ELISABETH VAN MEER

'THE NATION IS TECHNOLOGICAL'

TECHNICAL EXPERTISE AND NATIONAL COMPETITION IN THE BOHEMIAN LANDS, 1800–1914*

In 1891, a teenager by the name of Vladimír List (1877–1971) visited the Provincial Jubilee Exhibition in Prague. The exhibition was organized to showcase the latest 'Bohemian'[1] accomplishments, in celebration of a century of progress since the first industrial exhibition held in Prague in 1791.[2] Strolling along the fair grounds, visitors like List could encounter displays from agricultural, sugar and paper manufacturers, and the more recently established mechanical and electrical works.[3] The electrical company of František Křižík in particular bedazzled visitors with a waterfall that lit up in multicolour. Křižík had also installed the first electric tram track in Prague (which connected Letná to the exhibition grounds).[4] The young List was impressed by this modern spectacle, as were many among the millions of visitors attending the Jubilee that year.[5]

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[1] I will use the term 'Bohemian Lands' (*České země* in Czech, *Böhmen* in German) to designate the historic territories of Bohemia, Moravia and Austrian Silesia.

[2] CATHERINE ALBRECHT, Pride in Production. The Jubilee Exhibition of 1891 and Economic Competition between Czechs and Germans in Bohemia, in: Austrian History Yearbook 14 (1993), p. 101-118, p. 102.

[3] OTTO SMRČEK, Pražské výstavy v letech 1877–1898 a strojírenství, in: Dějiny věd a techniky 24 (1991), p. 91-101, p. 95-98; ALBRECHT, Pride in Production, p. 114.

[4] Ibid., p. 113; SMRČEK, Pražské výstavy, p. 98.

[5] SMRČEK, Pražské výstavy, p. 94 notes the exhibition drew close to two and a half million visitors; ALBRECHT, Pride in Production, p. 102 cites similar reactions from visitors. And even Emperor Franz Joseph 'clearly found the exhition's industrial and commer-

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In interwar Czechoslovakia, List would become a prominent professor of electrical engineering. Looking back at the 1891 exhibition in his memoirs, the event had become linked both to a budding sense of patriotism and his commitment to technical expertise:

> 'The exhibition showed me the scope of Czech industries and the workmanship of Czech crafts [...] and I was especially interested in the machines that are moved by steam engines, by electricity and other [means] [...]. At that moment I really became a patriot, proud of Czech work, which presented to the world even the marvellous fountain of Křižík.'[6]

By 1895, List, who also spoke German, enrolled in the Czech rather than the German Technical College in Prague. By 1908, he accepted a professorship at the Czech Technical College of Brno.[7] And, as we will see below, he became a leading voice for reforming Austrian and especially Czech technical education.

List's visit to the Provincial Jubilee Exhibition is therefore exemplary for the key questions examined in this article. What did it mean to be a 'technical expert' in nineteenth-century East Central Europe? And how did the imperial context shape the position of technological knowledge and expertise in the new Czechoslovak state after World War I? For engineers in the Bohemian lands like List, these questions were not easy to answer. As part of the Habsburg Empire, the province was home to speakers of German and Czech who, especially before 1848, were often bilingual and nationally indifferent. But by the turn of the century, the question whose industry and technology an engineer ultimately was creating – the Habsburg Empire's, the Bohemian lands', the nation's, and/or the profession's – became a prominent one. Similarly, the question whether the 'state' or the 'nation' actually recognized engineering graduates as technical experts became of key concern.

This article will explore these questions by looking at the writings of Bohemian engineers who published mostly in the Czech language (including monographs, memoirs and articles in the professional journals and the intellectual magazines of the time). We will see that as the century progressed, and as Bohemia industrialized at an impressive rate, technological

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cial displays fascinating'. HUGH LECAINE AGNEW, The Flyspecks on Palivec's Portrait. Francis Joseph, the Symbols of Monarchy, and Czech Popular Loyalty, in: The Limits of Loyalty. Imperial Symbols, Popular Alliances, and State Patriotism in the Late Habsburg Monarchy, ed. by LAURENCE COLE/ DANIEL UNOWSKY, New York 2007, p. 86-112, p. 99.

[6] VLADIMÍR LIST, Paměti, Ostrava 1992, p. 26-27 (author's translation).

[7] Český biografický slovník XX. století, ed. by JOSEF TOMEŠ et al., vol. 2, K-P, Praha 1999, p. 279.

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expertise became increasingly caught in national terms. By the early twentieth century, a trio of young Czech engineers adopted the position that technology stood at the core of a 'modernizing nation'. At the same time, they complained that their profession was not recognized as having expert status over that nation. In an effort to boost their expert status, this trio then appropriated American scientific management ideology. Perhaps counter-intuitively, this paper also finds that imperial Germany remained a key source for technical reform movements throughout the nineteenth and early twentieth century.

1. Before Engineering was National: Technical Expertise in the Bohemian Lands, 1717–1848

From the eighteenth century until the liberal national revolutions of 1848, technical expertise in the Bohemian lands was not national, but linked to Bohemian and imperial interests. The Bohemian nobility were among the province's first entrepreneurs. They extended their economic base beyond traditional agriculture in the eighteenth century. Especially after Emperor Joseph II abolished serfdom in 1781, several Bohemian nobles exploited mines and established agricultural industries on their estates, and then, by the nineteenth century, invested their wealth in banks and railroads.[8]

The first engineering schools and scientific societies were thus set up under the auspices of the Bohemian estates as well. As early as 1717, a small engineering college was established in Prague. Students of this Estates College were mostly sons of the nobility and high-ranking officers.[9] Also, the Royal Bohemian Society of Sciences in Prague, established around 1772, promoted the production and diffusion of scientific work. Its earliest members included enlightened nobility, clericals, professors from Charles University and bourgeois scholars.[10]

In 1806, the Bohemian nobility and Emperor Franz I approved the transformation of the Estates College into Prague's Polytechnic Institute. Loosely modelled after the French *École Polytechnique* (1794), the school

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[8] EAGLE GLASSHEIM, Between Empire and Nation. The Bohemian Nobility, 1880–1918, in: Constructing Nationalities in East Central Europe, ed. by PIETER M. JUDSON/ MARSHA L. ROZENBLITT, New York 2005, p. 61-88, p. 63.

[9] FRANTIŠEK JÍLEK/ VÁCLAV LOMIČ, Dějiny Českého vysokého učení technického, vol. 2, part 1, Praha 1973, p. 103, p. 144; MAGDALENA TAYLEROVÁ et al., Česká technika/ Czech Technical University, Praha 2002, p. 13, 21, 25.

[10] JOSEF F. ZACEK, The Virtuosi of Bohemia. The Royal Bohemian Society of Sciences, in: East European Quarterly 2 (1968), p. 147-169, p. 150-151.

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was to further industrial development as well. Students received a theoretic grounding in geometry, mechanics and advanced mathematics as well as in the practical arts (such as engineering, architecture, technical drawing, shop practice, chemistry and agricultural technology).[11] Vienna gained the empire's second Polytechnic Institute in 1815.[12] Between 1820 and 1848, their graduates helped lay the foundation for the Habsburg Empire's first period of sustained economic growth.[13]

The language of instruction at these institutions was German. Especially since the reign of Emperor Joseph II, German had become the vernacular language designated to serve as the language of state throughout the territories.[14] However, language use was not thought of as linked to nationality. Recent historical research has shown that, especially before 1848, Bohemians were 'linguistically neutral hermaphrodites'.[15] Often, Czech-speaking parents sent their children to neighbouring families in the summertime to learn German and vice versa.[16] Similarly, although the Royal Bohemian Society published most of its work in German or Latin, members on occasion spoke Czech during sessions. Ultimately, the work of the society was committed to the Bohemian Lands.[17]

The concept of a 'fatherland' was therefore initially not a national one either. Bohemian schools did teach history with the purpose of instilling a 'love of fatherland' in children. By the eighteenth century this meant a

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[11] JÍLEK/ LOMIČ, Dějiny, p. 154, 166-169; TAYLEROVÁ et al., Česká technika, p. 35-39.

[12] By the 1840s, there were polytechnics in Prague, Vienna, Graz, Krakow, Lvov (Polish: Lwów, Ukrainian: L'viv, German: Lemberg), Pest, Milan, Venice and Trieste. GARY B. COHEN, Education and Middle-Class Society in Imperial Austria, 1848–1918, West Lafayette 1996, p. 14.

[13] DAVID GOOD, The Economic Rise of the Habsburg Empire, 1750–1914, Berkeley 1984, p. 39-73; RICHARD H. KASTNER, Die Entwicklung von Technik und Industrie in Österreich und die Technische Hochschule in Wien, in: Blätter für Technikgeschichte 27 (1965), p. 1-186; JIŘÍ POKORNÝ, Ingenieure in Böhmen und der Tschechoslowakei, 1890–1939, in: Professionen im modernen Osteuropa, ed. by CHARLES MCCLELLAND/ STEPHAN MERL/ HANNES SIEGRIST, Berlin 1995, p. 367-381, p. 368.

[14] FREDERICK C. GAMST, Introduction to the English Edition. The Long Road to a Terminus in America. The Railroad Engineering Career of Franz Anton von Gerstner, in: Early American Railroads. Franz Anton Ritter von Gerstner's Die Innern Communicationen (1842–1843), ed. by FRANZ ANTON RITTER VON GERSTNER, Stanford 1997, p. 4.

[15] TARA ZAHRA, Kidnapped Souls. National Indifference and the Battle for Children in the Bohemian Lands, 1900–1948, Ithaca 2008, p. 1, 23. For the significance of 1848 as a starting point in the history of national identity formation and competition in Bohemia: JEREMY KING, Budweisers into Czechs and Germans. A local history of Bohemian Politics. 1848–1948, Princeton 2002, p. 22-30.

[16] Ibid.

[17] ZACEK, The Virtuosi of Bohemia, p. 157.

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sense of loyalty to the entire monarchy, but could be combined with a love for the province or crown land.[18]

One of the most prominent technical experts in this early nineteenth century, serving both Bohemia and the empire alike, was Franz Joseph Gerstner (1756–1832). It was Gerstner who convinced authorities to establish the Prague Polytechnic. The son of a harness maker in Komotau/Chomutov, Gerstner was admitted to Prague's Charles University and the University of Vienna on the basis of his talents in mathematics and engineering. In 1789, Gerstner was appointed professor of advanced mathematics at Prague University. He soon gained a large student following for combining lectures in theoretical mathematics with practical applications. Gerstner also served as the Polytechnic's first head (1806–32), as professor of engineering (1806–32) and as professor of advanced mathematics (1806–22).[19] He built and tested a steam engine there in 1806–07.[20]

In other words, Gerstner's professional life was guided by the vision that technical expertise stemmed from the combination of theoretic and practical knowledge. He expected his students, and his colleagues, to serve as technical experts promoting Bohemian and imperial industry. His own significance as expert consultant remained unparalleled: 'Almost no great technical issue in Bohemia was decided without [his] advice.'[21] Gerstner worked with various iron works, assisted in the construction of several bridges, headed a Bohemian hydraulics agency and advocated the construction of a railway link between the Danube and Moldau rivers.[22] Recognizing his status as an imperial expert,[23] Emperor Franz I elevated Franz

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[18] ERNST BRUCKMÜLLER, Patriotic and National Myths. National Consciousness and Elementary School Education in Imperial Austria, in: The Limits of Loyalty, p. 11-35, p. 23, 26. Before the eighteenth century, fatherland commonly meant province or crown land – such as Bohemia.

[19] GAMST, Introduction, p. 3-9.

[20] TAYLEROVÁ et al., Česká technika, p. 40.

[21] GAMST, Introduction, p. 7; TAYLEROVÁ et al., Česká technika, p. 40, similarly argue that '[e]ven [Gerstner's] contemporaries viewed him as an exceptional individual – a person who had grasped and understood best the significance of technology and the natural sciences for the needs of the economy'.

[22] TAYLEROVÁ et al., Česká technika, p. 40; GAMST, Introduction, p. 7-8.

[23] Architects who designed the monumental Ringstraße in Vienna may be seen as other examples of imperial experts. Also, Otto Wagner, who gained international fame in the late nineteenth century, sought ultimately to 'achieve an imperial universal style'. Notably, this style was contested by two of his students, Pavel Janák (1882–1956) and Josef Chochol (1880–1956) who, like the younger generation of engineers introduced later in this chapter, identified more as Czechs and 'mounted an opposition to Wagner's imperial rationalism'. FRIEDRICH ACHLEITNER, The Pluralism of Modernity. The Architectonic 'Language Problem' in Central Europe, in: Shaping the Great City. Modern Architecture in Central

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Joseph Gerstner into the 'hereditary nobility of the transformed state' in 1810.[24] Gerstner's oldest son, Franz Anton 'Ritter von' Gerstner, subsequently continued in his father's ennobled footsteps. He graduated from the Prague Polytechnic to become a professor of practical geometry at the Vienna Polytechnic. He constructed the first continental (horse-drawn) railway between Linz and České Budějovice (Budweis) that was first proposed by his father.[25] F. Anton von Gerstner was also among the first Bohemians to travel overseas to study American technology.[26]

2. Technical Education and the Nationalization of Engineering in Bohemia, 1848-1914

Emperor Franz Joseph (ruled 1848–1916) was also committed to the development of the Bohemian lands. From the imperial perspective, modernization was needed to keep Austria powerful on the European continent. The rise of Prussia and, after 1871, the unified German Empire, was of concern. Austrian reforms were often modelled after German examples. And from this perspective, Franz Joseph's reforms were a success. They facilitated the 'railroad boom' of the 1860s and 70s.[27] Austrian capitalism ultimately transformed in ways comparable to Germany. By 1914, the Austrian economy was 'scarcely more than a decade' behind its northern neighbour in terms of its scale of industrial concentration.[28]

From a Bohemian perspective, industrialization and educational reforms went hand in hand with new linguistic and, ultimately, national divisions. In 1867, Franz Joseph granted relative autonomy to the Hungarian crown lands in an accord that became known as the *Ausgleich*. Czech Bohemian

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Europe, 1890–1937, ed. by EVE BLAU/ MONIKA PLATZER, Munich 1999, p. 94-106, p. 100-101.

[24] GAMST, Introduction, p. 8.

[25] F. Anton von Gerstner was unable to complete the entire line, however. He faced mounting criticism for 'overbuilding' and ultimately failed to receive sufficient funding. Ibid., p. 12-14.

[26] Von Gerstner left for the United States in 1838. He died in Philadelphia in 1840. His reports were published posthumously, respectively by his wife and an associate: CLARA VON EPPLEN-HÄRTENSTEIN, Beschreibung einer Reise durch die Vereinigten Staaten von Nordamerica in den Jahren 1838 bis 1840, Leipzig 1842; LUDWIG KLEIN, Die inneren Communikationen der Vereinigten Staaten von Nordamerica, Wien 1842–1843.

[27] The period between 1869 and 1873 is known as the *Gründerzeit*. Railroad production stimulated output and technological and organizational changes in mining, iron and steel production, machine works and banking. GOOD, The Economic Rise, p. 164.

[28] Ibid., p. 229.

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leaders together with a faction of the Bohemian nobility had been petitioning for a similar recognition of Bohemia's historic crown land rights.[29] Yet, Bohemia's gains in 1867 were limited to those comprised in the Fundamental Laws. These laws, amongst others, gave 'every race' in Cisleithania 'the inviolable right to preserve and cultivate its nationality and language'.[30] Specifically, it gave Czech (and German) speakers in the Bohemian lands the right to receive elementary education in 'the mother tongue' if they constituted a linguistic majority.[31] Although these laws were not intended to link language use and instruction with nationality, in practice this became increasingly the case.

This was true for higher technical education as well. Although the Prague Polytechnic was founded as a Bohemian institution, with German as the language of instruction, by the early 1860s, three professors initiated lectures in Czech as well.[32] In 1863, the Polytechnic initially accepted a new 'organic statute' promising to teach all core courses in both Czech and German.[33] But in the aftermath of the 1867 *Ausgleich* with Hungary, national tensions and resentment in Bohemia significantly increased. In 1869, the Bohemian Diet and Franz Joseph therefore allowed for the Polytechnic to be separated into German and Czech institutions.[34] Other Bohemian institutions of higher education followed. Brno's Technical College in Moravia, established as a polytechnic in 1850, was divided in 1899. Charles University in Prague split up in 1882.[35]

The establishment of separate linguistic educational tracts reinforced the formation of separate professional identities also after graduation. For example, in 1866, the Society of Engineers and Architects in the Bohemian Crown Lands (*Spolek inženýrů a architektů v království Českem* – SIA) was established as a professional Bohemian organization. Its journal was published in both Czech and German editions. But when the Prague Polytech-

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[29] The states rights faction among the nobility was known as the *Feudal-Konservative*. Opposing them were Bohemian nobility who believed in strong centralization from Vienna with German as a universal, imperial, state language. These were the *Verfassungstreue Großgrundbesitzer*. GLASSHEIM, Between Empire and Nation, p. 68-69.

[30] Cited in KING, Budweisers, p. 37.

[31] BRUCKMÜLLER, Patriotic and National Myths, p. 14. See also: HANNELORE BURGER, Sprachenrecht und Sprachgerechtigkeit im österreichischen Unterrichtswesen 1867–1918, Wien 1995.

[32] TAYLEROVÁ et al., Česká technika, p. 61.

[33] Ibid., p. 62.

[34] Ibid., p. 64; JÍLEK/ LOMIČ, Dějiny, p. 492-513.

[35] OTAKAR FRANĚK, Dějiny české vysoké školy technické v Brně, vol. 1 – until 1945, Brno 1969, p. 38, 64.

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nic separated, a group of SIA members left to form the German Polytechnical Society (*Deutscher polytechnischer Verein*). In 1883, those who remained in the SIA rewrote the bylaws to render it an association representing Czech engineers in Bohemia.[36] Furthermore, in 1895, the Czech Technical Foundation (*Česká matice technická* – ČMT) was established in Prague. To compete with the primacy of technical literature in German, this publishing house devoted itself to the production of 'high quality, yet cheap Czech technical literature'.[37]

But if linguistic educational reforms ultimately had a divisive nationalistic impact on the engineering profession in Bohemia, Franz Joseph's strengthening of the academic standing of all technical colleges meant that the possibility for a shared imperial outlook was retained for the profession as well. The impetus for these reforms was given by Franz Grashof, a founding member of the Association of German Engineers (*Verein Deutscher Ingenieure*) in Berlin. His 'Manifesto of 1864' called for a technical college (*technische Hochschule*) to train engineers of all specializations for employment in civil service and industry.[38] The Vienna Polytechnic became a *Hochschule* in 1872, Prague gained a *Hochschule* and a *vysoká škola technická* in 1879 and Brno's polytechnic became a *Hochschule* in 1873.[39]

Increasing the academic standing and employability of its growing number of students was also of common concern to the leadership of the Bohemian colleges. This was again equally true for the German *Hochschulen* and the Czech *vysoké školy*. Linguistic separation was not perfectly synonymous with nationality, nor did it preclude use and knowledge of each others' facilities. For example, many students who identified as Czech continued to enrol in the German technical colleges in Prague and Brno. At Prague's German Technical College, Czech students made up about one fourth of enrolments in the 1870s, one third in the 1880s, and about twenty per cent by 1890.[40]

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[36] EMIL ŽENATÝ, Spolek Československých inženýrů, in: Průvodce světem techniky, ed. by BEDŘICH MANSFELD, Praha 1937, p. 365-367, p. 365; IRINA SEIDLEROVÁ, Science in a Bilingual Country, in: Bohemia in History, ed. by MIKULÁŠ TEICH, Cambridge 1998, p. 229-243, p. 237.

[37] LADISLAV VOTRUBA, Centenary of the Česká Matice Technická. A Foundation for Publishing of Technical Books, in: Dějiny věd a techniky 28 (1995), p. 177-187, p. 187.

[38] KEES GISPEN, New Profession, Old Order. Engineers and German Society, 1815-1914, Cambridge 1989, p. 78-80. The Berlin Hochschule was established in 1879.

[39] COHEN, Education, p. 51; POKORNÝ, Ingenieure in Böhmen, p. 367.

[40] VÁCLAV LOMIČ, PAVEL HORSKÁ, Dějiny českého vysokého učení technického, vol. 1, part 2, Praha 1978, p. 175.

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Czech students who enrolled in Prague's Czech Technical College also regularly audited classes in their German counterpart.[41] Consequently, changes that were introduced at Czech-language technical colleges were partly intended to better compete with German-language institutions. For example, new professors were expected to bring in considerable practical experience. At Prague's Czech Technical College, Professor of Machine Engineering Jan Tille built his own machine models for teaching in 1875.[42] Brno's Czech Technical College hired leading engineers from nearby machine works, such as František Kovářík, as 'honorary lecturers'.[43] Technical colleges also tried to offer their students more hands-on practical training. The model for this again came from imperial Germany. In the mid 1890s, German technical colleges began establishing research laboratories after several professors, including Professor of Mechanical Engineering Alois Riedler, had visited the 1893 World's Columbian Exposition in Chicago.[44] Research laboratories, they believed, had allowed American technology to run ahead of German engineering.[45] Austria's technical colleges sought to follow suit. For example, one of the earliest research institutes at Prague's Czech Technical College was devoted to the sugar industry.[46] In 1905, Prague's German Technical College established a small laboratory for mechanical engineering, while Vienna's Technical College was scheduled to receive one in 1912.[47] In 1913, Professor Antonín Smrček received permission to construct a laboratory for hydraulic engineering there – among the first in Austria and the world.[48] In 1911, Professor Karel Ryska built a laboratory for testing cutting tools.[49]

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[41] Ibid., p. 57.

[42] Ibid., p. 151; TAYLEROVÁ et al., Česká technika, p. 73.

[43] FRANĚK, Dějiny české vysoké školy technické v Brně, p. 86.

[44] The World's Columbia Exhibition celebrated the four-hundredth anniversary of Christopher Columbus's voyage to the Americas. This fair attracted more than twenty million visitors and emphasized America's rise as an industrial and cultural world power. NORMAN BOLOTIN/ CHRISTINE LAING, The World's Columbian Exposition. The Chicago World's Fair of 1893, Champaign 1992; ROBERT MUCCIGROSSO, Celebrating the New World. Chicago's Columbian Exposition of 1893, Chicago 1993; TRUMBULL WHITE/ WILLIAM IGLEHEART, World's Columbian Exposition, Chicago, 1893, Boston 1893.

[45] GISPEN, New Profession, p. 151-159.

[46] ALBÍN BAŠUS, Technické školství a jeho význam, in: Přehled 15 (1911), p. 272-274, p. 274.

[47] VLADIMÍR LIST, Technické studium, in: Technický obzor (1911), p. 170-174, 178-180, 184, 187-188, p. 172.

[48] FRANĚK, Dějiny české vysoké školy technické, p. 275.

[49] OTTO SMRČEK, Přehled vývoje obrábění kovů v letech 1900-1945, in: Studie z dějin techniky 1 (1988), p. 43-227, p. 217.

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Consequently, between 1848 and 1914, a larger cadre of academic engineers was created in Bohemia than ever before.[50] Graduates of *technische Hochschulen* and *vysoké školy technické* in Brno and Prague alike considered themselves technical experts on account of their higher technical education. As in Gerstner's days, this belief was based on their specialized theoretic and practical knowledge – now trained with greater hands-on experience. However, linguistic separation in education had also begun to produce lasting professional divisions into German and Czech institutions.

3. The Nationalization of Bohemian Industry and Technology, 1848-1914

Bohemia rose as an industrial power within the empire over the course of the nineteenth century. This process of modern industrialization was shaped by nationally indifferent, Czech and German Bohemians alike. Fortunate geological and geographic conditions, and Habsburg educational reforms and economic policies all contributed as well. However, starting in the 1880s, the question of who produced and owned what components of Bohemian industry became a prevalent one. Both German and Czech nationalists began to pursue an increasingly aggressive strategy of economic nationalism to boost greater political leverage over the province. This economic nationalism was facilitated by the introduction of regular censuses in the 1880s. Austria's census required citizens to register one language of use (*Umgangsprache*) only. Again, from the imperial point of view, this did not represent nationality. Yet it soon inspired nationalists to compete over their 'national property' (*Nationalbesitzstand*, *národní majetek*).[51]

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[50] COHEN, Education, p. 279: If in 1889/90, a total of 1,789 students were enrolled in a technical college in Austria-Hungary, a decade later, in 1899/1900, there were 5,334. And by 1909/1910, as many as 10,805 students were enrolled.

[51] PIETER M. JUDSON, Guardians of the Nation. Activists on the Language Frontiers of Imperial Austria, London 2006, p. 27. German economic nationalism is analysed in: PIETER M. JUDSON, 'Not Another Square Foot!' German Liberalism and the Rhetoric of National Ownership in Nineteenth Century Austria, in: Austrian History Yearbook 16 (1995), p. 83-97. Czech economic nationalism is the topic of: CATHERINE ALBRECHT, National Economy or Economic Nationalism in the Bohemian Crown Lands 1848-1914, in: Labyrinth of Nationalism. Complexities of Diplomacy. Essays in honour of Barbara and Charles Jelavich, ed. by RICHARD C. FRUCHT, Columbus 1992, p. 69-83; CATHERINE ALBRECHT, The Rhetoric of Economic Nationalism in the Bohemian Boycott Campaigns of the Late Habsburg Monarchy, in: Austrian History Yearbook 12 (2001), p. 47-68.

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In other words, the Bohemian industrial economy was being split up into German and Czech accomplishments, depending for example on the national loyalty of its founders or the source of its (investment) capital. Regarding the latter, Czech Bohemians claimed companies financed by credit cooperatives, cooperative sugar refineries and other agricultural coops, or businesses owned by the *Živnoštenská Banka* (a Czech universal joint stock bank).

Bohemian businesses that were imperial in outlook and/or amorphous in their nationality found themselves pulled into this national economic competition. The Škoda machine works in Pilsen/Plzeň, for example, were originally set up by Emil Škoda (1839–1900) in 1869. Educated at Prague and in Karlsruhe, Škoda likely thought of himself as an Austrian first, as did his son Karel Škoda (1879–1929) who inherited a majority share in the works in 1900.[52] Much of its management staff and labour force likely had a mix of nationally indifferent, German and Czech loyalties. But the company was present at significant Czech industrial exhibitions.[53]

The most important of these was the Jubilee Exhibition of 1891. On the one hand, this Prague exhibition fitted in the tradition of industrial fairs dating back to the eighteenth century. This tradition had gained special prominence by 1851 with the Great Exhibition at the Crystal Palace in London. Late nineteenth-century fairs, amongst others, sought to celebrate industrial progress, to sell products and to exchange technical information. But most of all, a fair was to boost popular pride of and international

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[52] Emil Škoda's father, Franz Škoda, was a physician in Pilsen/Plzeň. He climbed the imperial ladder and was knighted by Franz Joseph in 1866. Emil Škoda was born in Pilsen/Plzeň in 1839. He studied four semesters at the Prague Polytechnic, graduating ultimately from Karlsruhe Polytechnic in the early 1860s. He was named a member of the House of Lords in Vienna, where he joined the centralist '*Verfassungstreue*' Bohemian nobility (see note 29). His son Karel Škoda studied at the *Technische Hochschule* in Stuttgart and Zürich. SKODA, Skodawerke 1869–1939. Jubiläums-Denkschrift der Skodawerke, Pilsen 1939, p. 9-10; Český biografický slovník XX. století, ed. by JOSEF TOMEŠ et al., vol. 3, Q-Z, Praha 1999. Valentina Fava's contribution, People's Cars and People's Technologies. Škoda and Fiat Experts face the American Challenge (1918–48), in this volume significantly analyses Škoda's use of American knowledge starting in the interwar period, after Czechoslovakia had 'nostrified' the company. (This process of naturalizing joint-stock companies is described in: ALOIS RAŠÍN, Financial Policy of Czechoslovakia during the First Year of its History, Oxford 1923, p. 135-137. ALICE TEICHOVA, An Economic Background to Munich. International Business and Czechoslovakia 1918-1938, Cambridge 1974, p. 196 specifically analyses the transfer of Karel Škoda's shares in 1919).

[53] Škoda participated at the exhibit organized by the SIA in 1887 and at the Jubilee Exhibition of 1891. SMRČEK, Pražské výstavy, p. 92, 97.

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esteem for the nation state and/or the imperial power that hosted it.[54] What was unusual about the Provincial Jubilee Exhibition, therefore, was that the industries, crafts and arts on display aimed to strengthen the cause of an aspiring nation that was as yet without the recognized rights of a state.

As described in the introduction above, the Jubilee Exhibition came to constitute a turning point. Initially, it was scheduled to display all of Bohemian accomplishment. However, during the long process of preparation, German Bohemian leadership decided to boycott the fair.[55] The exhibition subsequently emerged as the first national Czech industrial exhibition. All Czech Bohemian industries, or those compelled for economic reasons to align themselves with the Czech nationalist cause, were present at the Jubilee. Consequently, the 1891 Jubilee came to be remembered as having demonstrated for the first time the impressive technological dimension of the Czech nation. Besides List, Czech engineer Jaroslav Veselý also reflected on how the Jubilee Exhibition 'for the first time led to the realization that the Bohemian lands and the Czech nation had a lot of meaning, in economy, industry and technology'.[56]

The establishment of the Technology Museum of the Bohemian Crown Lands in 1908 was another pivotal event in the 'nationalization' of Bohemian industries. It also once more showed the significance of imperial German examples. In 1903, Oskar von Miller (1855–1934) established the Deutsches Museum in Munich. It boosted the accomplishments of German industry and technology – i.e. the technological dimension of the German nation – and presented them to a broad audience. In Austria, both Wilhelm Franz Exner (1840–1931) at the Agricultural University in Vienna and the faculty of the Czech Technical College in Prague sought to follow the example of the Deutsches Museum.[57]

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[54] There is a growing historiography on industrial fairs and exhibitions. Recent work specifically concerned with East Central Europe includes: ALBRECHT, Pride in Production; ALICE FREIFELD, Marketing Industrialism and Dualism in Liberal Hungary. Expositions, 1842-1896, in: Austrian History Yearbook 19 (1998), p. 63-91; ALEXANDER GEPPERT, Fleeting Cities. Imperial Expositions in Fin-de-Siècle Europe, New York 2010; ALENA JANATKOVÁ, Modernisierung und Metropole. Architektur und Repräsentation auf den Landesausstellungen in Prag 1891 und Brünn 1928, Stuttgart 2008. An early work on American world's fairs is: ROBERT W. RYDELL, All the World's a Fair. Visions of Empire at American International Expositions, 1876-1916, Chicago 1984.

[55] ALBRECHT, Pride in Production, p. 108-113; AGNEW, The Flyspecks, p. 98-99.

[56] Cited in SMRČEK, Pražské výstavy, p. 99 (author's translation). Veselý was the first head of the Technical Museum in Prague, discussed below.

[57] WILHELM FRANZ EXNER, Das Technische Museum für Industrie und Gewerbe in Wien, Wien 1908; JOSEPH GRUBER, Technické museum pro království České, Praha 1908.

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Exner envisioned a centralized Museum of Technology for Industry and Trade in Vienna, dedicated ultimately to imperial accomplishments. In Prague, it was particularly Czech economist Joseph Gruber (1865–1925) who led efforts to prevent Bohemian achievements from being claimed by Vienna. 'We owe it to our technological past to establish our own museum,' he argued.[58]

In the end, two new technology museums were created. Emperor Franz Joseph laid the keystone for the Technical Museum in Vienna in 1909.[59] The Technical Museum in Prague was officially devoted to Bohemian accomplishments. However, as had been the case with the Jubilee Exhibition, German Bohemian leadership preferred to refrain from participating.[60] Prague's Museum of Technology of the Bohemian Crown Lands became another Czech victory in their competition for 'national ownership' of 'industrial property'.

4. 'The National Economy is Technological': The Rise of Scientific Management in the Bohemian Lands, 1909–14

By the late nineteenth century, thus, Czech and German national leaders competed over Bohemian industry and technology. Yet, this did not mean that academic engineers were seen as national leaders, or even recognized as technical experts.

Compared to Czech university graduates, for example, few engineers had obtained a leading position with a Czech political party before 1900. Jan Kaftan (1841–1909), a prominent railroad engineer, was one exception. He was elected to the Austrian parliament for the Young Czech Party in 1891.[61]

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[58] GRUBER, Technické museum, p. 16 (author's translation).

[59] 100 Jahre. Technisches Museum Wien, http://www.tmw.at/default.asp?id= 2666&cid=2666&al=Deutsch, accessed 20 March 2009.

[60] O technické museum pro království České a jeho významu v průmyslovém i živnostenském pokroku, in: Národohospodářský obzor (1910), p. 392-399, p. 395.

[61] The leadership of the Old Czech Party had included the historian František Palacký, architect Joseph Hlavka and economist Albín Bráf. The Young Czech Party leadership included physicians Edvard Grégr, Václav Samánek, Joseph Sil and Emanuel Engel, mathematicians František Tilsner and Gabriel Blažek, economists Joseph Kaizl and Karel Kramář, and engineer Jan Kaftan. The Czech People's Party, often called the Realist Party, was established in 1901 by professors of philosophy Tomáš Masaryk and František Drtina, and economists Joseph Gruber and Cyrill Horáček. See BRUCE M. GARVER, The Young Czech Party 1874–1901 and the Emergence of a Multi-Party-System, New Haven 1978, p. 133, 134, 304.

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In addition, there were few engineers actually in charge of 'technological work'. In the new world of corporate capitalism, Bohemia's growing cadre of academic engineers was hired into salaried, managerial positions. Jurists held the majority of civil service jobs. This situation was again not unique to Bohemia. Alois Riedler, professor of mechanical engineering at the Berlin Technical College, first commented on the position of academic engineers for the imperial German context. 'Recognition is only given to the work of engineers,' he noted in 1898, 'not to the engineer [himself] and his mental labour.'[62]

By the late nineteenth century, therefore, Bohemian engineers, like their colleagues around the world, sought to develop professional strategies to counter this trend. One alternative, explored by the SIA, was to bolster professionalism at the imperial level. From 1880 to 1900, the SIA sent representatives to the Congress of Austrian Engineers and Architects held in Vienna. Led by the Society of Austrian Engineers and Architects (*Österreichischer Ingenieur- und Architekten-Verein* – ÖIAV) this was a platform that developed a deliberately 'non-national' and 'party-neutral' stance.[63] United in their shared academic background, 'Austrian' engineers so petitioned the imperial government for recognition of their technical expertise.[64]

By the early twentieth century, the SIA could claim some results through their participation in this strategy. The 1907 elections had sent four engineers from Bohemia into parliament.[65] Moreover, in 1908, a Ministry of Public Works was created. It centralized several technological activities, such as bridge and road construction and hydraulic engineering.[66] However, SIA members were also quick to protest that this imperial Ministry of Public Works still provided few high-level positions for engineers compared to jurists.[67]

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[62] ALOIS RIEDLER, Unsere Hochschulen und die Anforderungen des zwanzigsten Jahrhunderts, Berlin 1898, p. 64 (author's translation).

[63] PETER M. BOGRAD, Beyond Nation, Confession, and Party. The Politicization of Professional Identity in Late Imperial Austria, in: Austrian History Yearbook 27 (1996), p. 133-154, especially p. 134, 144-148.

[64] O dosavadní činnosti stálé delegace rakouských inženýrů ve Vídni, in: Technický obzor (1906), p. 21-22, 54-55.

[65] These included Jan Kaftan and Antonín Smrček. JAN BRABEC, Zastoupení obyvatelstva poslanci-techniky, in: Zpráv Spolku architektův a inženýrů v král. Českém 21 (1909).

[66] Obor působnosti ministerstva veřejných prací, in: Zpráv Spolku architektův a inženýrů v král. Českém 26 (1908).

[67] JAN BRABEC, Z debaty o rozpočtu ministerstva veřejných prací, in: Zpráv Spolku architektův a inženýrů v král. Českém 28 (1909).

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Beginning around 1909, three young Czech engineers – mechanical engineer Albín Bašus (1885-1914), chemical engineer Jindřich Fleischner (1879-1922) and civil engineer Stanislav Špaček (1876-1954) – therefore decided upon a new approach. Their strategy to gain recognition as technical experts was to embrace 'scientific management'.[68]

More specifically, the trio sought to persuade the Czech public, Czech leadership as well as their colleagues that only engineers had the necessary modern expertise to keep the national economy competitive within Bohemia, within Austria and even in the world at large. Their outlook was best summarized by Fleischner in 1911, in the preface to *Technika XX. století*. The intent was to

> 'demonstrate to the Czech public at large the possibility of improving our life, our culture, our economy, business, public administration etc., through more intensive technical cooperation, while at the same time reminding the technical intelligentsia of its duty to become engaged in public activities and to contribute to the improvement of our life'.[69]

In other words, rather than waiting for Bohemian or imperial authorities to grant academic engineers better rights, Fleischner, Bašus and Špaček preferred to simply start acting as experts by publicly recommending technological improvements for the betterment of the nation.

These rebellious views of Bašus, Fleischner and Špaček were reflective of their generation. Born into lower-middle-class backgrounds in small Bohemian towns, they had enjoyed a fully Czech education, and had grown up in a period of intensified national economic competition.[70] Yet, at the same time, they were still inspired by German examples as well. It was in

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[68] Developed by American machine engineer Frederick Winslow Taylor, scientific management was originally a system for 'modernizing' machine shops. The term scientific management was coined in 1910 by attorney Louis D. Brandeis in his case against proposed rate hikes by the Eastern Railroads. If the railroads adopted 'scientific management', Brandeis argued, they would be able to cut costs and decrease rates for the public instead. LOUIS D. BRANDEIS, Scientific Management and Railroads. Being Part of a Brief Submitted to the Interstate Commerce Commission, New York 1912. Taylor published his own Principles of Scientific Management, New York 1911, to capitalize on the publicity.

[69] Uvod, in: Technika XX. Století. Revue pro kulturu a technickou ekonomii (1911) (author's translation).

[70] Fleischner was born in Jičín, in 1879, into a Czech-Jewish family. He studied chemical engineering at Prague's Czech Technical College. TOMEŠ, vol. 1, A–J, p. 324. Bašus was born in Velký Nehvizdy, in 1885. He studied mechanical engineering at Prague's Czech Technical College. OTTO SMRČEK, Albín Bašus – Propagátor vědecké organizace práce, in: Dějiny věd a techniky (1992), p. 170-177, p. 171. Špaček was born in 1876 in Slepotice and studied civil engineering at Prague's Czech Technical College. Čestní členové THJ, in: Nová práce (1938), p. 68-69, p. 68.

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Berlin that Bašus and Špaček first met and recognized the potential of scientific management as a professional strategy and an industrializing principle. Taylorite Georg Schlesinger taught at the Berlin Technical College.[71] His journal *Werkstattstechnik*, begun in 1907, promoted new shop floor methods to a broader professional audience.[72] Also, several electrical industries in Berlin – Siemens, Borsig, Bosch and Osram – experimented with Taylorite measures.[73] All these developments much impressed Bašus and Špaček. Upon their return to Prague, they regularly met with Fleischner to discuss their vision.[74]

The trio concluded that the SIA, although Czech, was out of touch with their generation. As Bašus put it: 'Every practicing engineer knows that the SIA is indeed a centre of engineering bureaucracy – to practical industrial life however it is of no significance.'[75] Bašus's verdict on the SIA's journal was the same: It was too devoted to academic technical treatises in civil engineering. The ČMT, established in 1895 as mentioned above, had similarly only published five works on mechanical engineering.[76] To reach out to a broader audience, the trio instead contributed articles to national magazines such as *Přehled* (Digest), *Naše doba* (Our Age) and *Technika XX. století* (Technology of the Twentieth Century) as much as to national professional journals like the *Národohospodářský obzor* (National Economic Review) and the SIA's *Technický obzor* (Technical Review).

In his articles, Bašus, first of all, emphasized the need for Czech industries to reform their interior organization. It was especially his internship at the Siemens-Schuckert works in Berlin that had convinced him of the necessity of a more Taylorite organization. He admired the company's technical department, its team of sales engineers, its shop order system, and its precise system of calculating wages, direct costs and overhead.[77]

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[71] MARY NOLAN, Visions of Modernity. American Business and the Modernization of Germany, New York 1994, p. 19.

[72] SMRČEK, Albín Bašus – Propagátor vědecké organizace práce, p. 173. Bašus praised *Werkstattstechnik* in ALBÍN BAŠUS, Akce k zvelebování průmyslu, in: Národohospodářský obzor (1911), p. 21-29, p. 26.

[73] NOLAN, Visions of Modernity, p. 43.

[74] STANISLAV ŠPAČEK, Inž. Albín Bašus o taylorismu, in: Nová práce (1929), p. 131-133.

[75] BAŠUS, Akce k zvelebování průmyslu, p. 25 (author's translation).

[76] ALBÍN BAŠUS, O hospodářských podkladech a vývoji průmyslu strojnického v Čechach, in: Naše Doba (1909), p. 14-22, 113-118, 187-191, p. 189.

[77] Ibid. These kinds of organizational features are also emphasized in his articles upon his return from Germany: ALBÍN BAŠUS, Obchodní politika průmyslových závodů v Německu, in: Národohospodářský obzor (1913), p. 16-28; ALBÍN BAŠUS, Systemy mzdové v průmyslových závodech strojních, in: Technický obzor (1911), p. 44-46, 50-51, 60-61.

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Few Bohemian industries had introduced such piecemeal reorganizations. Bašus criticized them for focusing too narrowly on 'exterior' issues of economic policy. Industrial strength could not be achieved by cartelization, syndicalism, trusts and other legal and corporate policy issues alone.[78] 'If we want to increase the efficiency of our enterprise, make it more competitive, cheapen its production and improve its prosperity,' Bašus insisted, 'we must change its interior structure, we must gain control over production itself. And this problem is not of a general, nor of an economic-political nature – but it is technological!'[79]

Secondly, Stanislav Špaček especially aimed to demonstrate what technical experts, using 'American' technology and scientific management, could achieve when put in charge of public works. Špaček himself was one of four engineers conducting a series of engineering projects along the Jizer river. He first published a study of American hydraulic engineering works, followed by two reports detailing the construction of a bridge at Sojovice and modifications to the lower stretches of the Jizer river.[80] The latter two reports showed the reader, with the help of numerous photos, the modern use of concrete in constructing the bridge as well as in bolstering the river banks. Špaček also emphasized how his team had precisely calculated the consequences and effectiveness of their engineering designs before actual construction. Moreover, like Bašus, Špaček strongly recommended the use of Taylorite time studies in determining workers' wage rates and their anticipated speed of work. He believed this was also in the workers' interest as it would increase wages for the same amount of energy spent.[81]

Thirdly, Jindřich Fleischner emphasized the significance of 'technological culture'.[82] Humanity had infinite needs, he argued, yet the amount of energy in the world was stable and finite. Over the course of history, technology had allowed people to satisfy more needs, decrease the human work load and increased free time by finding increasingly efficient ways of energy conversion. In Fleischner's vision, technology thus became the essence of culture and social progress. 'If we consider all the influences, besides the direct technical impact,' he argued, 'on law, medicine, art [...]

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[78] BAŠUS, Poznámky k hospodářské politice průmyslových závodů, p. 363.

[79] BAŠUS, Akce ke zvelebování průmyslu, p. 23 (author's translation).

[80] STANISLAV ŠPAČEK, Rozpojování a doprava hmoty hydraulickým způsobem splachovacím, Praha 1909; STANISLAV ŠPAČEK, Stavba mostu přes Jizeru v Sojovicích, Praha 1910; STANISLAV ŠPAČEK, Úprava dolního toku Jizery, Praha 1913.

[81] ŠPAČEK, Úprava dolního toku Jizery, p. 24-28.

[82] JINDŘICH FLEISCHNER, Technická kultura, in: Technický obzor (1911), p. 150-154.

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and so many other fields, we have a mental picture of our immediate future, of technological culture.'[83]

Finally, while comparing Czech education to imperial German examples, the trio also called for further reforms of technical education to prepare engineers still better for their role as technical experts. In this aspect of their campaign they were joined by Vladimír List, then a young professor in electrical engineering. He provided students with lecture notes and lithographs of electrical components, and included legal and economic aspects of electrical engineering in his course.[84]

The foursome, in this case, demanded that Czech technical colleges 'in all specializations, be equipped with laboratories, model [machine] shops and construction sites, so that lectures and practical training in lab, shop or construction create a uniform whole'.[85] In addition, Austrian technical colleges were, once again, to follow the example of Berlin's Technical College which, in 1902, had begun to teach law to mechanical engineers.[86] List and Bašus called for more courses in law, economics and administration and industrial management.[87] Such a more well-rounded and integrated technical education was to produce 'organizers' and 'leaders', the technical experts with 'initiative' needed to further shape a modern nation.[88]

5. Conclusion

Over the course of the long nineteenth century, East Central Europe experienced significant shifts in the notion of 'technical expert'. In the aftermath of the Napoleonic Wars, commoner Franz Joseph Gerstner rose up in Bohemia to become a prominent imperial consultant. He was recognized for his technical expertise by the Bohemian estates, various iron works and by Emperor Franz I alike. To the generations of technologists who came after him, Gerstner's career, even if unusual, represented the ideal in terms of the level of influence he had wielded.

By the second half of the nineteenth century, the Habsburg Empire emerged as an industrial power in Central Europe. Technical education

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[83] FLEISCHNER, Technická kultura, p. 152 (author's translation).

[84] LIST, Paměti, p. 105-107.

[85] LIST, Technické studium, p. 188 (author's translation).

[86] ALBÍN BAŠUS, JINDŘICH FLEISCHNER, Technikové a veřejná správa. Technika a věda právni, přípustění techniku k veřejné správě, Praha 1910.

[87] LIST, Technické studium, p. 188.

[88] BAŠUS, Technické školství a jeho význam, p. 274 (author's translation).

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expanded and its academic status was elevated to that of a technical college. A larger contingent of aspiring technical experts, still mostly from humble middle-class backgrounds, graduated than ever before. But, especially in Bohemia, industrialization developed hand in hand with an increasingly competitive process of national identity formation. And these twin processes reshaped the notion of technical expertise.

On the one hand, nationalized education produced an increasingly nationalized self-image within the profession; Špaček and his colleagues acted primarily as Czech engineers. On the other hand, Bohemia's industrial rise also contributed to an increased appreciation for the role of technology in the constitution of national economic strength. Yet, like their colleagues in imperial Ger-many,[89] the United States[90] and elsewhere[91] in the early twentieth century, the trio of Czech engineers were forced to conclude that their academic training did not automatically translate into a publicly recognized position of technological expertise.

Consequently, American scientific management, learned principally in Berlin, was appropriated by Bašus, Špaček and Fleischner to gain the kind of influence that Gerstner had had a century before. Their strategy was to address a wider national audience, reaching out to a readership beyond the SIA. They promoted the vision that the nation was technological. As technical experts, or 'technical intellectuals', they ultimately sought a public role – a real 'mandate'[92] – as national experts on industry, on civil engineering projects and on 'technological work' in general.

Over the course of Word War I, this assertion of national technical expertise ultimately gained significant national political backing. In 1919, Stanislav Špaček received one million Czechoslovak crowns from then President Tomáš Masaryk to build an engineering academy, the Masaryk Academy of Work (*Masarykova Akademie Práce*, MAP). As the embodiment of Špaček's prewar vision, this mostly Czech-speaking and Prague-based institution was legally authorized to, amongst others, appropriate

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[89] GISPEN, New Profession.

[90] EDWIN LAYTON, The Revolt of the Engineers. Social Responsibility and the American Engineering Profession, Cleveland 1971.

[91] HARRY LINTSEN, Ingenieurs in Nederland in de negentiende eeuw. Een streven naar erkenning en macht, Den Haag 1980; LOREN GRAHAM, The Ghost of the Executed Engineer. Technology and the Fall of the Soviet Union, Cambridge 1992, p. 103.

[92] 'Mandate' is the term Johan Schot coined in the context of Dutch engineers' demands: JOHAN W. SCHOT, DICK VAN LENTE, Techniek as politiek. Ingenieurs en de vormgeving van de Nederlandse samenleving, in: Techniek in Nederland in the twintigste eeuw, deel VII, Techniek en Modernisering. Balans van de twintigste eeuw, ed. by JOHAN W. SCHOT et al., Zutphen 2003, p. 197-231, p. 199.

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American scientific management to modernize the new multinational nation state.[93]

[93] EMILIE TĚŠÍNSKÁ, Vnik Masarykovy akademie práce. Technokratické tendence a účast přírodovědců, in: Technokracie v Českých zemích (1900-1950), ed. by ANTONÍN KOSTLÁN, Praha 1999, p. 103-134, p. 108-110.

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