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LANDMARK EMANCIPATION OF TECHNICAL INTELLIGENCE IN PRE-WORLD WAR II CZECHOSLOVAKIA

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Abstract. This paper describes the development, activities, and both the scientific and social contributions of the Masaryk Academy of Labour, Czechoslovakia's first technically oriented scientific institute and a major centre of the science at that time. It marked the first time an institution devoted to science and engineering had ever been established in the territory of what would eventually become the Czech Republic. Coming on the heels of Czechoslovakia's independence at the end of the First World War, it succeeded the pre-war Royal Bohemian Society of Sciences and was integrated with the Czech Academy of Sciences and Arts and the newly established Czechoslovak National Council as the youngest of the Czech scientific institutions. In 1952, it was merged with other institutions to form the Czechoslovak Academy of Sciences, the predecessor of today's Czech Academy of Sciences. The significance of the Masaryk Academy of Labour lay mainly in its targeted, practical application of science and engineering.

Keywords: History of Science and Technology, Masaryk Academy of Labour, IV. department of mechanical and electrical engineering, Czechoslovakia, 1918–1953, education, Albert Adalbert (Vojtěch) Velflík, cooperation with the USA, Stanislav Špaček, Czechoslovak Academy of Sciences.

1. Introduction

The Masaryk Academy of Labour (MAL) was founded out of the necessity for Bohemian and Czechoslovak technical and industrial circles to recover from World War I. They desired to accelerate the economic uplifting of the country through the effective exploitation of natural resources, increasing primary production, and appropriate organisation of technical work. Worldwide competition and changing social conditions required improvements in manufacturing methods to achieve economies of scale in materials, labour, and time, which were essential to reduce the prices of all industrial and commercial products. Science would now be harnessed to generate economic progress. To achieve this goal, the Masaryk Academy of Labour would engage with all sciences whose purpose was to enhance creative engineering in every direction of practical production. Toward this end, specialists in engineering and practical applications worked together. It was essential to identify and describe the natural resources available to the newly formed country. Czech engineers saw the establishment of an engineering academy as the culmination of their long-time aspirations to be properly appreciated for the importance and significance of what they had accomplished for the country and the public at large [1]. What sparked the drive for the first-ever Czech-language engineering institute was the establishment of an independent Czechoslovakia in 1918, which created more favourable conditions for national life, culture, education, and science to develop. This was reflected in new universities and the founding of scientific institutions[1] along with stronger and more organised scientific and technical research [2]. In other words, the time had come to construct a new national economy on a democratic foundation.

Czechoslovak President Tomáš Garrigue Masaryk (1850–1937) appropriated one million korunas for its establishment in December 1919. The money had come from citizens and immigrants of Czech and Slovak origin living in the United States. Donating this amount, he wrote in a letter dated December 24, 1919 to the scientists and engineers associated with the academy that would bear his name (translated from Czech): *"Let me express my confidence to those who have endowed me with such a fund for my discretionary use that you will approve of this decision as much as I am certain that your Academy of Labour will learn much from American workers."* [1]. The gesture essentially laid the foundation for a close cooperation between the Academy in Czechoslovakia and the United States, which would last until 1939. The first formal sitting of the MAL took place in the meeting room of the Ministry of Education and National Enlightenment on March 6, 1920, virtually on the eve of President Masaryk's 70$^{\text{th}}$ birthday. Albert

[1] Independent scientific institutes established after Czechoslovakia was founded included the Slavic Institute (1922–1952), Oriental Institute (1922–1952), State Historical Publishing Institute (1921–1952), and the State Institute of Archaeology (1919–1952). The energy expended by the newly-established republic in international relations resulted in the merger of the International Union of Academies and the International Research Council.

Vojtěch Velflík[2] (1856–1920) (Figure 1), a professor of civil engineering at the Czech Technical University, was elected the first president of the Masaryk Academy of Labour, Czechoslovakia's first technical institution [1].

2. The predecessors of the Masaryk Academy of Labour

Before the Academy was founded, there was only one institution on Czech soil that brought together technicians and engineers, the *Society of Engineers and Architects in the Kingdom of Bohemia* established in 1865. However, it was only a grouping of professionals and they had ever undertaken no systematically organised scientific work. The Masaryk Academy of Labour's primary missions were to organise science and engineering projects, encourage research in these fields, and develop new production processes. Yet when it was founded, a balance between basic and applied research was emphasised, which a division of the Academy into two sections would ensure. These were the *Board of Experts* and the *Scientific Council*. The Board of Experts was composed of leading technical figures from the practical world, while the Scientific Council consisted of scientific experts with outstanding achievements in a particular field of the MAL. Members were appointed for life and they set the direction of the scientific research each of the departments in the Academy would be conducting [2].

Among the organisations that laid the groundwork for what would be the first Czech technical academy was the *Imperial and Royal Patriotic-Economic Society in the Kingdom of Bohemia*, an organisation financed by the Habsburg Monarchy.[3] Set up in 1769, it operated in Bohemia until 1872. In 1770, a similar society was established in Moravia and Austrian Silesia, the *Moravian-Silesian Society for the Improvement of Plowing, Natural Science and Homeland Studies*.[4] However, neither society directly specialised in scientific research. Their main mission was to disseminate practical agriculture and forestry knowledge and practically popularise new scientific and technological inventions [5].

The *Bohemian Hydrotechnical Society* was founded as a private organization in 1807 to design the most advantageous waterway to link the Moldau (or the Vltava in Czech today) with the Danube. It was headed by Antonín Isidor Lobkowicz (1773–1819), a member of the Bohemian aristocracy. The society's scientific director, Franz Josef Gerstner[5] (1756–1832), later abandoned the water route and instead opted for a horse-drawn railway connection between Budweis (now České Budějovice) and Linz, whose construction Franz Anton von Gerstner (1795–1840) subsequently inaugurated in 1825 [7].

Figure 1. Albert Vojtěch (Adalbert) Velflík (1856–1920) [6].

In the 19th century, practical science received a significant boost from the *Jednota ku povzbuzení průmyslu v Čechách (Union for Encouragement of Industry in Bohemia)* [8]. It was founded on 1 March 1833, and strongly contributed to the spread of new scientific discoveries and technical breakthroughs from industries operating in Bohemia. The entrepreneurial classes were well represented in the Union and it provided the Bohemian authorities with information about the state of industry in the kingdom. Starting in 1834, it published *Mitteilungen für Gewerbe und Handel (Trade and Commerce Communications)*, a professional journal issued in German.[6] The Union also organised exhibitions, announced tenders and had

[2]Velflík was a prominent technical expert in bridge construction, who was thrice elected the rector of the Imperial and Royal Bohemian Technical University in Prague (1897–98, 1899–1900, and 1906–07). See [3].

[3]The Patriotic-Economic Society published professional journals and calendars between 1796 and 1872. See [4].

[4]The Journal *Mitteilungen der K. k. mährisch-schlesischen Gesellschaft zur Beförderung der Ackerbaues, der Natur- und Landeskunde* was published from 1821 to 1891.

[5]Having been inspired by the École Polytechnique in France, in 1803, Gerstner proposed the reorganisation in Prague of the secondary Institute of Engineering Education, originally decreed by Emperor Joseph I on 18 January 1707 at the request of Christian Josef Willenberg (1676–1731), a civil engineer and professor of engineering,. into the tertiary Royal Bohemian Polytechnic Institute, a precursor of today's Czech Technical University in Prague.

[6]In 1838, it started publishing a second German language journal, an annual report for manufacturers, tradesmen, physicians, chemists, engineers, pharmacists, and economists of progress, improvements, and inventions in industrial arts and craftsmanship, physics, and chemistry. By 1840, both German journals had merged to become the *Encyclopädische Zeitschrift des Geverbewesens*.

rooms where machines and industrial products were kept. The next year, in 1835, the first ever public library in Bohemia dedicated to engineering was opened. The Union for Encouragement of Industry likewise promoted education in industrial arts and, in 1837, opened a Sunday vocational school for crafts, which would be supplanted by the first evening vocational school devoted to industrial arts twenty years later in 1857. Between 1837 and 1840, it also published Bohemia's first ever technology magazine to foster the spread of useful knowledge in crafts, arts, trade, and the local economy [9]. Funds were later dedicated in 1881 to finance the publication of textbooks for use in vocational and trade schools. In addition, it organised public lectures and discussions. An independent Czechoslovakia freed Bohemian industry from the dependence on the public administrators in Vienna and as such, the Union's importance subsequently declined, although it would not be formally dissolved until 1950 with its incorporation into the National Technical Museum [9].

Another major development that foresaw the eventual creation of the Czech Technical University was the establishment of *České matice technické (Czech Technical Association)*[7] in 1895, to promote the dissemination of Czech-language technical literature. At its annual general meeting in 1917, engineer Emil Zimmler (1863–1950) pressed for the establishment of a central authority for science, engineering, and labour, an institution that would later come into existence as the Masaryk Academy of Labour.

3. The contemporaries of the Masaryk Academy of Labour

Professional institutions and associations have always played a significant role in ethnic Czech society both in education in the Czech language and the raising of national self-awareness, especially since the second half of the 19th century. In 1865, important institutions of this type included the *Society of Engineers and Architects in the Kingdom of Bohemia*. These endeavours by the associations and institutions to promote industrialisation and urbanisation in Czech-speaking Bohemia and Moravia were followed up after Czechoslovakia became an independent country by the *Masaryk Academy of Labour* from 1920 and with the establishment of the *Československá národní rada badatelská (Czechoslovak National Research Council)* in 1924, both of which would remain separate institutions until 1952 [10]. Alongside them, well-established scientific institutions from the previous regime continued to function. One of them was the Royal Bohemian Society of Sciences (organised in the late 1760s and early 1770s with the name used from 1784 to 1952) [11–16], [17, p. 10], [18, p. 573], [19, pp. 16,23], whose members were prominent personalities from throughout the entire Habsburg Monarchy and especially from Bohemia, as well as outside Austria-Hungary. Their work was regularly published in the weekly *Learned News* (*Gelehrte Nachrichten* or *Učené zvěsti*), although mostly in German. The society continued under its previous name even after 1918 and also during the Nazi occupation of Czechoslovakia. To some extent, it illegally replaced the Czech-language universities that had been closed. *It was eventually shut down in the period following the 2nd World War and forced to merge with the Czechoslovak Academy of Sciences in 1952,* which operated from 1953 until the division of Czechoslovakia at the end of 1992. A similar institution, the *Czech Academy of Sciences and Arts* (1888–1891 and 1918–1952),[8] came into existence as a result of the exceptional patronage provided by Josef Hlávka (1831–1908), an architect and civil engineer[9] who was also elected as its first president. Its mission was to provide funding for Czech-language science and literature as well as to support Czech-language arts. While publishing was its most significant endeavour, the academy also awarded scholarships and grants as it developed smaller research institutions and laboratories.

Besides the organisations earlier mentioned, there were others technologically decisive to the country's development like the *Electrical Engineering Union of Czechoslovakia* (founded in 1919), which played a major role in the country's electrification, and the *Czechoslovak Standardization Society* (1922), which sought to achieve compatibility and high level of quality among technical products both in their engineering and technology. In post-war Czechoslovakia, these institutions were accommodated both in the legislation and executive action. For instance, the legislation to systematically electrify the country was quickly adopted in Act 438/1919 and government authorities

[7] As early as 1831, there had been a *Matice česká (Czech Association)* to encourage the dissemination of literature in the Czech language by patriots seeking to elevate the use of Czech language in discourse and literature. Česká matice technická specialised in funding the publication of technical literature written in Czech.

[8] It began on 18 May 1891 as the *Emperor Franz Joseph Czech Academy for Sciences, Literature and Arts.* Having become a central scientific corporation, it changed its name on 10 November 1918 to the *Czech Academy of Sciences and Arts.* Discussions regarding the original institution were actually initiated by Josef Hlávka, who had pledged 200 000 Austro-Hungarian gulden and served as its first president from the Academy's formation in 1890 until his death in 1908. He eventually linked it with his own Josef, Marie, and Zdenka Hlávková Foundation, which he had founded in 1904. The Czech Academy of Sciences and Arts was divided into classes: with the first covering Philosophy, Social Sciences, and History, the second natural sciences, the third Philology, and the fourth encompassing arts, music, and literature. In 1923, the membership in the Academy was opened to women. It issued a range of annual scientific proceedings, such as its discourses (*Rozpravy České akademie věd a umění*) and individual volumes. It was only in 1928 that an engineering section was created within the Czech Academy of Sciences and Arts from a division of its natural sciences class into five sections: mathematics and physics; chemistry, mineralogy and geology; biology; medicine; and, finally, engineering. See e.g. [20].

[9] Inter alia e.g. [21]. See also [22].

such as the Ministry of Public Works were created in 1918, soon after the independence, to manage and organise major government-funded jobs and construction projects.

Interest in incorporating technical sciences (including economics and some social disciplines) into the *Česká akademie věd a umění (Czech Academy of Sciences and Arts)* had been expressed even before the First World War. This was partially fulfilled when the *Národohospodářský ústav (National Economic Institute)*[10] was formed within it in 1905.

World War I marked both the end of the long 19$^{\text{th}}$ century that had started with the French Revolution and the system the period had produced. In the war, non-European powers like the US and Japan had been decisive players even though it was fought primarily in Europe. The outcome fundamentally changed the map of Europe and the Middle East with the disappearance of Austria-Hungary and Ottoman Turkey, two empires that had, together, shaped European history for more than three centuries. The war also cost Europe the position it had held as the defining force in the international development (and likewise in science and engineering) ever since the Age of Discovery left the pre-war Great Powers of Europe, both victorious and defeated, either decisively weakened or vanished. The Treaty of Versailles symbolised both the end of an era and the changes World War I had brought [24]. With it came a new way in how intellectuals and representatives of the industrial and professional elite thought, both affirming their long advocacy of a free European civil society.

Into this new European order and its further political, economic, and socio-cultural significance stepped the president of a new pluralist and democratic country, T. G. Masaryk (1850–1937) [25–28], with his own concept of a national point of view with a humanitarian value [29, 30], where it was precisely the emergence of democratic forces that strived to meld a nation: "[...] *for every national idea, the general idea of the humanities should be the determining factor.*" [31]. These reflections have created a modern personality of a (European) citizen whose beliefs and freedom of thought, speech, and expression must remain unbowed and respected by society. The new global order would thus include the formation of a Pan-European grouping. One outlet for these considerations was supposed to be a worldwide federation of engineers organised in the United States during the 1920s. To some extent, this matched the vision expressed in *Pan-Europa, of a Federation of Nations*, which had been promoted, since 1922, by Richard Nikolaus von Coudenhove-Kalergi (1894–1972), an Austrian-Czech politician and author [32].

The quest for defined European integration was also pursued by engineering organisations and institutions whose activities were to be interconnected. International professional engineering organisations had set up national committees and professional associations that functioned like branches of an organisational tree. They promoted an open system where both technical information and networks should flow freely, just as electricity is distributed a circuit [33]. Such a liberal attitude was also encouraged by businesses, as the men who ran them believed that such a state of affairs would both boost the economic growth and lead to the development of rational international cooperation in manufacturing and the transmission of energy and technical information [33].

Reality drove these thoughts and plans, as without them, any economic development in the interwar period to come would have been unthinkable, and they were based on cooperation between the engineers, transfer of technical knowledge, and research developed in technical fields. It was technical research institutions such as the Masaryk Academy of Labour that played such a crucial role in this process.

The concept of the *Masaryk Academy of Labour* in the 1920s was in line with both the technical and technocratic efforts in Europe and the US that were seeking to create conditions for both engineering and research to move as rapidly as possible into practical development and positively influence society. To some degree, it also allowed engineers and technicians to become more involved in corporate management and encouraged them to set up companies to promote engineering. There was also supposed to be a definite political impact [34, pp. 163–348], together with the ability to regulate the economic sector through the correct allocation of resources without setting off a crisis.[11] Technical experts would "contribute to collective intelligence and be decision-makers" [34, pp. 163–348]. Political authority should, therefore, be concentrated among them, and their knowledge should be used in corporate management along with science. This concept would eventually be followed by thoughts about a post-industrial society.

4. The creation of the Masaryk Academy of Labour

After several years spent on preparation, the Masaryk Academy of Labour (Figure 2) was founded in 1920, with the support from President Masaryk and also his fellow countrymen, to conduct technical and economic research while maintaining a degree of autonomy. A motion for its formation was tabled at the *Národní shromáždění (National Assembly)* on 20 December

[10] Masarykův ústav a Archiv Akademie věd ČR (Masaryk Institute and Archives of the Czech Academy of Science), Fond Národohospodářského ústavu, 1905–1955 (National Economic Institute, 1905–1955). See also [23].

[11] Technical skills aroused technocratic tendencies variously visible in the writings of economists, sociologists and managers such as US economist Torstein Veblen (*The Engineers and the Price System*, published in 1921), James Berkheim (*Managerial Revolution*, 1941), and John Kenneth Galbraith (*Economic Development* and *The New Industrial State*, written and published in the 1960s).

FIGURE 2. Main building of the Masaryk Academy of Labour: Palace of the family Kinský on Old Town Square (1920s).

1918, just as Masaryk was arriving in Czechoslovakia. It was adopted in Act No. 86 of the Czechoslovak Republic on 19 January 1920.[12] During the interwar period, it met the need for a decisive central authority to govern the scientific efforts among engineers and technicians in Czechoslovakia. For the first time ever, practical engineers could meet with university professors in a common scientific environment and, together, build up the newly-freed republic on a multinational foundation. **In the year of its foundation, 180 people were appointed to the Masaryk Academy.**

In the years after the Academy was established, it was primarily engaged in promotion. Any sense of thrift and frugality had been damaged by World War I and the wartime economy. Through its lectures and publications, the Academy sought to stress the importance of economic development and efficiency in both the private and government sectors. This was done through the application of scientific management of labour in certain industries and trades. It offered companies guidelines and work plans to rationalise production and improve the social, economic, and cultural status of the people employed there and their employers [36, carton 1–9, not inventoried].

Right away, industrial engineers vigorously and energetically seized the opportunity handed to them, demonstrating their readiness to become involved in the country's industrial operations and to present their own recommendations to the government for the economy and the business sector. Two such examples were the *Stálá komise pro studium a tvorbu hospodářské politiky (Standing Committee for Study and Drafting of Economic Policy)* and the *Česká společnost pro plánovité hospodářství (Czechoslovak Society for a Planned Economy)*. The Academy also developed a specific Czech and Czechoslovak aspect to scientific management of labour started in the United States by Frederick Winslow Taylor and Frank Bunker Gilbreth. One of its experts, Professor Václav Verunáč (1893–1960), mentioned *Laboretism*, a Czech school of economic thought from the 1920s, which, in contrast to the US approach, stressed an ethical approach towards people.

Throughout its existence, the Masaryk Academy of Labour espoused technocratic ideas of civil service operating by scientific and technical procedures. The *First Prague International Management Congress* in

[12]The law had only three sections. The first declared the Masaryk Academy of Labour to be an independent and autonomous scientific institution headquartered in Prague. The academy's mission was defined as the utilisation of technical work efficiently in order to harness the capabilities of the entire population and natural resources in an economically beneficial way. Section 2 of the Act clarified that the Masaryk Academy of Labour would be governed by rules issued in executive regulations. One third of its membership would be appointed by the government. The appointment of the Masaryk Academy of Labour's president would be sanctioned by the President of the Republic. The Act vested oversight over its operations in the national government. The final section of the Act set the effective date as when it was promulgated. Executive authority was vested in the Ministry of Education and National Enlightenment. The law was signed by T. G. Masaryk, Tusar, and Habrman. See [35].

1924 was sponsored by the MAL, President Masaryk, and then Secretary of Commerce Herbert Clark Hoover (1874–1964), who would later be elected President of the United States [2]. The US was represented by members of *The American Engineering Council*, *The American Society of Civil Engineers*, and *The Society of Industrial Engineers*, among others. Also attending was Lillian Moller Gilbreth, a leading advocate of the scientific organisation of labour in the US and the wife of Frank Bunker Gilbreth, who had died earlier that year. Two years later, the *Československý národní komitét pro vědeckou organizaci (Czechoslovak National Committee for Scientific Organization)* was founded on the heels of the Congress.

5. The scientific activity of the Masaryk Academy of Labour

Organization of the young Czechoslovak Republic's technical and economic development was the core task undertaken by the experts and scientific councils of the Masaryk Academy of Labour. Its activities were divided into six numbered departments:

(1.) Medical and natural science,

(2.) Agriculture and forestry,

(3.) Civil engineering,

(4.) Mechanical and electrical engineering,

(5.) Chemical engineering, and

(6.) National economic, and social sciences.

For example, the Department of Medical and Natural Sciences (Department 1), among other things, looked into the possibilities and methods of petroleum extraction and proofread maps of Czechoslovakia for the *Vlastivědná komise (Commission Homeland Studies Commission)*. It was accordingly active in publishing a study of Czechoslovakia's local history.[13] The department also had a *Radiotelegrafická komise (Radiotelegraphy Commission)*[14] and a *Komise pro dějiny exaktních a technických věd (Commission for the History of Pure and Technical Sciences)*, whose members attended many international science history conferences [37]. In 1930, the *Komise názvoslovná (Nomenclature Commission)*[15] edited science and engineering terminology. Others were the *Komise pro racionalizaci a normalizaci v lékařství a lékárnictví (Commission for Rationalization and Standardization in Medicine and Pharmacy)*, the *Komise geologická (Geology Commission)*, and the *Komise eugenická (Eugenics Commission)*, which, in 1922, started collaborating with the Faculty of Medicine at Charles University in Prague at its Institute of General Biology and Experimental Morphology, with the Czechoslovak Institute for National Eugenics and the Czechoslovak Eugenics Society in the enhancement of Czechoslovakia's gene pool. For instance, the Eugenics Commission investigated the impact of the decline in the birth rate on the country's productivity, researched the causes of longevity, and examined fertility among university educators. It also explored the eugenic implications of child labour, alcoholism, "inferiors", and hereditable traits. The commission additionally conducted genetic research into a selected family, the Pejšes, and published the results in Charles University's *Anthropologie* journal [2]. The genealogy of three other Czech families, Frič (Anton Johann Fritsch), Myslbek (Josef Vaclav Myslbek) and Purkyně (Johann Evangelist Purkinje), were likewise researched. The department ran two separate organisations: the *Ústav pro ochranu přírody a krajiny (Institute for Nature and Landscape Protection)*, which established nature reserves throughout Czechoslovakia and arranged for their protection, and the *Ústav pro použitou ornitologii (Institute for Applied Ornithology)*. Its main competencies were eugenics, practical ornithology, hydrobiology, local history, and monitoring the country's natural resources, such as coal, timber, vegetable oils, peatlands, and water. It additionally oversaw methods of extracting petroleum and efficient economic use of all resources [2].

The Department of Agriculture and Forestry (Department 2) cultivated and harvested forests and transported the timber cut from them. They also investigated the potential automation of previously manual coating and machining of wood, the development of profitable dredging and limits to technical progress in agriculture. It accordingly engaged in continued land reforms, fish farming, dendrology, flour milling, use of seeds from the United States, democratisation of education and independent rural learning, education of rural youth, and agricultural enlightenment. Forty-seven commissions were eventually set up for areas, such as barley production, red clover seed and other fodder production, preservation of regional varieties, arable farming, composting, and dairy cooperatives. Its concerns included the production of enough food to meet domestic needs with optional importation and

[13] A total of 13 volumes were published by the department. They covered nature, humans, language, history (two volumes), government, labor, writing, art, technology, lifelong education, the written Czech and Slovak languages, and ethnography.

[14] In 1923–1927, members of the Radiotelegraphy Commission co-wrote the law covering the use of wireless receiving and transmitting stations and included August Žáček (1886–1961), inventor of the cavity magnetron, and Ludvík Šimek (1875–1945), a pioneer of radio engineering in Czechoslovakia. After the independence in 1918, he constructed a radiotelegraph transmitter at the Petřín Lookout Tower in Prague for the government's needs. It became the first wireless connection between Czechoslovakia and the rest of the world when it provided radio communication with Paris. Classified dispatches from the Foreign Ministry used to be transmitted over this link. A year later, radiotelephone transmissions began from this station. Subsequently, radio links with Moscow and Rome were established. Profesor Šimek was the lead specialist in the MAL's Department of Mechanical and Electrical Engineering (Department 4).

[15] It was superseded in 1931 by the *Názvoslovným sborem pro vědy exaktní, přírodní a technické (Nomenclature for Exact, Natural and Technical Sciences)*.

the use of calcium cyanamide in agriculture. There were likewise two institutions within the Department of Agriculture and Forestry. The *Ústav pro výstavbu vesnic (Institute for Rural Development)* sought to regulate the layout of villages and rural hygiene. The other organisation was the *Ústav pro hospodárnost práce v zemědělství (Institute for Agricultural Economical Labor)*. Most of Department 2's remit was assigned in 1924 by the newly-established *Československá akademie zemědělská (Czechoslovak Academy of Agriculture)*, itself founded that year and which survived until 1952.[16]

Researchers and engineers in the Department of Civil Engineering (Department 3) were members of a commission that organised the construction of new railway stations in Prague or the reconstruction of the city's existing stations. They explored new brick-making processes, cost-saving machine designs, circular cross-section pipes, and different sand and cement mixtures; examined the underlying physics and resistance to motion associated with rolling friction; reviewed materials and construction methods for fast and inexpensive construction of residential buildings and stone-filled embankments; and considered automatic recording devices for measuring water depths and velocities. They also conducted scientific research on how to increase the efficiency and profitability of Czechoslovak railways and how to modify the network of major roads in Czechoslovakia. The different commissions operating under the department researched and tested physical structures and construction materials used in civil engineering, studied methods for more economical construction work, standardised civil engineering, promoted cooperation among engineers in defence, preserved engineering monuments and experimented with weirs and valley-dam models. The *Ústav pro stavbu měst (Institute for Urban Construction)* focused on the application of systematic technological procedures and practical techniques for construction in towns and communities. It was also engaged in urban development, regulation and planning for cities in Czechoslovakia as well as the construction of sewer systems, and the preservation of monuments, green zones and medicinal springs, while also serving as an advisory body for Czechoslovakia's new building code [39]. A prominent member was František Klokner (1872–1960), rector of Czech Technical University in Prague, who founded there the *Výzkumný a zkušební ústav hmot a konstrukcí stavebních (Building Testing and Research Institute)*. It was later renamed and is known today as the Klockner Institute.

[16]In 1952, the Academy was dissolved by the act that created the Czechoslovak Academy of Sciences. Its activities were taken over by the Czechoslovak Academy of Agricultural Sciences (1952-1962), then afterwards by the Czechoslovak Academy of Agriculture (1969-1993), and today, they are currently carried out by the Czech Academy of Agricultural Sciences. All of these academies sought to endorse and coordinate agricultural research in Bohemia and Moravia, and accordingly in all of Czechoslovakia. See [38].

The Department of Mechanical and Electrical Engineering (Department 4) brought together mechanical, electrical, metallurgical, foundry, and mining engineers acting in the public interest and was extremely active. It underwrote the development of a number of inventions that would have otherwise never seen the light of day, funded publications and launched literary competitions on social issues in technology that were being discussed and debated at the time. Intriguing solutions often came to the surface like a proposal by librarian Sava Medonos to establish a central depository for technical documents, suggested in one such literary competition. Following up on the suggestion, preparations were made in 1946 for the necessary documentation from all technical disciplines under the *Dokumentační komise (Documentation Commission)* to be placed there. The intention was to supplement scientific and technological knowledge from countries with which scientists in Czechoslovakia had lost contact for six years because of Nazi occupation.

The *Komise pro živnostenské dílny (Craft Workshop Commission)* endeavored to standardise workshops for tradesmen, while the *Komise pro výzkum a zkoušení materiálu pro strojní průmysl (Commission for Material Research and Testing in the Engineering Industry)* and the *Komise pro výzkum obráběcích strojů (Commission for Machine Tool Research)* coordinated progress at universities and industries. Examples of their work included hardness testing of various materials, structural testing of wood, examining the effect of phosphorus on the mechanical properties of cast steel, and investigating the mechanical properties of cast iron solder for aluminium parts.

The *Kouřová komise (Smoke Commission)* was already striving to allay environmental concerns, such as mitigating the impact of smoke, soot, and ash that was making life difficult in Prague. It persuaded national railways to replace steam locomotives moving trains at Prague's main stations with electric models, considerably reducing the dust and ash generated.

Closely related to the Smoke Commission's efforts was the mission of the *Komise plynárenská (Natural Gas Commission)*, which monitored the development of Czechoslovakia's gas industry, and of the *Komise pro cenu elektrické energie (Electricity Price Commission)*, which sought to unify electricity prices and make them affordable for the general public. Department 4 also prepared a fuel nomenclature, determined each fuel's properties, and studied liquid fuels.

The *Dopravní komise (Transport Commission)* tried to develop automotive technology that would defend Czechoslovakia against attack by Nazi Germany, a viable threat in the late 1930s. Many serious steps were taken and recommendations made to the Czechoslovak government and leading state representatives that came out of a *Memorandum to the Czechoslovak Government outlining automotive transport solutions for the defence of the country* and a *Memorandum on automotive transport in Czechoslovakia* were submitted

to the government on 20 October 1938.

The *Komise pro řešení otázky hluku v Praze (Prague Noise Abatement Commission)* sought to reduce street noise from traffic and factories located in residential neighbourhoods. The specialists serving on this commission developed systems for reducing noise from trams, motorcycles, cars, and other means of transport and addressed complaints about noise in Prague in a *Memorandum from the Masaryk Academy of Labour*.

A commission in charge of comments on public buildings and projects dealt in 1930–31 with the Štěchovice Reservoir, where engineers had not received sufficient information about the planned construction of its dam. Its members felt that the project had significant flaws and published their reservations, resulting in a statement by the Department of Mechanical and Electrical Engineering that summarised the central points and the commission's requirements for how the MAL should communicate its position on public works and projects.

The electrical engineers in Department 4 advocated experimental and testing facilities for high-voltage insulators at Czech Technical University. They also worked towards the electrification of Czechoslovakia and its railways while cooperating with the Radiotelegraph Commission on the amendment of government regulations implementing laws on telegraphs and the sale of radiotelegraph equipment.

Meanwhile, the mechanic engineering section concentrated on standardising the engineering industry. In 1920, standardisation was the overriding issue that had to be addressed. Vladimir List (1877–1971) proposed to the scientific council the establishment of the *Československá normalizační společnosti (Czechoslovak Standardization Society)*. To achieve this goal, the *Komise normalizační (Standards Commission)* was founded, which developed direct contact with the country's industry, ministries, and other officials in its preparatory work. Developed in cooperation with the metalworking and electricity sectors, it was a practical example of how specific initiatives from the Masaryk Academy of Labour built the foundation for the society it subsequently created, which turned out to be incredibly active in standardisation. Besides this, the Department of Mechanical and Electrical Engineering also faced the issue of rationalisation.

At the instigation of the Central Committee, an experimental and testing station for water turbines was proposed and subsequently constructed by local companies. In October 1921, Department 4 suggested experiments with Kaplan turbines at the government-owned hydroelectric power plant in Poděbrady. It also worked with a commission drafting a new law governing boilers. The department also announced a tender for constructing and furnishing exemplary mechanical engineering workshops.

The department's mining section was headed mainly by Alois Parma from the Mining University in Příbram, which developed a respiratory protective device for the Czechoslovak Army. The first ever breathing apparatus designed in Czechoslovakia supplied rescuers with a considerable amount of oxygen to enable them to do even strenuous work while wearing it. Specialists in mining and metallurgy from the Department of Mechanical and Electrical Engineering were also represented on committees organising foundries, preserving medical springs, protecting towns against the impact of mines, and studying liquid fuels [40].

As Nazi Germany was annexing the Sudetenland in October 1938, Emil Zimmler wrote his proposed rescue of the homeland. Part of the proposal addressed obtaining the cheapest possible energy for propulsion systems and rationalisation of the country's electrification. An investigation was conducted to determine whether concentrating the numerous departments engaged in producing and distributing could not lower the price of supply to replace the lost frontier Ervěnice and Poříčí power plants [40]. They also looked at how to save on gasoline purchases abroad and adapt propulsion machinery in automobiles and driving engines in fixed machinery so they could be fuelled by home-produced wood gas.

Research into the physical properties of steam at the highest possible pressures and temperatures conducted by the commission in charge of high-voltage steam research was of great importance and produced valuable results. It was mainly overseen by Jaroslav Havlíček, Ján Zvoníček, and Ladislav Miškovský, the engineers who designed and assembled the device. It was able to achieve extremely precise results. Only five such devices existed in the world. The engineers in the commission presented their research at the Fuel Conference, held in London in 1928, and at international conferences on steam in London (1929), Berlin (1930), and in New York, Washington, and Boston (1934). The High Voltage Steam Research Commission was the principal research unit, evidenced by its role in the *International Steam Tables Conference*, holding the secretariat from 1934, which allowed it to record the research being conducted by the teams and to remain in constant contact with members from the United States, Great Britain and Germany. In July 1938, the efforts of these specialists were appreciated on the commission in a statement by Joseph Henry Keenan (1900–1977) from the *Department of Mechanical Engineering at the Massachusetts Institute of Technology*. Ultimately, the commission was shut down in 1940, when its international character became troublesome during the Nazi occupation of Czechoslovakia. By that time, its work had already been terminated.

The Department of Chemical Engineering (Department 5) was divided into a group producing sugar from maize, a zymotechnical group (brewing, uniform testing of spirits and beer, finding practical applications for spent yeast), a group that tested and standardised the production of ceramics groups, which also

contributed to the establishment of the *Institute for Silicate Research*, and a group devoted to inorganic and organic chemistry. The chemistry group regulated the iron and steel industry and the use of spent sulfite liquor from pulp and paper mills, studied explosives and vegetable oil, and handled the preparatory work for the establishment of the *Coal Institute*. It also handled criticism about the new US regulations on the testing of mine explosives, investigated the chemical stability of stoneware sewer pipes against acids, standardised the testing of explosives, engaged in the manufacture of alkali through electrolysis, and was involved in coal research and experiments with molten cement from France that the Czech Technical University conducted at its laboratories. The department also dealt with reforms in teaching technical subjects at secondary vocational schools. Department 5's commissions included one studying the utilisation of atmospheric nitrogen, chaired by Czech Technical University rector and inorganic chemical technology professor Jaroslav Milbauer (1880–1959), and another dedicated to reforms in the teaching of chemistry in secondary schools [39].

Among others, the Department of National Economics and Social Sciences (Department 6) worked with the Technical Museum, the Union for Encouragement of Industry in Bohemia, the Society of Architects and Engineers, and Czech Technical University and together, they contributed significantly to the establishment of the *Ústřední technická knihovna (Central Technical Library)* in Czechoslovakia. The department was responsible for the ground-breaking *Psychotechnický ústav (Psychotechnical Institute)*, founded during this time, which was conducting psycho-technical examinations of railway transport workers, tram drivers, pilots, and military personnel. It also psychologically analysed manual labourers while they were working and also analysed skilled trades, evaluating the suitability of jobseekers for certain occupations, which were divided into intellectual, clerical, manual, and industrial jobs. Department 6 was the chief centre for promoting the Masaryk Academy of Labour's scientific management of work. It also collaborated closely with the Kingdom of Yugoslavia to encourage the establishment of a similar technical institute in Zagreb. The institutes operating in the department were involved in the scientific organisation of trade, economic relationships from emigration and colonisation, and the technical aspects of managing and organising resources within an industrial context. The *Ústav pro technické hospodářství průmyslové (Institute for Industrial Technical Management)* dealt with industrial losses and suggested how to prevent them [39]. In 1946, Slovene native Ivan Žmavc[17] (1871–1956), a technocrat promoting energeticism and sociotechnics in Czechoslovakia, founded the *Sociotechnical Institute* within the Department of National Economics and Social Sciences. His idea was to measure the energy expended by people at work as the similar energy needed to cover the energy deficit and appropriate such "scientific money" accordingly [42]. Accused of fascist tendencies, sociotechnics later fell out of favour, and never developed any further.

The Masaryk Academy of Labour also encompassed numerous interdisciplinary institutes and commissions such as the *Československý svaz pro výzkum a zkoušení technicky důležitých látek a konstrukcí*, *Výzkumný ústav silikátový*, *Komise pro výzkum paliv*, *Komise pro soupis kamenných lomů (Czechoslovak Union for Research and Testing of Technically Important Substances and Structures, Institute for Silicate Research, Commission for Fuel Research)* and a commission inventorying stone quarries that was associated with the State Geological Office. **There was *Komise pro předcházení úrazům a ochranu pracovníků (Commission for Preventing Injuries and Protecting Workers)* created to prevent loss of productivity at different businesses due to occupational injuries and diseases** [39]**.**

Among other things, the Czechoslovak Union for Research and Testing of Technically Important Substances tested gravel used to manufacture concrete, investigated the use of stone in building facades, researched new methods for testing the adhesion of iron to cement mortar and concrete, and roofing tar paper for fire resistance [39].

The *Ústav pro stavbu měst (Institute for Urban Construction)* would play a major role when it was established within the Department of National Economics and Social Sciences before it moved to the Department of Civil Engineering. Renamed the *Ústav urbanismu a regionalismu (Institute of Urbanism and Regionalism)*, it eventually merged with the *Ústav pro výstavbu vesnic (Institute for Rural Development)* in the Department of Agriculture and Forestry. It engineered procedures and techniques for constructing settlements and towns, urban improvement, construction of sewers, development of rural villages, preservation of monuments, and protection of green zones and medicinal springs. The institute also acted as an advisory body for the enforcement of Czechoslovakia's new building code [39].

6. The meaning of the Masaryk Academy of Labour

Experts from the Masaryk Academy of Labor, especially from Department 4, commented on proposed government measures and reforms in technical secondary and university education among social and societal needs. They also suggested their own solutions to specific issues. The text of their proposed reforms of secondary education was sent to the Ministry of Education and National Enlightenment Text

[17] Žmavc served as secretary general of the Masaryk Academy of Labour for three years, from 1929 to 1932. He published a number of articles based on his socioenergetics and sociotechnics research that discussed scientific management of labour and the application of scientific methods in the social sciences and economics. See [41].

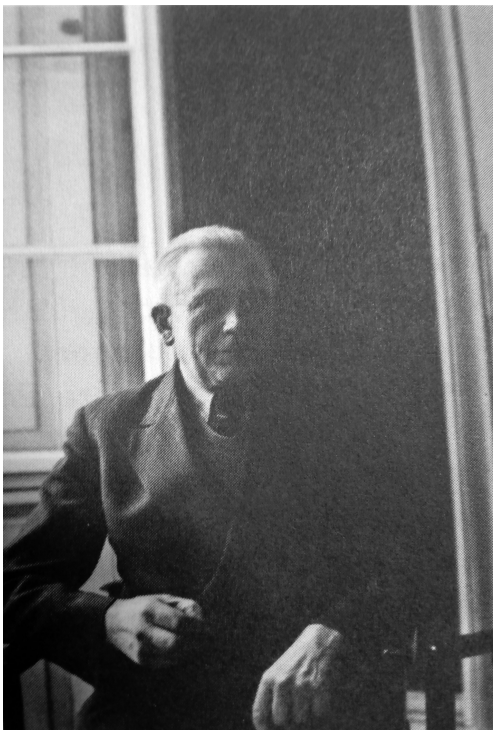

Figure 3. Stanislav Špaček (1876–1954) [39, p. 320].

as early as 1922. Their ideas transcended the times since among their recommendations was not to burden pupils with rote learning but rather to spark intellectual thinking and to develop strong will, character, decisiveness, and good judgment. They would not just memorise and regurgitate, as had been the practice earlier. They also emphasised immersion in foreign languages and practical teaching of them. Such a republican-democrat mind-set was evident in the suggestions they made to distinguish themselves ultimately from the ossified doctrine inherited from the Habsburg Monarchy, which in the post-war years, still prevailed among older pedagogues. In higher education, the faculties of mechanical and electrical engineering also needed to be reformed. The specialists at the Department of National Economics and Social Sciences sought, together with professional educators, to revise the curricula so students would not be overwhelmed by the scope of lecture material and to incorporate constructive and practical subjects.

As part of their promotion and development of the nation's education system, the Masaryk Academy of Labour published technical manuals particularly aimed at factory workers, who were then expected to become more accountable for what they manufactured and to sharpen their interest in the vocation they had chosen to pursue.

From the very start, the Technical Academy showed an affinity toward the United States of America and was inclined toward the system in the US, from where much technical knowledge and modern ideas were put into practice within Czechoslovakia. Even with a donation from Americans of Czech origin to Thomas Garrigue Masaryk of one million Czechoslovak korunas (about $ 29 500 at the exchange rate of the 1920s), the goodwill between the two nations was mainly derived from the US's rapidly developing industry, which was promising for the overall development of newly-established Czechoslovakia.

Accordingly, Czechoslovakia's friendship with the United States stood on similar democratic foundations. The Washington Declaration of the historical rights of the Czech nation and the self-determination of the Slovak nation had been written by President Masaryk in the US capital on 18 October 1918 and was inspired by the United States' own *Declaration of Independence* on 4 July 1776. The friendly relationship enjoyed by the Masaryk Academy of Labour with professional organizations of US engineers and technicians created the opportunity for their Czechoslovak counterparts to receive training and education in US industries, an undertaking considered quite progressive at the time. Stanislav Špaček (1876–1954) (Figure 3) was the Masaryk Academy of Labour's most important intermediary with the US industry, in the years between 1920 and 1924, he worked in the US as legal advisor to the technical and economic section of the Foreign Ministry and as science attaché at the Embassy of Czechoslovakia in Washington. Afterwards, he returned to Czechoslovakia and joined the Ministry of Public Works as an official in technical, economic, and foreign affairs. He had also been crucial in the founding of the Masaryk Academy of Labour. Špaček took the opportunity while he lived in the US to collect scientific and practical information about local industry and transmitted it to Czechoslovakia. The number of contacts he made there enabled the Masaryk Academy of Labour to initiate negotiations for Czechoslovak engineers to work and receive practical training at major US industrial enterprises.[18]

Foreign contacts were established with the Institut Scientifique et Industriel in Paris, the Instituter for arbeidsteknik in Sweden, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Massachusetts Institute of Tech-

[18] A rather illustrious intern in the United States was Marie Zubaníková (1900–1966), a graduate of Czech Technical University in Prague and the first female university-educated civil engineer in Czechoslovakia. In 1924, with assistance from the Masaryk Academy of Labour, she also became the first Czech female civil engineer to complete training in the US, spending her internship in Chicago. Stanislav Špaček handled her stay in the United States and kept in constant contact with her during her entire time there. In Chicago, between the years 1925 and 1929, she worked for Sears, Roebuck & Co. as a designer and structural engineer, working in the building materials department. In the US, Zubaníková was vice president of the American Association of Czechoslovak Engineers in Chicago and joined Chicago Women in Architecture, the American Association of University Women, and the National Geographic Society. She was also a member of Včelky (Bees), a local women's club of compatriots, and the Association of Czechoslovak Engineers in Czechoslovakia. She became quite well known among her friends as a pianist and violinist. Zubaníková would have articles on women's issues published in the United States and later focused her efforts on hygiene, housing, and architecture.

nology or with the Dutch Fédération Internationale de Documentation. During the research of high-voltage steam, close contacts were maintained with similar organisations in the United States of America, the United Kingdom of Great Britain and Northern Ireland (The British Engineering Standards Association, The Royal Institution of Great Britain, The Institution of Electrical Engineers, The British Electrical and Allied Manufactures Association, The United Nations Standards Coordinating Committee), and Germany. The MAL papers on technical-economic problems were also published in the Indian press, Engineering Supplement Advocate of India. MAL collaborated with the Instituto de Comercia e Industria in Madrid on the issue of technical study reform.

Prominent world figures in science and technology were also elected foreign members of the MAL, such as the French professor of metallurgy Albert Portevin (1880–1962), who worked at the École Centrale des Arts et Manufactures, École Supérieure de Fonderie et de Forge a École Supérieure de Soudure. He collaborated with famous chemists of the time, such as Henry Louis Le Châtelier (1850–1936) and Léon Guillet (1873–1946). After the war, he researched steel technology and aluminium-magnesium alloys. He headed the French Société des Ingénieurs Civils, in this company, he founded the Groupement amical Franco-Tchécoslovaque. He was also interested in Czechoslovak graduates so that they could receive a special education in France.

MAL also worked closely with foreign experts with military rank, for example, Louis Faucher (1874–1964), the general from Deux-Sèvres in France, at that time the head of the French military mission in Czechoslovakia and an honoured doctor of technology (École Polytechnique, École de Fontainebleau, École supérieure de guerre) and Émile Rimailho (1864–1954) of Calvados, a French Colonel and a member of the French National Committee for the Scientific Organisation of Work, which was concerned with the construction of cannon and military armament. Among the foreign members, for example, the Russian emigrant prof. Alexey Stepanovich Lomshakov (1870–1960) was accepted too.

Another close relationship was maintained with the Kingdom of Yugoslavia, where it initiated the establishment of a similar technical institute in Zagreb. Contacts are also documented with Japan, where Ing. Dr. Špaček (1876–1954) presented a proposal for the establishment of the World Engineering Federation at the World Congress of Engineers in Tokyo [43].

7. The demise of the Masaryk Academy of Labour

The Protectorate of Bohemia and Moravia suppressed the original Masaryk Academy of Labour, although it continued under the new name of the *Czech Academy of Technology*, so that the name of Czechoslovakia's first president, Thomas Garrigue Masaryk, would not appear as a reminder of democracy when it existed and a nation that was free.

With the end of World War II, the Masaryk Academy of Labour returned to its old name and went back to its pre-war activities. Unfortunately, that would last for only three years, and this tenure came after losing so many personalities who had paid the ultimate price for the liberation of Czechoslovakia. Having finally concluded its previous missions, the Masaryk Academy of Labour and specifically the Department of Mechanical and Electrical Engineering was looking ahead and addressing environmental issues, such as harnessing wind power to drive industry and expanding the use of nuclear energy. However, circumstances would force it to fulfil these ambitions and plan no further. In 1952, a law adopted in Czechoslovakia (Act 52/1952) established a unified *Czechoslovak Academy of Science* that would be organised according to the model employed in the Soviet Union. It eventually took over the role of some former traditional scientific institutions like the *Royal Bohemian Society of Sciences*, founded in 1784, the *Czech Academy of Sciences and Arts* (1890) and the *Masaryk Academy of Labour* (1920).

Nonetheless, science outside of Czech universities had strong roots in Czech society and has grown over the centuries to become today's esteemed Czech Academy of Sciences. The Masaryk Academy of Labour, as the first ever Czech technical academy, contributed significantly to science today as it assisted in establishing the foundations of modern science and engineering.

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