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VYNOKUROV M.V. ON SCINETIFIC CONTRIBUTION OF THE CARRIAGE ROLLING STOCK: RETROSPECTIVE ASPECT

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ВИНОКУРОВ М.В. ЩОДО ВНЕСКУ ВЧЕНИХ У НАУКУ ПРО РУХОМИЙ СКЛАД: РЕТРОСПЕКТИВНИЙ АСПЕКТ

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The article covers the retrospective aspect of the history science and technology through the prism of the Professor views M.V. Vinokurov for researching activity of various scientists and engineers who made their contribution to the development of Ukrainian railways, in particular the science of moving glass, and nowadays have the scientific-theoretical and practical significance for transport. The experience of foreign countries, and above all, the USA, which influenced the views of domestic scientists in the field of carriage engineering, was analyzed. The factors of formation professor M.V. Vinokurov scientific concepts on the development science of rolling stock.

It has been found out that the domestic scientists fixed the high priority in developing of important theoretical positions on the rolling stock, created effective structures and individual units of the railway carriage.

The creation of new scientifically grounded sciences - construction mechanics and dynamics of a railway carriage, the founders of which is M.M. Belyaev, M.V. Vinokurov, V.Z. Vlasov, M.M. Davidenko, O.M. Dinnick, M.E. Zhukovsky, O.M. Lyapunov, M.I. Lobachevsky, Y.O. Paton, M.P. Petrov, I.V. Podzolov, S.V. Serensen, Y.S. Umansky, M.M. Filonenko-Borodich, A.A. Holodetsky, S.O. Chaplygin and others.

Mikhail Vinokurov, a well-known engineer of communications, a specialist in the field of rolling stock, participated in a series of experimental and theoretical research, theoretically substantiated the possibility of creating original and perfect in operation of rolling stock structures in the USSR and, in particular, in Ukraine.

List of works by M.V. Vinokurov for the application of new technologies in carriage construction is very impressive. The diverse activities of the scientist testify to the recognition of his authority in the scientific and administrative circles of the Ministry of Railways. Wherever he used his knowledge and qualifications of the engineer, these were the most important areas of state policy in the field of car-building and operation of rolling stock of railways.

Key words: *M.V. Vinokurov, scientists, scientific researches, dynamics, mechanics, rolling stock, carriages, car building*

Introduction. Nowadays the Ukrainian people are striving to return their historical heritage; therefore, our attention is attracted by problems connected with the history of national science and technology.

Since the time of railroad transport existence there was accumulated an extensive experience in the sphere of construction and operation of railways as well as the rolling stock. Based on this there appeared the national transportation science, in particular, the science of rolling stock. Many fundamental scientific studies have been conducted in Ukraine, which influenced the history of transportation science. *Mykhailo Vasyliovych Vynokurov (1890-1955)* is a vivid example among the founders of the science of rolling stock in our country: Doctor of Engineering Sciences, professor, general director of draft of the II rank, specialist in the field of constructions of railroad vehicles, dynamic interaction of rolling stock and track, a teacher and organizer of new course in the transport science [1, p. 543].

Statement of the problem. This topic has not been widely explored and there is only a reference to scientific research of M.V. Vynokurov as a highly skilled specialist in the field of rolling stock designs, implemented in separate scientific articles and referenced in monographs on the history of railway transport.

Analysis of recent research. There are very few special works in which the study of the development of the science of rolling stock and scientists who worked on it, among them are the works of O.L. Brodovsky, O.M. Solovyova, L.A. Shadura, M.O. Zenzinova, S.O. Ryzhaka, G.M. Kirpa, O.M. Pshin'ka, I.V. Agiyenko. Activities of professor M.V. Vynokurov are described only in encyclopedias.

Purpose of the article. Highlights of the retrospective aspect of the history of science and technology through the prism of the views of professor M.V. Vynokurov for the research activities of various scientists and engineers who made their contribution to the development of Ukrainian railways, including the rolling stock science, until now have scientific, theoretical and practical significance for transport. The factors of formation of professor M.V. Vynokurov's scientific concepts of the development of the rolling stock science are considered.

Presentation of the main research material including the full justification of the scientific results obtained. The outstanding scientist, founder and first head of the "Wagons" department of the Dnipropetrovsk Institute of Transport Engi-

neers[1], Mykhailo Vasyliovych Vynokurov, was a highly educated and talented person in mathematics, physics and industrial culture. While working at the Institute, he made a major contribution to improving the educational process and the development of science. He owns fundamental scientific works on the dynamics of the carriage of cars, calculation and design of the rolling stock components, and the operation of wagons [2].

Mykhailo Vasyliovych was a moderate person; he worked a lot as a public official, organizer of the educational process, and headed many experimental and theoretical researches. 1947-1955 – he was a member of the Academic Council at the Academy of Railway Transport. 1948-1955 – he worked as an editor-in-chief of the "State Transport Railway Publishing House", was the author of the 7th volume of "Locomotive and Carriage Economy", edition of the "Railroading Technical Guide" (total 13 volumes). Below stated is the contribution of individual scientists and the characteristics of their studies by Professor M.V. Vynokurov [3].

One of the founders of the rolling stock science in the former Russian Empire was Professor *Mykola Pavlovych Petrov (1836-1920)*. His scientific heritage includes more than 100 published works and articles, which deal with the problems of friction, traction of trains, the interaction of rolling stock and the upper structure of the track. Among the outstanding works of scientific and practical importance in the field of car building, his work on the hydraulic theory of lubrication should be considered.

M.P. Petrov's research "Friction in the cars and the lubricant's effect", made it possible to create rational constructions of the box and the box bearings, to choose lubricating oils for different nodes of the friction surfaces of the rolling stock depending on the conditions of their work [4].

Hydraulic friction theory, created by professor M.P. Petrov, laid the foundation for a series of research works of both domestic and foreign scientists. Among the works on the study of the theory of friction, it is necessary to highlight the scientific works by professor *Mykola Yegorovych Zhukovsky (1847-1921)* and *Sergiy Oleksiyovych Chaplygin (1869-1942),* who solved the problem of the thrust[2] movement in the bearing. Experiments were conducted to create typical designs of lubricating devices, among which the "lubricating pad"[3] was chosen as optimal [5, p. 35].

Many experiments were conducted by professor M.P. Petrov concerning the dynamics of rolling stock, which were highlighted in the following works: "Resistance of the train on the railway with the possible increase in the probability of traffic safety", "Dangerous train speeds", "Effect of the transverse velocity of the wheel on the tension in the rails," "Tension in the rails from the vertical the pressure of rolled wheels", "The pressure of the wheels on the railways, the strength of the rails and the stability of the track" and others.

By analyzing his works, M.V. Vynokurov wrote that in these scientific works professor M.P. Petrov first outlined the laws of the movement of railway cars and determined the working conditions of the upper structure of the track under the influence of the train's undercarriage. The practical question of the dynamic interaction of the wheel and the track remained open until the publication of the monograph by M.P. Petrov "Pressure of wheels on rails" [6, p. 292].

Professor *Anthoniy Adamovych Kholodetsky (1855-?)* also studied the dynamics of rolling stock. In 1898, he established that the railway vehicles, while passing the curves, occupy a position in which the guiding efforts are minimal. This law laid the basis to the modern theory of the inclusion of locomotives in the curve. In Germany, this law on curves was confirmed by professor V.I. Goyman only 15 years later.

Based on the work of professor A.A. Kholodetsky Professor *Pavlo Vasyliovych Koturnytsky (1844-1913)* in 1898 issued the original method of calculating strutted[4] carriage frames [7].

The valuable scientific contribution to the theory of springs, the creation of original structures of spring hanging, as well as studies on the smooth of movement by *Yegor Yegorovych Noltein (1854-1934),* who for the first time established the concept of transverse stability of wagons and determined its numerical value.

Professor Ye.Ye. Noltein proved the formula for determining the numerical value of such an important factor of smoothness of the course, as the relative friction coefficient in bolster springs. This factor is used in all calculations related to the smoothness of the carriage cars. A similar study in France conducted by Professor G. Marier [8].

Professor M.V. Vynokurov wrote that, with regards to calculations connected with the smoothness of the course, many of the findings of domestic scientists are set forth in US encyclopedias.

Professor *Mykhailo Volodymyrovych Gololobov (1870-1919)* in 1907 developed a method for calculating bolster springs and derived an exact formula for determining their deflection. In 1918, the formula based on this calculation was invented in Germany under the name "Witsig's formula".

As a result of experiments conducted by domestic scientists, methods for calculating bolsters and springs, important theoretical studies related to the issues of wagon construction technologies, the strength of car structures, smooth running of cars, improving the safety of traffic and determining the basic parameters of rolling stock.

Professor M.V. Vynokurov noted that during the creation and designing new cars it was always a very difficult and important problem to determine the magnitude of the external forces affecting the car during its operation. Moving car in the train is influenced by vertical and horizontal forces, and the latter act on the car both at the transverse along the track, and in the longitudinal directions. Under the influence of these forces, the car carries fluctuations, which can be significantly reduced by rational choice of parameters of spring hanging and the correct design of shock-relief devices. Along with these questions, there arise tangential questions of the strength of parts of the car, its longevity and safety of passengers [9, p. 24].

The original theoretical experiments of domestic scientists in the field of disturbing movements of cars made it possible to determine the quality and choose the optimal variant from among this or that type of spring mounting, and experimental research confirmed the theoretical results and gave a clear idea of the magnitude of the vertical and transverse horizontal forces acting on the body of the wagon. All this enabled us to confirm the strength of the existing and new carriages that were built and to ensure the safety of their movement.

[1] Dnipropetrovsk Institute of Transport Engineers is now called Dnipropetrovsk National University of Railway Transport named after Academician V. Lazarian.

[2] Thrust - part of the shaft or axle that comes in contact with the freighter and takes the load from the latter. The thrust is a kind of spike that is designed to provide a rotary movement.

[3] "Lubricating pad " - special devices for lubricating the crank axle of wagons, are widely used for the needs of rolling stock.

[4] Strutted frame - is an auxiliary structure that strengthens the beam in the plane of its bend, consisting of a strip, one or more racks inserted between the string and the bottom of the beam. It is intended to prevent the deflection of the middle part of the frame.

The degree of safety of motion and smoothness of the rolling stock can be determined according to the criteria set by the scientist *Oleksandr Mykhailovych Lyapunov* in his work "General issue of motion stability" (1892).

The scientific and correct elucidation of the issues related to the choice of briddle, the calculation of frames and body of wagons, the design of the longitudinal profile of the track and the management of heavy trains could only be in the case of deeply studied longitudinal train dynamics. Analyzing the domestic technical literature, we understand that this issue became of particular importance among our scientists, for example, the work of professor Mykola Yegorovych Zhukovsky "The work of Russian cross-cutting and American noncircular traction device when starting at the beginning of movement" (1919) [10, p. 31-67].

M.V. Vynokurov, analyzing this work, wrote about the significance of M. Ye. Zhukovsky's views, where he considers the efforts which arose in the devices of the through and separate screed during the starting and movement on a broken profile. Based on a number of his studies, he came to the conclusion that the traction power of the locomotive increases instantaneously and later remains constant if the train is composed of uniform and equally loaded cars. The resistance of the train in motion has not been taken into account.

Mykhailo Vasyliovych concluded that M.Ye. Zhukovsky gave an approximate performance of the task definition of force at a screw-thread, considering the train as an elastic rod with a load (locomotive) at one end, and also pointed out the ways precisely this task when considering the train as a system of solids, connected by elastic bonds [11].

Theoretical and experimental research on the longitudinal dynamics of the train were conducted by a group of scientific researchers, students and followers of professor M.V. Vynokurov at the Dnipropetrovsk Institute of Transport Engineers under the direction of Doctor of Engineering *Vsevolod Arutyunovich Lazarian (1909-1978)* [12; 13, p. 406-416].

In their studies, domestic scientists adopted the calculation scheme of the train, indicated by Professor M.Ye. Zhukovsky, in the form of an elastic rod. Also, the scientists considered the forces, speeds and displacements that arose in different parts of the train, made up of homogeneous and equally loaded cars, connected by a scattered screw or a railway coupling[5] with a monotonous or nonmonotonic increase in the traction forces of the locomotive.

M.V. Vynokurov stated that the research of domestic scientists makes it possible to determine the amount of effort in clamping devices when starting, during braking, the approach of the locomotive to the carriage and the riding of cars. The influence of fractures of the longitudinal profile of the gauge on the forces that arose in the trains' boarding gear was studied.

In France, the issue of longitudinal dynamics was studied by scientist *Anri Amé Rezal (1828-1896),* a French mechanic, mathematician, physicist and engineer, a member of the Paris Academy of Sciences (1887), a member of the Swedish Academy of Sciences (1887). In his work on the study of the process of movement during the train's starting, A. Rezal did not prove the analysis before obtaining formulas that would allow to deduce the efforts that have arisen in the gears, the speed and displacement of various parts of the train [14, p.141-145].

Experimental research conducted by domestic scientists questioned the strength, unreasonableness of the calculations of the American Rail Association (ARA), which was set during the design of cars. Not always samples of foreign technology fit our railways, based on the above example, and observing the current situation on the railways of Ukraine.

Professor MV Vynokurov found that at a voltage in different nodes of a car defined by ARA methods used in the US, this voltage differed significantly not only in magnitude, but sometimes in a sign from actual tensions.

As a result of use of inaccurate methods of calculation, many critical elements of the bearing structures were of low strength, and therefore cracks appeared, for example, belt strikes were formed in the bogie bogs, as well as cracks

occurred in other nodes, mainly in the back frames, slopes of frames and walls of tanks.

Domestic scientists have created new scientifically grounded branches of science - building mechanics and dynamics of a car, among them M.M. Belyaev, M.V. Vynokurov, V.Z. Vlasov, B.G. Galerkin, M.M. Davydenko, O.M. Dynnyk, M.Ye. Zhukovsky, O.M. Krylov, O.M. Lyapunov, M.I. Lobachevsky, Ye.O. Paton, M.P. Petrov, I.V. Podzolov, S.V. Serensen, Ye.S. Umansky, M.M. Filonenko-Borodych, A.A. Holodetsky, S.O. Chaplygin and others [15].

Among the theoretical works that laid the foundation for the science of rolling stock, there should be included the work of *Mykola Mykhailovych Belyaev (1890-1944)*, who for the first time studied the tense state at the point of contact of the bandage with the rail, which allowed to highlight the difficult issues of the metal bandage and rails. This fundamental work has been recognized throughout the world.

Professor *Oleksandr Vasyliovych Makhov (1889-?)* studied the work of the car axles. He substantiated the need for a 100% introduction of the heat treatment of the axis after the forging, which was introduced for the first time. Professor Makhov correctly figured the real connection between the so-called "austenitic grain size" and the properties of the axial metal and conducted comparative, so-called "transshipment experiments", to determine the possibilities of different axial steel grades to work partly at significant overloads. Also O.V. Makhov for the first time has established the value of the impact viscosity for the axes.

Professor *Mykola Petrovych Shchapov (1896-1968),* working in the field of steel research for cars manufacture, has established the qualitative characteristics of its increased strength, which made it possible to reduce the weight of the car and increase its strength.

Professor *V.A. Kysliak* found the characteristics of steel for wheels and bandages of cars. The conclusions from these experiments for the first time made it possible to determine the influence of chemical composition, thermal treatment and mechanical properties on the stability of wheels and bandages in operation.

Professor M.V. Vynokurov analyzed the studies of domestic scientists about antifriction alloys for car bearings and their thermal treatment.

Based on theoretical and experimental experiments, professor *Oleksiy Oleksandrovych Popov (1905-1966)* proposed more precise methods for determining the tension in the car axles, bands, hubs, knives and rims of the wheel center.

During this period, experiments were also carried out on the strength of the forging of car wheel centers. Professor *M.P. Zobnin* investigated the strength of the carriage wheels as a collective responsible knot of the press connections of the axes. He established the presence of plastic deformations in the spokes of the car centers, proposed methods and regimes to improve the quality of the surface to be tightened [16].

M.V. Vynokurov wrote that foreign designers considered the frame of passenger carts as a construction consisting

[5] Railway coupling CA-3 - an automatic coupling device for connecting units of rolling stock among themselves, was used on the railways of the USSR, Mongolia, Iran and Finland

of separate longitudinal and transverse beams, connected by joints.

In his view, such a simplified method did not make it possible to determine the actual stresses in the various elements of the frame, so the sides of the carts were heavy, but not strong.

In the years 1934-1936, based on the study of the reasons for the appearance of cracks in the carriages of subway types "A" and "B" cars, scientists concluded that the need to consider the so-called "skew-symmetric"[6] loads of frame frames caused by deviations in the rigidity of the bolsters and springs, as well as the inequalities of the track. It was then that the domestic experts proposed for the first time an accurate method for calculating the frames of a telescopic system, taking into account skew-symmetric loads.

Particular attention is paid to theoretical studies conducted in the field of the strength of cars by professor *Borys Mykolayovych Gorbunov (1901-1944)* of the Ukrainian Academy of Sciences (formerly the Soviet Union). In this paper, based on the theory of calculation of thin-walled rods, created by professor *Vasyl Zakharovych Vlasov (1906-1958)*, the refined theory of calculating frames from thin-walled rods is given, taking into account the elastic deformation of nodes.

This theory with exhaustive completeness gives an opportunity to explain the appearance of cracks in the car frame designs and to give a correct assessment for new car designs.

For an accurate calculation method, Professor Gorbunov in his work "Approximate methods of calculating frames" proposed these methods for frames of thin-walled profiles. Such a method took into account the spatial effect of the induced loads, in addition to the deflection, there was also scrolling of the rods, which was accompanied by significant additional stresses. The tensions, which were determined by the approximate method, were based on the result of precisely sufficient for practical purposes [17].

M.V. Vynokurov pointed out that, analyzing the technical literature of Western Europe and the United States, he used only domestic sources for the methods of calculating the complex frame structures of cars and trucks, as well as in the field of calculating tanks of tanks, because they were introduced for the first time.

Using the method proposed by professor Vlasov, which made it possible, through the calculation, to fully determine the tension in the tank resistance zone, as well as to select the optimum wall thickness in the area of the supporting surfaces.

Leading a large number of theoretical and experimental experiments in this area of study, professor M.V. Vynokurov denied the calculation methods adopted in the US for the design of metal passenger cars.

He points to the false assumptions that longitudinal forces in a passenger metal carriage are perceived by the back frame. An example of this is theoretical studies that have proven that a significant part of the longitudinal effort is perceived by the body and the removal of the back frame from the middle of the car will slightly affect the changes in the magnitude of stresses in the walls, floor and roof of the body, therefore the basis of all structures should be a longitudinal set, unlike transverse. Replacing the transverse to longitudinal allows you to lower the deadweight and simplify the technology of manufacturing the body. The conducted experiments proved the optimality of the methodology for calculating metal wagons and allowed the creation of an original design of a domestic car with an autocrane, but without a back frame.

[6] Skew-symmetry (antisymmetry) is the property of a mathematical object, which is a function of several arguments, to change a sign (get a multiplier -1) by rearranging any two arguments.

Professor M.V.Vynokurov himself was engaged in and analyzed the works of various researchers, who, in addition to the field of construction mechanics, achieved a lot and created a new science - "the dynamics of cars." It is noted that in the foreign technical literature, such questions were raised very little.

In this process, the main issues of the dynamics of wagons are considered, as well as the exceptional importance was paid to the smooth running of cars and increased traffic safety.

Domestic scientists have developed a method for selecting the parameters of the car, which allowed to determine its optimal size.

Our railways came from Mytyshchynsk and Kryukivsk Rail-Cart Manufacturing Plants. During the study of a number of new welded structures, scientists created the perfect original structures of the car frame middle node - the so-called "nodes with piercing." In this node, the ends of the transverse beams were passed through the cuts made in the inner and outer walls of the beam sidewalls, with which they were carefully welded along its perimeter.

For structures for underground cars and rail transport there were used stamped sheet steel parts, which were formed to fit for connecting them with each other by welding. The advantages of stamping and welding have led to significant weight relief in contrast to cast structures.

M.V. Vynokurov pointed out that in 1931, as a result of attempts to remove balancers in the "Fette" carts and replace the riveting with welding, an unbalanced trolley appeared. The same year, the "Khanin's bolsterless bogie" was released. Later, in these series of trolleys introduced wedge-type shock absorbers, which gave the possibility of smoother movement of the car, which was not inferior to the quality of the carriage of cars on the carriages with other, more complex structures of shock absorbers.

We consider the widespread use of welding in wagon construction as the world-renowned contribution to the creation of original and perfect structures of rolling stock. Our scientists not only invented welding, but also for the first time in the world began to use it in wagon construction. As a result of the introduction of welding in the wagon construction, there were produced wagons with significantly lower deadweight and higher load carrying capacity, more passenger-sized, and passenger welded trolleys from rolling mill stamps of perfect original designs, are significantly less heavy than cast frame ones of all other railways in the world.

The introduction of welding works into the carriage of construction was carried out by the Institute of Welding of the Academy of Sciences of Ukraine, headed by academician *Yevgen Oskarovych Paton (1870-1953).* He proposed the original design of a tank in which the automatic welding was used [18, p. 175-201].

Also, domestic scientists under the leadership of E.O. Paton were carried out the tasks to reduce the weight of cars. The container of the improved car of conventional steel had a weight of 2 tons less than that of conventional cars. A cohort of scholars also developed metallic cars made of low-alloy steel.

Conclusions. Mykhailo Vasyliovych wrote that the domestic scientists set a high priority in the development of important theoretical positions on the rolling stock, created effective constructions and individual units of the car.

Professor M.V. Vynokurov argued that the design of passenger cars in the former Soviet Union, Western Europe and the United States was based on completely different principles.

Based on his works, the rules of designing cars of foreign countries were different, in particular, in the United

States there was laid the principle of preservation in the wreck of the car, and not the actual life of people. Therefore, too rigid body designs were used there, resulting in very strong jolts during the collision, in which passengers could not stay in their seats and retreated with great acceleration to the walls or partitions of the body, which led to terrible consequences.

The basis of the design standards for domestic wagon structures was primarily the concern for people and the predictability of this concern in dangerous moments. Consequently, there was high importance of ensuring the safety of travel through the creation of a safe deformation for the car, which prevented the car body from breaking down, resulting in a significant reduction in the acceleration during collision. In accordance to this provision, the elements of the body and frame were designed. These elements were estimated for the corresponding load and had to absorb the dangerous energy during wagons collision.

Therefore, it is now important to conduct a retrospective analysis during the state-building period in our country, we should not focus on western or eastern tendencies, which, as practice in the field of rolling stock showed, did not meet their own expectations, but we should look for their own priorities.

Mykhailo Vasyliovych Vynokurov set up the science about cars and made a significant personal contribution in the area of modern Ukraine. His textbook "Cars" (1949) for professionals and students is in tremendous demand. We have the opportunity to trace that all scientific research in the field of rolling stock in Ukraine and abroad is based on the fundamentals of his works.

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Устяк Н.В. Винокуров М.В. щодо внеску вчених у науку про рухомий склад: ретроспективний аспект.

У статті висвітлюється ретроспективний аспект щодо історії науки і техніки через призму поглядів професора М.В. Винокурова на дослідницьку діяльність різних учених та інженерів, які зробили свій посильний внесок у розвиток українських залізниць, зокрема й науки про рухомий склад, і нині мають науково-теоретичне і практичне значення для транспорту. Проаналізовано досвід зарубіжних країн, і передусім США, що впливав на погляди вітчизняних учених у галузі вагонобудування. Розглянуті чинники формування професором М.В. Винокуровим наукових концепцій щодо розвитку науки про рухомий склад.

З'ясовано, що вітчизняні вчені закріпили високий пріоритет у розробках важливих теоретичних положень про рухомий склад, створили ефективні конструкції та окремі вузли вагона.

Визначено створення нових, науково обґрунтованих наук – будівельна механіка і динаміка вагона, основоположниками яких є М.М. Беляєв, М.В. Винокуров, В.З. Власов, М.М. Давиденков, О.М. Динник, М.Є. Жуковський, О.М. Ляпунов, М.І. Лобачевський, Є.О. Патон, М.П. Петров, І.В. Подзолов, С.В. Серенсен, Є.С. Уманський, М.М. Филоненко-Бородич, А.А. Холодецький, С.О. Чаплигін та інші.

Михайло Васильович Винокуров – відомий інженер шляхів сполучення, фахівець у галузі рухомого складу, брав участь в проведенні низки експериментальних і теоретичних наукових досліджень, теоретично обґрунтував можливість створення оригінальних і досконалих в експлуатації конструкцій рухомого складу на теренах СРСР і, зокрема, в Україні.

Список праць М.В. Винокурова щодо застосування нових технологій у вагонобудуванні дуже вражає. Різноманітна діяльність ученого свідчить про визнання його авторитету в наукових і адміністративних колах Міністерства шляхів сполучення. Де б він не застосовував свої знання і кваліфікацію інженера, це були найважливіші сфери державної політики в галузі вагонобудування та експлуатації рухомого складу залізниць.

Ключові слова: *М.В. Винокуров, учені, наукові дослідження, динаміка, механіка, рухомий склад, вагон, вагонобудування*

Устяк Н.В. Винокуров М.В. по поводу вклада ученых в науку о подвижном составе: ретроспективный аспект.

В статье освещается ретроспективный аспект по истории науки и техники через призму взглядов профессора М.В. Винокурова на исследовательскую деятельность различных ученых и инженеров, которые сделали свой посильный вклад в развитие украинских железных дорог, в том числе и науки о подвижном составе, и сейчас имеют научно-теоретическое и практическое значение для транспорта. Проанализирован опыт зарубежных стран, и в первую очередь США, которые влияли на взгляды отечественных ученых в области вагоностроения. Рассмотрены факторы формирования профессором М.В. Винокуровым научных концепций по развитию науки о подвижном составе.

Выяснено, что отечественные ученые закрепили высокий приоритет в разработках важных теоретических положений о подвижном составе, создали эффективные конструкции и отдельные узлы вагона.

Определено создание новых, научно обоснованных наук – строительная механика и динамика вагона, основоположниками которых являются Н.М. Беляев, М.В. Винокуров, В.З. Власов, Н.Н. Давиденков, А.Н. Динник, Н.Е. Жуковский, А.С. Ляпунов, М.И. Лобачевский, Е.О. Патон, Н.П. Петров, И.В. Подзолов, С.В. Серенсен, Е.С. Уманский, М.М. Филоненко-Бородич, А.А. Холодецький, С.А. Чаплыгин и другие.

Михаил Васильевич Винокуров – известный инженер путей сообщения, специалист в области подвижного состава, участвовал в проведении ряда экспериментальных и теоретических научных исследований, теоретически обосновал возможность создания оригинальных и совершенных в эксплуатации конструкций подвижного состава на территории СССР и, в частности, в Украине.

Список работ М.В. Винокурова по применению новых технологий в вагоностроении очень впечатляет. Разнообразная деятельность ученого свидетельствует о признании его авторитета в научных и административных кругах Министерства путей сообщения. Где бы он ни применял свои знания и квалификацию инженера, это были наиболее важные сферы государственной политики в области вагоностроения и эксплуатации подвижного состава железных дорог.

Ключевые слова*: М.В. Винокуров, ученые, научные исследования, динамика, механика, подвижной состав, вагон, вагоностроение.*

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