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The contribution of Academician I. H. Aleksandrov to the construction of railways and bridges

Abstract. *One of the most important tasks of the modern history of science and technologies is the study of the activities of leading scientists and practitioners of the past, the influence of their ideas on the development of world science and the process of training specialists in the relevant sectors of the national economy. In the opinion of the authors of the article, one of such figures of the early twentieth century is Academician I. H. Aleksandrov. Historical and scientific analysis of life and activity of I. H. Aleksandrov as a scientist, engineer, organizer of science is of high topicality due to the scale and versatility of his scientific contribution. In the context of the development of hydro-engineering and hydropower, the development of transport communications, I. H. Aleksandrov had world-class achievements that glorified national science. Scientific creative work of I. H. Aleksandrov can be divided into five main directions of development of science and technologies: hydro-engineering, hydropower, geographic zoning, railway transport and irrigation. The construction of the Dnipro hydroelectric power station near Zaporizhzhia (1927-1932) (he prepared a project and directed the construction of the largest hydroelectric power station in Europe at that time), the development of the general plan for the electrification of the USSR (compiled projects of electrification of Central Asia and Eastern Siberia), participation in the construction plan Baikal-Amur railway line, development of the methodology of economic zoning of the Soviet Union and the theory of railway "super-*

mainlines" can be ascribed to the academician. The article concludes that the highly qualified teaching staff of the Moscow Higher Technical School and the Moscow Engineering School of the Office of the Ways of Communications contributed to the thorough theoretical training of a young engineer I. H. Aleksandrov. On the basis of a significant number of sources it was found that occupying different positions, I. H. Aleksandrov participated in solving complex technical issues of contemporary epoch, and scientific research was carried out by I. H. Aleksandrov in the context of the tasks of the engineering science of his time. I. H. Aleksandrov initiated scientific discussions on the construction of ports and canals, in his work he contributed in every way to the development of home industry and the introduction of progressive forms of transport, in particular railway. The authors assert that the modern view on the scientific heritage of I. H. Aleksandrov in the context of the development of hydro-engineering, hydropower and rail transport unambiguously acknowledges that in a concentrated-generalized form ideas, theories and concepts, put forward and scientifically grounded by academician I. H. Aleksandrov, today contribute to the development of scientific and technological process.

Keywords: *I. H. Aleksandrov; railway construction; railway bridges; railway transport; railways; railway machinery*

Introduction

Investigation of the life and activities of Academician I. H. Aleksandrov was mainly carried out by historians without the use of a "technical" toolkit, which objectively made it impossible to consider in full the work of I. H. Aleksandrov in the context of the history of home hydro-engineering and hydropower. There were no exceptions to the study of a few engineers who studied the scientific work of I. H. Aleksandrov. Therefore, the vast majority of publications about the scientist has a pronounced historical, ethnographic, literary-journalistic or popular science features. Besides, the main achievements of academician I.H. Aleksandrov are called only the development of the project and the construction of the Dniprohes and the creation of the theory of economic zoning of the USSR. We argue that the scientific contributions of Academician I. H. Aleksandrov are much bigger and more powerful.

Thus, 1901-1912 in the life and activities of I. H. Aleksandrov is characterized mainly by railway engineering projects (various man-made structures for the Orenburg-Tashkent railway, projects of engineering structures for the lines of Simbirsk-Ufa and the Central Amur Railway, the bridges across the Matyra, the Finnish bridge, Starytskyi bridge, etc.). In 1920-1925 I. H. Aleksandrov developed a draft of the Demuryno-Marhanets high-speed railway, proposing the use of electric traction. During 1921-1923 I. H. Aleksandrov was the head of the regionalization section and chairman of the Commission on new types of transport of the State Planning Committee of the USSR. In 1931 he proposed the idea to construct the Baikal-Amur high-speed railway. In 1932 he was a member of the Scientific and Technical Council of the People's Commissariat of Railways (NKPS) of the USSR. As Chairman of the Transport Commission of the Academy of Sciences of the USSR

I. H. Aleksandrov defended the development of the railway (the construction of locomotives, the introduction of electric traction and the development of rolling stock for various purposes), automobile, river, aviation transport, pipelines, and the construction of seaports.

In addition, the academician's papers include scientific articles, which indicate that in the area of his scientific and engineering interests there were urgent issues of rail transport development.

Research methods

The methodological basis of the work comprises the scientific principles of research, such as objectivity, historicism, systemic, complexity (Pylypchuk & Strelko, 2017; Pylypchuk & Strelko, 2018a; Pylypchuk & Strelko, 2018b). The principles of objectivity and that of historicism enable consideration of the studied historical events in their interrelation and development, giving the grounds to a comprehensive analysis and reliable assessment of historical facts. The application of the systemic method to the work allowed investigating comprehensively the achievements of I. H. Aleksandrov in the field of railway and bridge construction.

Results and discussions

At the turn of the XIX-th and XX-th centuries, a large railway network in the Russian empire, surpassing the network of any European country, as well as the largest in the world along the length of the railways, the availability of a number of technical advances showed a relatively high level of rail transport development in Russia (Kharlanovich, 1994, p. 132). In the 1890s there was an industrial upsurge in the country and at the same time the second rise in railroad construction. Between 1890 and 1900 more than 21 thousand miles of new railway lines were built. The length of the railway network, which amounted to 29,400 km in 1889, grew in 1900 to 50,700 km, i.e. in 60%. A number of railways were built in the Volga region, in black-soil provinces, in the north, in the Trans-Caucasian region. In the 1880s, the Trans-Caspian Railway was built in hard natural conditions, through a sandy desert. Since 1900, research had been carried out, and then the construction of the Orenburg-Tashkent railway with a length of 1852 km was initiated. In 1909, for goods transportation from the ports of the Caspian Sea, the Astrakhan-Red Corner line was put into operation deep into the country. At the same time, a railway line 236 km long from the Armavir station to Tuapse was built. In 1891 the construction of the Great Siberian Road from the Urals to the Pacific Ocean began (Soloveva, 1975).

In the 1890s fast-growing industry influenced the development of railroading in the Russian empire and provided the railways with the necessary equipment. In 1900, the number of locomotives increased to 12.6 thousand, freight wagons – up to 290 thousand and passenger cars – up to 16.4 thousand (Mokrshytskyi, 1941). Since the '80s of the XIX-th century, the role of the state in the development of rail transport was getting stronger. The policy of governmentalization of railways was carried out all around the country: firstly, new railways were built at the expense of the state, and

secondly, private railways were bought up by the government. From 1881 to 1900, 37 private railways were bought out, including the railways of the Main Society of Russian Railways. By 1912 about 70% of the network of main railways was "in the hands of the state treasury" (Vykup Yuho-Zapadnykh zheleznykh doroh, 1906, p. 81-83).

In 1885, the Statute of Russian Railways was approved, which regulated the activities and responsibilities of the railway administration (Khadonov, 1998).

Since the late 80's of the XIX-th century, railways management in Russia was carried out by three agencies: the Ministry of Railways (MSS), the Ministry of Finance and State Control. In the MSS there was concentrated all the administrative management of state railways, under its jurisdiction the technical, operational and economic aspects of the railway were. In 1892 in the MSS there was created the Engineering Council, which was involved in the development of technical specifications for the construction of railways, railway projects, estimates, feasibility studies, etc. (Salov, 1908).

The huge rise of railroad construction, the commissioning of new railway lines served as a powerful impetus for the further development of the metallurgical and machine-building industry, for economic and trade relations with other countries. Thus, at the end of the nineteenth and early twentieth century, the construction of railways in the Russian Empire had become large. And this had led to the need for the construction of many metal bridges. By that time home engineers had gained extensive experience in the design and construction of bridges and systematization of their technical solutions (Zenzinov & Ryzhak, 1978a). At that time, an independent branch of construction machinery was formed as well, in which a special role was given to building mechanics development: bridge designing and erecting.

However, before being actively involved to this process Ivan Havrylovych Aleksandrov had gone a long way. In the Moscow Technical College (today it is the Moscow State Technical University named after M. E. Bauman), in which the young I. H. Aleksandrov, lectures were delivered by Yevhen Oskarovych Paton, at that time, a young professor. He was a well-educated engineer, an outstanding connoisseur of bridge construction, theoretical and practical construction mechanic engineering (Zenzinov & Ryzhak, 1978b). Over time, I. H. Aleksandrov and Ye. O. Paton established friendly relations during their joint work on the design and construction of large bridges. That is, in 1896, in the third year of the technical school, I. H. Aleksandrov took a great interest in bridge construction and decided to devote all his life to this. In 1898, Ivan Aleksandrov moved to the Moscow Engineering School, which in a few years was renamed the Moscow Institute of Railway Engineers. The course in this school was designed for 5 years: three years of theoretical studies and then two years of practical training on a railway. The theoretical course of the mentioned engineering school I. H. Aleksandrov completed in 1901. The practice took place at the construction of the Orenburg-Tashkent railway, where he was engaged in drainage problems solving and designed road structures: bridges, viaducts, and later on he directed their construction.

In 1903, after ending his practical training, I. H. Aleksandrov returned to Moscow. He submitted a detailed report of his work practices and, after its defence, received a diploma certifying his approval as a civil engineer. Just-graduated engineer I. H. Aleksandrov went back to Central Asia, where during 1904 he worked in the Office of the section on the construction of the Orenburg-Tashkent railway (the office was located at the station Turkestan). In 1905 when his work contract on the railway construction finished, I. H. Aleksandrov returned to Moscow and restarted his work under the leadership of Ye. O. Paton on designing large bridges. Together they developed some issues of construction equipment; in particular, they were seriously engaged in calculating the dependence of additional stresses on the stiffness of riveted nodes of bridge farms (Zenzinov & Ryzhak, 1978c).

Works by I. H. Aleksandrov in the field of bridge construction (construction of poles and runways) have undoubted interest till now and reflect his work as a talented practical engineer. Although among other engineering works by I. H. Aleksandrov they are a small volume, their value is quite large. It is I.H. Aleksandrov who introduced into the practice the landing for collecting runways, wooden portal cranes, which were used in bridge construction as long as the middle of the XX-th century. He created many projects for light pedestrian bridges, various railway bridges of small, medium and large runs, a number of racks, caissons for erecting bridge supports, etc. In general, I. H. Aleksandrov, working on the construction of certain railroads, being at the very young age, carried out projects and participated in the erection of more than two dozen original structures, in the functioning of which the reliability, simplicity, and clarity of the schemes were closely linked, lower complexity of manufacturing and erection compared with the bridges of previous years and others designs.

To select the system of the runway structure to be built I. H. Aleksandrov in his projects necessarily took into account the production and economic characteristics of construction: the complexity of manufacturing and erection, weight, transportation, etc. Based on the works of well-known Russian bridge builders, I. H. Aleksandrov made a significant contribution to this field with his innovative work. Ivan Havrylovych not only designed but also supervised the work on the manufacture of metal structures of runways, various devices, and mechanisms for servicing all the operations for the creation of caissons for the erection of bridge supports. The construction of railway bridges and railway overpasses by I. H. Aleksandrov is worth particular mentioning. Thus, until 1906 there was the construction of the Orenburg-Tashkent railway, where, according to the projects by I. H. Aleksandrov, several bridges and many other structures were built (Sybyrskaia tsentralnaia zheleznaia doroha, 1889).

The discovered materials allow us to consider the participation of I. H. Aleksandrov in the development of bridge structures for artificial premises on the Orenburg-Tashkent railway, bridges across the Neva, the Moskva and the Volga rivers. On the specified railway line, based on local conditions (the width of water obstacles, the presence of an intersection with the roads, geological conditions) the

main practice was to design bridges of small runs in the form of cut-out beam systems. This determined I. H. Aleksandrov's choosing the appropriate constructive decisions on runway bridges. The operation of these runways is characterized by an analysis of the interaction of those real forces (in the form of the effect of a constant load on the weight of the railroad, and of temporary loads, on the re-variable load, as well as on a uniformly distributed load) that are created while the train movement and are taken into account in the calculation the "effort" scheme. These "forces" are perceived by the cross section of the metal main bridge trusses in the form of bending moments and transverse and longitudinal forces. I. H. Aleksandrov, considering the development of cut-out beam systems of bridges in the nineteenth century, noted that they were simplified for the purpose of "successful" manufacturing. That is, aesthetic considerations dictated the use of these systems to obtain "clearer and more common lines" of different forms of bridges.

Of course, I. H. Aleksandrov in his research relied on the scientific and engineering concepts and engineering practices of predecessors. So, developing the heritage of M. A. Beleliubskyi in the field of bridge construction, I. H. Aleksandrov at the beginning of the XX-th century unified the runway bridges. For small bridges from 7.2 to 19 m long there were unified cutting beam designs with a solid wall height of 0.92-2.3 m, with the "top" movement; with lattice farms with a height of 2.8 m at runways 19-21 m. In these runways, the bridges of two main unified beams (or trusses) of cross-sectional construction were "split" with lumbar vertical and longitudinal horizontal ties.

From 1905 to 1910, I. H. Aleksandrov, besides solving other problems, was actively involved in the design of railways and bridges. In particular, he took an active part in the development of the Orenburg-Tashkent railroad project, a number of bridges (the Finnish bridge over the Neva, the Borodino bridge in Moscow, the Starytskyi bridge over the Volga, etc.). Since 1912 scientific and engineering interests of I. H. Aleksandrov moved on to study irrigation problems, he developed projects for the construction of irrigation canals in Central Asia, which actively began to be used already in the soviet period.

The first large bridge with the participation of I. H. Aleksandrov was built in 1910-1912 in St. Petersburg (engineers M. A. Beleliubskyi, H. H. Kryvoshein, I. H. Aleksandrov, architect V. P. Apiskov, assistant engineer M. A. Chystiakov) and it was called – Finnish Railroad Bridge. The pedestrian movement on this bridge was forbidden. The design type is an arc with "bottom" traffic, a metal one, of seven runs, the main run up to 44.7 m, the total length of 1139 m. It is interesting that the bridge had two railway tracks (Bunin, 1986).

History shows that St. Petersburg at that time along the entire course of the Neva began to be systematically built up by large bridges. Among the large bridges across the Neva – Liteinyi, Troitskyi, Okhtynskyi – the Finnish bridge was built on the order of the announcement of the competition. The design of this bridge was absolutely in line with the high technical requirements of the time; its design was executed in a modern style. Cross-through arches with a tightening motion, "bottom" traffic and a

split run in the middle of the bridge are very favourably distinguished from other bridges. Thus, the bridge design reflected that time fashion: addiction of the combined systems and was executed in a clear engineering spirit. The Finnish bridge had seven arched runs. A significant increase above the river banks and the need to eliminate the level crossroads required the construction of a reinforced concrete rack – one of the first buildings of this kind. Externally, the bridge looked "heavy", but the approach used in its construction became a bold innovative solution. Today, after reconstruction, this bridge consists of 4 identical runs of 100 m each, in the form of arches with "bottom" traffic, two coastal runways and a split bridge in the middle. On the left bank, the entrance to the bridge passes by a railway multi-run overpass (built in 1911-1923 by a Danish company), on the right – a metal overpass. The engineering principles adopted in this bridge also influenced the system of the last of the city bridges constructed at the same time, and in this construction, the advantage was given to the beam-indistinguishable cross-section system with the lower curvilinear belt (Kochedamov, 1958).

In its constructive and compositional solution, the Finnish bridge is similar to Velykookhtynskyi. The construction of the Finnish bridge was repeated: the railway bridge across the Daugava in Ryha, it also resembles the famous one-run arched bridge in Sydney (Australia). For some time this bridge was called "New", and subsequently it became known as the "Finnish" because the bridge was built mainly on the funds of the Grand Duchy of Finland, which connected the Finnish railway with other railways of the Russian Empire.

We believe that the participation of I. H. Aleksandrov in the construction of such a significant bridge across the Neva River in St.Petersburg is a great achievement by a young engineer. This bridge made I. H. Aleksandrov's name well-known in the engineering world. Actually, this became another success I. H. Aleksandrov in the construction of large bridges. Thus, in the years 1911-1912 in Moscow, through the river of the same name the iron arches of the Borodino and Novospaskyi bridges began to be built (Nosarev & Skriabyna, 2004). The competition announced on the draft of anniversary Borodino Bridge, involved the best specialists of the time. Particularly interesting were several projects. Thus, one of the bridges in three runs, very successfully decorated in the memory of the Battle of Borodino, belonged to academician H.P. Prederii. Another project by engineers H. H. Kryvoshein and I. H. Aleksandrov, architects V. O. Pokrovskyi and Ye. I. Konstantinovych had four runs, emphasizing the national character of this monument, reviving the traditions of the famous builders of the Great Stone Bridge in the forms of the national stone architecture. Unfortunately, these and other, not less interesting projects were not implemented.

I. H. Aleksandrov took an active part in the construction of bridges in other cities and on ordinary roads. The widespread of metal bridges of various types are characteristic for the end of the XIX-th and the beginning of the XX-th century. At the beginning of this period, there were still trends in the construction of cast iron arches. But gradually the leading role was taken over by the iron beam farms that were

"transported" to the city from the railways, where they had long been used on a large scale. A number of city bridges of cantilever-beam type with a "bottom" traffic were being built. These include bridges in cities Pskov, Novgorod, Kyiv, Saratov, bridge projects for Nyzhnii Novgorod, Irkutsk and other cities.

From the beginning of the twentieth century, the massive construction of bridges from reinforced concrete was promoted by M. A. Beleliubskyi (Komech, et al., 2012). The beginning of this process was the construction of regional and local bridges in the territory of modern Ukraine. In the majority, these were bridges of a very simple beam construction without claims to the "high" architecture, but inexpensive and easily built. They represented the interpretation of wooden bridges in reinforced concrete, had original split icebreakers, but were primitive in shape. Subsequently, reinforced concrete was widespread to the railway structures. For instance, on the Kruglobaikalskaia railroad, all bridges, except for the big ones, were built of reinforced concrete. Some of them even now have a very picturesque look.

I. H. Aleksandrov also joined the process described. He is the author of the magnificent Starytskyi Bridge, built in the town of Starytsia, a small and obscure town on the Volga, 65 kilometres from Tver (Prokofev, 1965, p. 312-319). It is noteworthy that the construction was carried out at the same place, which in 1912 the military engineer, professor H. H. Kryvoshein and a young engineer I. H. Aleksandrov offered to the city authorities. But their proposed project was never fully implemented. However, in the old photographs, we see a bridge, somewhat similar to the modern one. The modern look of this bridge built in 1963 is impressive. There is definitely a lot for its design taken from the project by .H. Aleksandrov. The old bridge by I. H. Aleksandrov had served exactly 50 years.

For medium and large runs I. H. Aleksandrov developed unified run-off structures with a length of 36-85 m with grating main farms, with "bottom" traffic. Horizontal bonds took place on the upper and lower bridges belts, on the supporting slopes were assembled portal links – frames; the upper and lower belts of the main farms were executed as two-walled. Thus, the projects of such bridges by I. H. Aleksandrov became examples of a successful combination of the simplicity of the scheme of construction, improvement, and clarity of the lines of the bridge, the rationality of the intersections of all elements and nodes of the structures. The reflection of all the elements of the bridge design allowed to achieve a reduction in its labour capacity during the factory's production. This project was implemented during the construction of dozens of bridge crossings (Starytskyi most, 2016).

Bridge systems by I. H. Aleksandrov became traditional. By now, in the railway bridge construction, continuous beam-wall schemes of metal runways and triangular truss frames continue are to be used. The standardization of the cross sections of such grating farms in a welded version allowed the engineers to resolve the issue of the restoration of the country's railroads after the Second World War as soon as possible. As a permanent consultant in the trust of Stalmist and its divisions – Giprostalmist and the Main office of assembling works – I. H. Aleksandrov studied in detail the rationalization proposals put forward to his consideration. Contemporaries were

impressed with engineer I. H. Aleksandrov's skills to sort out the merits of the proposal and quickly compare the rationality of the proposed design change to the one that was usually used. A brilliant page of home bridge construction is the work during the industry recovery after the Civil War.

From the beginning of his engineering activity, I. H. Aleksandrov worked a lot and fruitfully at all stages of bridge construction. Restoring the destroyed railway bridges became an even more difficult task than building new ones. Each demolished runoff required the use of an individual approach and recovery methods due to the individual nature of the destruction. The acute shortage of metal made it necessary to make a correction for the large volumes of work on the replacement of crushed metal in place. The largest volumes of assembling works I. H. Aleksandrov had to perform in the recovery period after the first world and civil wars, as well as in subsequent years after these periods. At that time, most runs of railway bridges were restored. I. H. Aleksandrov introduced original and at the same time simple and highly effective methods to carry the works out in the conditions of lack of skilled workers and engineers and technicians, and lack of equipment, acute shortage of steel and metal rolling.

I. H. Aleksandrov united around himself gifted engineers, workers and led the specialists to build every bridge, created an organizational "core" of a team of soviet metal assemblers. During this period, the accumulation of experience in the reconstruction of bridges was accompanied by the training of personnel and the creation of a park of new assembly equipment. This was the most important and effective stage in the creation of a school of home metal assemblers.

Conclusions

Within an article, we do not have the opportunity to describe enormous I. H. Aleksandrov's contribution to the restoration of bridges. But each of the reconstructed bridges was unique in terms of the nature of the destruction, and it was necessary to find individual solutions and devices for its restoration. It should be noted that the reconstruction of railway bridges, which was carried out in Russia and in the soviet union during the Civil War and in the years after its completion, occurred during the years of devastation and acute shortage of metal, in the absence of the necessary mounting mechanisms. In a difficult environment, it was also necessary to solve food issues, baking bread, finding shelter for workers, and so on. It was a brilliant period in the activity of I. H. Aleksandrov. Here he manifested himself as a great organizer. A team educated by I. H. Aleksandrov accumulated great skills and got a high qualification. Subsequently, they began to solve the problems of manufacturing and assembling metal structures of industrial premises of the young soviet country, which also needed to be restored.

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Внесок академіка І. Г. Александрова у будівництво залізниць та мостів

Анотація. *Одним із актуальних завдань сучасної історії науки і техніки є вивчення діяльності провідних науковців та інженерів-практиків минулого, впливу їхніх ідей на розвиток світової науки та на процес підготовки спеціалістів відповідних галузей народного господарства. На погляд авторів статті, однією із таких постатей початку ХХ століття є академік І. Г. Александров. Історично-науковий аналіз життя та діяльності І. Г. Александрова як вченого, інженера, організатора науки є актуальним з огляду на масштабність та різноплановість його наукового внеску. У контексті розвитку гідротехніки і гідроенергетики, розвитку транспортних комунікацій, І. Г. Александров мав досягнення світового рівня, які прославили вітчизняну науку. Науково-творчий доробок І. Г. Александрова можна умовно розділити на п'ять основних напрямів розвитку науки і техніки: гідротехніка, гідроенергетика, географічне районування, залізничний транспорт та іригація. У доробку академіка – будівництво Дніпровської ГЕС біля Запоріжжя (1927–1932) (підготував проект і керував будівництвом найбільшої на той час ГЕС у Європі), розробка генерального плану електрифікації СРСР (склав проекти електрифікації Середньої Азії та Східного Сибіру), участь у створенні плану будівництва Байкало-Амурської залізничної магістралі, розробка методології економічного районування Радянського Союзу та теорії залізничних «надмагістралей». У статті зроблено висновок, що висококваліфікований професорсько-викладацький склад Московського вищого технічного училища та Московського інженерного училища Відомства шляхів сполучення сприяв ґрунтовній теоретичній підготовці молодого інженера І. Г. Александрова. На підставі значної кількості джерел встановлено, що обіймаючи різні посади, І. Г. Александров брав участь у вирішенні складних технічних питань сучасної йому епохи, а наукові дослідження І. Г. Александрова здійснювалися у контексті завдань інженерної науки його часу. І. Г. Александров вів наукові дискусії з питань будівництва портів і каналів, у своїй діяльності всіляко сприяв розвитку вітчизняної промисловості і впровадженню прогресивних форм транспорту, зокрема залізничного. З впевненістю можна стверджувати, що сучасне бачення наукової спадщини І. Г. Александрова в контексті розвитку гідротехніки, гідроенергетики та залізничного*

транспорту беззаперечно визнає, що в концентровано-узагальненій формі ідеї, теорії та концепції, висунуті та науково обґрунтовані академіком І. Г. Александровим, сьогодні сприяють розвитку науково-технічного процесу.

Ключові слова: *І. Г. Александров; будівництво залізниць; залізничні мости; залізничний транспорт; залізничні магістралі; залізнична техніка*

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Вклад академика И. Г. Александрова в строительство железных дорог и мостов

Аннотация. *Одним из актуальных задач современной истории науки и техники является изучение деятельности ведущих ученых и инженеров-практиков прошлого, влияния их идей на развитие мировой науки и на процесс подготовки специалистов соответствующих отраслей народного хозяйства. На взгляд авторов статьи, одной из таких фигур начала XX века является академик И. Г. Александров. Историко-научный анализ жизни и деятельности И. Г. Александрова как ученого, инженера, организатора науки является актуальным, учитывая масштабность и разноплановость его научного вклада. В контексте развития гидротехники и гидроэнергетики, развития транспортных коммуникаций И. Г. Александров имел достижения мирового уровня, которые прославили отечественную науку. Научно-творческое наследие И. Г. Александрова можно условно разделить на пять основных направлений развития науки и техники: гидротехника, гидроэнергетика, географическое районирование, железнодорожный транспорт и ирригация. В активе академика – строительство Днепровской ГЭС возле Запорожья (1927-1932) (подготовил проект и руководил строительством крупнейшей в то время ГЭС в Европе), разработка генерального плана электрификации СССР (составил проекты электрификации Средней Азии и Восточной Сибири), участие в создании плана строительства Байкало-Амурской железнодорожной магистрали, разработка методологии экономического районирования Советского Союза и теории железнодорожных «сверх-магистралей». В статье сделан вывод о том, что высококвалифицированный профессорско-преподавательский состав Московского высшего технического училища и Московского инженерного училища Ведомства путей сообщения способствовал основательной теоретической подготовке молодого инженера И. Г. Александрова. На основании значительного количества источников*

установлено, что занимая различные должности, И. Г. Александров участвовал в решении сложных технических вопросов современной ему эпохи, а научные исследования И. Г. Александрова осуществлялись в контексте задач инженерной науки его времени. И. Г. Александров вел научные дискуссии по вопросам строительства портов и каналов, в своей деятельности всячески способствовал развитию отечественной промышленности и внедрению прогрессивных форм транспорта, в частности железнодорожного. С уверенностью можно утверждать, что современное видение научного наследия И. Г. Александрова в контексте развития гидротехники, гидроэнергетики и железнодорожного транспорта беспрекословно признает, что в концентрированно-обобщенной форме идеи, теории и концепции, выдвинутые и научно обоснованные академиком И. Г. Александровым, сегодня способствуют развитию научно-технического процесса.

Ключевые слова: *И. Г. Александров, строительство железных дорог; железнодорожные мосты; железнодорожный транспорт; железнодорожные магистрали; железнодорожная техника*

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