



Evgeny O. Paton (to the 150th anniversary of the birth)



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ABSTRACT

The article is dedicated to Evgeny Oskarovich Paton, an outstanding Soviet scientist with brilliant engineering talent. It was he who created a unique school of bridge building. The most famous creation of Evgeny Oskarovich bears his name – the famous Paton Bridge in Kiev.

E. O. Paton is the author of more than 300 scientific papers and several theoretical courses on bridge building and welding: «Calculation of end-to-end trusses with rigid joints», «Iron bridges» in 4 volumes, «Wooden railway bridges», «Automatic bare electrode welding under a layer of flux», fundamental textbook «Course of bridges» in 5 volumes and

others. Organizer and editor-in-chief of the journal «Automatic welding» (1949–1953). Many of his textbooks are still being used in the study process.

The beginning of Evgeny Paton's professional, research and teaching career was directly related to transport and railways, teaching at the then MIIT, where the future great scientist headed the department «Bridges and Tunnels» (founded in 1896). It was there that Evgeny Oskarovich worked until 1904. Paton's laboratory has survived to this day and even continues to be used in teaching, and documents and photographs related to the scientist are carefully kept in the university museum.

Keywords: bridge construction, electric welding, electric submerged arc welding. Paton bridge, automated welding, electric arc, welding seam.

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A scientist in the field of bridge building and electric welding, academician of the Academy of Sciences of the Ukrainian SSR Evgeny Oskarovich Paton was born on March 5 (February 20, old style), 1870 in Nice, in the family of the Russian consul [1–6].

According to the archival documents of the Heraldry Department of the Governing Senate, he came from an old noble family, and on top of that, his godparents were ... *«His Imperial Highness Grand Duke Vyacheslav Konstantinovich and Her Imperial Highness Princess Alexandra Iosifovna, whose place was taken by the maid of honor Duchess Keller...»*.

The Patons themselves explained the rarest surname by the fact that the ancestors – ship craftsmen – were taken out of Holland by Peter I. Since before the revolution the Patons had a particle «von» before the surname, indicating a noble origin among the Germans, most likely their family originates from Germany. The mother of the future scientist, Ekaterina Dmitrievna, came from the family of the staff captain Shishkov. About the birth of her son, named Evgeny, there is an entry in the birth registers of the Orthodox Church in Nice (this church at the very foot of the Alps was called «Russian») for 1870 under No. 2: *«The certificate was given in 1870 on February 20th day (March 5 new style) that the Russian consul, retired Colonel of the Guards Oscar Petrovich Paton, of the Lutheran religion, and his legal wife Ekaterina Dmitrievna, of the Orthodox faith, both by their first marriage, had a son, Evgeny, who was baptized by the priest Vladimir Levitsky and the psalmist in the same year of March 29th day by Feodosiy Gulyaev...»*.

The boy received an excellent education at home. In addition to his native Russian language, he also studied French, German and English, which later came in handy for his scientific research work. *«There was strict discipline in the family. There were seven of us children in the family – five brothers and two sisters. Most of all, my father did not tolerate laziness and idleness. The girls were still given concessions, but the boys in the family were asked to the fullest extent. Father demanded that everyone speak Russian to each other at home, but he also insisted that all of us, in addition to our native language, also learn French, English and German. For this I was grateful to my father,*



**Pic. 1. Evgeny Oskarovich Paton.
5 March 1870–12 August 1953.**

and dozens of years later», the academician recalled about his childhood.

The older Patons boys studied in St. Petersburg in the Corps of Pages, and so Evgeny was prepared to serve at the court, or, in extreme cases, to engage in landlord farming on his parent's estate in Deniskovichy near Novozybkov. However, the consul Oskar Petrovich supported his son's interest in the exact sciences. In Germany, Evgeny was sent straight to the seventh grade of a real gymnasium. First there was a study in Stuttgart, then in Breslau, where Oskar Petrovich was transferred from Nice as a consul. In the senior class, the main family battles began. The mother continued to insist on the Corps of Pages, and the father supported his son, whom *«most of all he wanted in life... to design bridges»*!

In 1892–1893, the young man served on conscription in the Russian army in the artillery units of Kiev military district with the rank of fireworker (the rank of junior command personnel in artillery, non-commissioned officer).

Documents from German archives indicate that Evgeny Paton was *«included in the list of students and listeners of the Royal Saxon Technical School»*. It was there that the most serious bridge-building school was located. At



the engineering department of the Royal Saxon Technical School since 1888, he attended lectures by such famous professors as Zeuner, Moor, Frenkel. But at the end of his studies, Paton wrote to St. Petersburg: *«Let me defend my diploma at home, at the Imperial Institute of Railways»*. But Petersburg, in order to receive a silver badge of a Russian engineer, will offer Paton to sit down again for three years at the student's bench.

The renowned professor Wilhelm Frenkel, who headed the department of bridge construction and statics of building structures at the Royal School, will offer Paton the position of his assistant in the technical bureau, which is engaged in reconstruction of the main Dresden railway station — Mr. engineer Paton — clarifies one of the archival documents of 1901).

On Christmas Day 1891, Evgeny Paton was to serve his military service. Father advised: *«It is more useful for you to breathe the air of the Motherland!»* — the consul was most of all afraid that the children would grow up as foreigners.

In 1896, Paton received a diploma of St. Petersburg Institute (now a university) of railway engineers with a degree in Bridge Construction. Here he began to teach [7]. From 1896 he worked in the technical department of Petersburg—Moscow (now Oktyabrskaya) railway, and in 1907 he headed the technical department of the track service of Moscow—Yaroslavl—Arkhangelsk (now Northern) railway. In 1899 he was invited to teach at Moscow Engineering School of Railways (now Russian University of Transport), which was opened in 1896 [8; 9]. After successfully defending his D.Sc. thesis in 1901 and publishing a two-volume textbook, he was appointed to the post of extraordinary (supernumerary) professor and inspector of the school.

In 1904, Evgeny Oskarovich moved to Kiev, where he was appointed dean of the engineering faculty and head of the department of bridges of Kiev Polytechnic Institute, where the talent of engineer Paton was fully revealed. During the First World War, the young scientist actively works with the military. Thanks to him, the Russian engineering troops received special collapsible bridges — both road and railway. He taught at Polytechnic Institute until 1938: in 1904—1912, dean of the Faculty of Engineering, in 1905—1929 — head of the department of bridges, 1935—1939 head of the department of

welding. In 1921—1931 he was also the head of Kiev bridge testing station.

The scientist was the first to develop designs for steel folding bridges, which won the designs of the French engineer, builder of bridges and viaducts, A.G. Eiffel, the author of the famous tower, at an international competition. These bridges are called Paton bridges. According to his designs, over 50 riveted iron road and railway bridges were built in 1896—1929. He laid the foundations for the school of bridge building (expedient design, cheaper projects and construction of bridges due to innovations in structural forms and the economic use of metals) and conducted scientific research in the field of strength, stability and dynamics of bridges. For outstanding services in the field of bridge building [10], in 1929 he was elected a full member of the All-Ukrainian Academy of Sciences (VUAN, now the National Academy of Sciences of the Ukraine), in 1935—1953 — a member of the Presidium of VUAN (Academy of Sciences of the Ukrainian SSR), in 1945—1952 — vice-President of the Academy of Sciences of the Ukrainian SSR.

In 1928, Paton began to study the problems of electric welding of metals, which was used at that time in repair of iron bridges, since his work in the field of strength and reliability of permanent metal joints [11] theoretically and experimentally proved high technical and economic efficiency of replacing riveted metal structures with welded ones.

Evgeny Paton got his first haven for his experiments at Kiev plant «Bolshevik», where a welding shop already worked. Paton's laboratory consists of just one electrical engineer and an enthusiastic welder. The idea of doing electric welding caused slight bewilderment in the academic environment. Many believed that the topic was narrow, not for a prominent scientist, but for an ordinary engineer. But the Academy of Sciences of the Ukrainian SSR allocates three rooms in the basement of the former gymnasium.

The inventor insists that he must work hand in hand with industry! *«...The electric welding laboratory should not produce puffy scientific reports, but really help the industry to master new methods of metal welding. I warned them that I would have to go to factories a lot, help them cope with the difficulties of mastering welding, train personnel for factories, fight riveting supporters...»*. — Evgeny Oskarovich wrote in

his memoirs. And the work of the laboratory was closely related to production. All developments were immediately transferred to production. At Dnepropetrovsk plant of metal structures, Evgeny Paton's long-standing dream came true – the enterprise has begun to produce beams for all-welded bridges. So two main affairs of Evgeny Oskarovich's life merged into one.

Kharkov plant «Hammer and Sickle» sent to the laboratory for testing the frames of two threshers – riveted and welded. According to the results of the tests, the Kharkovites switched entirely to welding. In addition, Paton's laboratory refuses to purchase imported scientific equipment – it was decided to build its own test benches and machines.

Evgeny Paton headed Electric Welding Laboratory and Electric Welding Committee from 1929 to 1934. In the 1930s, he improved electric arc welding with a metal electrode, invented in 1888 by the Russian engineer N. G. Slavyanov [12], and published the first monographs, in which he summarized the basic principles of calculation and design of welded structures, formulated the basic provisions on the technological foundations of electric arc welding... He dealt with issues related to welded joints and structures, with their strength and operational reliability, optimal shape, reaction to static and dynamic loads, properties of an electric welding arc and a weld seam, mechanization and automation of electric welding, etc. In 1932, under his leadership, an automatic welding head [13] was developed for open arc electric welding. He created an in-line method of electric welding and their technologies in special conditions of varying complexity, developed industrial flow electric welding lines.

In 1934, on the basis of Electric Welding Laboratory and Electric Welding Committee, the scientist organized the world's first research institute for electric welding (NIIES) VUAN, which has been named after Paton since 1945, and was its director in 1934–1953. A feature of NIIES was the same close connection with production. The newest scientific methods of electric welding and equipment created at NIIES were immediately introduced into the national economy, which made it possible to solve the problems of practical application of electric welding in the shortest possible time. In 1940, he became an Honored Scientist of

the Ukrainian SSR and invented a new method of electric submerged-arc welding, which later became the main one in laying gas pipelines, manufacturing cars, boilers, beams for bridges and other structures. In 1941 he was awarded the State Prize of the first degree for development of the method and equipment for high-speed automatic electric welding.

On June 22, 1941, Evgeny Paton (a scientist over 70 years old) met on the train – he was heading to Ural Tank Plant on a business trip. The scientist had to organize welding of armor plates of steel. Upon learning of the beginning of the war, Evgeny Oskarovich sent a letter to Stalin right from the car: «*The Motherland is in danger, and I want to give my last strength to its defense*». On the recommendation of the scientist, Kiev Institute of Electric Welding was evacuated to Nizhny Tagil and placed at Uralvagonzavod No. 183, where NIIES had already introduced automatic welding in production of cargo cars from structural low-carbon steels.

T-34 and KV tanks created even before the war were superior to their German counterparts in most parameters. The main task set before themselves at Paton Institute was to achieve strength of the welded seam that exceeds strength of the armor plate itself. Until that moment, Soviet tanks were welded manually, which required participation of a highly qualified welder. And the process itself was very long and time consuming. Automated welding was supposed to reduce the requirement for worker qualifications and speed up the process. The evacuated institute, in fact, turned into one of workshops of the tank factory.

The technology of automatic submerged-arc welding in 1942 was introduced into production of tanks, air bombs, and other ammunition. Its use has accelerated welding production five to eight times and, at the same time, has reduced the requirements for the qualifications of a welder. Even a teenager could use Paton's apparatus. The production process of tanks has accelerated unprecedentedly, strong welds withstood the impact of armor-piercing shells. Until the very end of the war, no one in the world could repeat this technology! Paton's automatic welding machine can be safely put into the Victory Weapon Gallery together with the legendary Katyusha, Il-2 and T-34 attack aircraft. During the war years, the total length of «Patonov seam» was six thousand kilometers!



To imagine the degree of reliability of Paton's armored warriors, it is enough to quote the words of Yuri Maksarev, director of tank plant No. 183 evacuated to Nizhniy Tagil from Kharkov: *«It was necessary to expand the territory of Uralvagonzavod for workshops for new, peaceful products. And near the entrance there was a monument – a tank, «thirty-four» No. 35000. On May 26, 1945, the victorious year, on the very day when the plant was awarded the fourth military order, it left the assembly line simply on a pedestal. In 1975, this tank was reactivated from the factory lubricating oil and refueled with fuel. And under its own power, as if it had just rolled off the assembly line, and not three decades ago, the veteran T-34 climbed to a new pedestal near the new entrances».*

For his contribution to strengthening the country's defense capability in difficult wartime conditions in 1943, Paton was awarded the title of Hero of Socialist Labor. In 1944, he returned from evacuation to Kiev, headed the restoration of NIIES, was engaged in improving the process of automation of electric welding and research on creating the scientific foundations of electric welding, as well as electric welding in carbon dioxide. In 1946 and 1950 he was elected to the Supreme Soviet of the USSR. In 1946–1953, he comprehensively developed physical, metallurgical and thermal foundations of electric welding, scientific foundations of mechanization and automation of electric welding processes, created a theory of strength of welded structures and joints, solved the problems of electric-welded bridge construction, the introduction of electric welding into industry, led the design and manufacture of the first all-welded bridges using automatic electric welding. In 1953, an all-metal road bridge across the river Dnieper was put into operation in Kiev with a length of 1542 m, which was created without a single rivet and began to bear the name of Paton bridge. In total, over 100 welded metal road and railway bridges were built according to his designs. The NIIES team solved the problem of automatic submerged arc welding of vertical seams. He made a great contribution to creation of new industrial methods for production of metal pipes, ships, railway cars, mine cars, construction of main pipelines, oversized tanks, blast furnace structures, hulls for ballistic inter-continental and satellite missiles and other

objects, and invention of electroslag welding solved the problem of producing structures from workpieces of practically unlimited thickness.

Evgeny Oskarovich Paton died on August 12, 1953 at the age of 84, was buried in Kiev at the memorial Baikovo cemetery. After his death, the publishing house of Academy of Sciences of the Ukrainian SSR published his selected scientific works [14; 15]. He is the author of over 300 fundamental scientific papers, organizer and editor of the journal «Automatic Welding», and has been awarded 5 orders and numerous medals.

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