізовано погляди на винахід Миколи І. Кибальчича і його роль у розвитку інженерної думки в роботах європейських і американських вчених. Визначено основні тренди альтернативних думок щодо проекту Миколи І. Кибальчича. Критичний аналіз різних точок зору виявив ряд чинників, які справляють негативний вплив на погляди вчених, що розглядають цей внесок. Серед таких факторів відзначаємо революційну діяльність Миколи І. Кибальчича, його участь у вбивстві царя, ідеологізацію його імені в контексті створення «корисного минулого» для радянської космічної програми, інтерпретацію його технічного проекту як незастосовного до ракетно-космічної техніки і т. п. Проведений аналіз і його обговорення дають підстави для відмови від використання таких суджень для оцінки інженерного внеску Миколи І. Кибальчича у розвиток ракетної техніки.

***Ключові слова*:** ракетно-космічна техніка, ракетобудування, історія космонавтики, видатні особистості: Микола Кибальчич.

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НИКОЛАЙ КИБАЛЬЧИЧ В ИСТОРИИ МИРОВОЙ РАКЕТНО-КОСМИЧЕСКОЙ ТЕХНИКИ: ДИСКУССИОННЫЕ ВОПРОСЫ ОТЕЧЕСТВЕННОЙ И МИРОВОЙ ИСТОРИОГРАФИИ

Статья посвящена истории ракетно-космической техники и дискуссионным вопросам относительно роли Николая И. Кибальчича в формировании принципов создания космических летательных аппаратов. Народоволец Николай И. Кибальчич, находясь перед казнью в тюремном заключении за участие в покушении на царя Александра II, разработал проект «воздухоплавательного прибора». В основу этого проекта он положил ракетодинамический принцип. Его проект считается одним из первых, если не первым проектом ракетной техники, открывающим возможность полетов в космическом пространстве. Однако, как показало наше исследование, такая точка зрения разделяется не всеми, кто изучает историю освоения космоса и ракетно-космической техники. В статье рассмотрены подходы и взгляды, представленные в различных источ-

никах, относительно роли Н. И. Кибальчича в истории ракетно-космической техники. Приведены оценки этой роли исследователями Украины, России, бывшего Советского Союза. Проанализированы взгляды на изобретение Николая И. Кибальчича и его роль в развитии инженерной мысли в работах европейских и американских ученых. Определены основне тренды альтернативных взглядов о проекте Николая И. Кибальчича. Критический анализ различных точек зрения выявил ряд факторов, оказавших и оказывающих негативное влияние на взгляды ученых, рассматривающих этот вклад. Среди таких факторов отмечаем революционную деятельность Николая И. Кибальчича, его участие в убийстве царя, идеологизацию его имени в контексте создания «полезного прошлого» для советской космической программы, интерпретацию его технического проекта как неприменимого к ракетно-космической технике и т. п. Проведенный анализ и его обсуждение дают основания для отказа от использования таких суждений для оценки инженерного вклада Николая И. Кибальчича.

***Ключевые слова*:** ракетно-космическая техника, ракетостроение, история космонавтики, выдающиеся личности: Николай Кибальчич.