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Chapter 20

Beginnings of Rocket Development in the Czech Lands (Czechoslovakia)*

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Abstract

Although the first references are from the 15th century, when both Hussites and Crusaders are said to have used rockets during the Hussite Wars (also known as the Bohemian Wars), there is no strong evidence that rockets were actually used at that time. It is worth noting that Konrad Kyeser, who described several rockets in his *Bellifortis* manuscript, written 1402–1405, served as advisor to Bohemian King Wenceslas IV. Rockets were, in fact, used as fireworks from the 16th century in noble circles. Some of these were built by Vavřinec Kříčka z Bitýšky, who also published a book on fireworks, in which he described how to build rockets for firework displays. Czech soldiers were also involved in the creation of a rocket regiment in the Austrian (Austro-Hungarian) Army in the first half of the 19th century.

The pioneering era of modern rocket development began in the Czech lands during the 1920s. The first rockets were successfully launched by Ludvík Očenášek in 1930, with one of them possibly reaching an altitude of 2,000 m. Vladimír Mandl, lawyer and author of the first book on the subject of space law,

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patented his project for a multistage rocket (*vysokostoupající raketa*) in 1932, but this project never came to fruition.

There were several factories during the so-called Protectorate of Bohemia and Moravia in 1939–1945, when the Czech lands were occupied by Nazi Germany, where parts for German A-4/V-2 rockets were produced, but none of the Czech technicians or constructors was able to build an entire rocket. The main goal of the Czech aviation industry after World War II was to revive the stagnant aircraft industry. There was no place to create a rocket industry.

Interest in a rocket industry appeared at the end of the 1950s. The Political Board of the Central Committee of the Czechoslovak Communist Party started to study the possibilities of creating a rocket industry after the first flight into space, and particularly after U.S. nuclear weapons were based in Italy and West Germany in 1957 and 1959. The first project involved the meteorological rockets Sokol I and Sokol II in 1960, which were never completed, as the rocket industry and rocket development came under the exclusive sphere of interest of the Soviet Union. In Czechoslovakia a Rocket Research and Test Institute was created by the Czechoslovak Ministry of Defence in 1963. The first Czechoslovak rockets to find practical use were launched in 1965.

The Origins of Rockets in the Czech Lands

There is a possibility that the inhabitants of the Czech lands first came into contact with rockets during the Mongol invasion of central Europe in 1241. There were two streams of attacking Mongol forces—the northern stream in Silesia and the southern in Hungary. It is known for sure that the Mongols already knew rockets as weapons at that time. There is a strong indication that the southern Mongol force used rockets during the Battle of Móhi (also known as the Battle of Sajó River) on 11 April 1241. The question arises whether rockets were also used at the Battle of Liegnitz, which involved the northern Mongol force and took place 9 April 1241 in Silesia. It is known that, in this battle, troops from Moravia fought the Mongols, who defeated the Christian forces in both the northern and southern battles. Evidently Bohemian and Roman King Wenceslas IV was in charge of defense and created a strong army, which was, unfortunately, just one day's march away from the battlefield near Liegnitz. After their victory the Mongols did not seek battle with Wenceslas's fresh, strong troops and instead invaded through what is known as the Moravian Gate area of Moravia. Areas around Silesian towns, such as Opava (German Troppau), and Moravian towns, such as Olomouc (German Olmütz), were plundered by the Mongols. On the other hand, however, the Mongols almost certainly did not capture any of the

fortified towns in Moravia, despite besieging them. The Mongol troops from Silesia then united with the Mongol force in Hungary.¹

The most significant book on weaponry in the Middle Ages is without doubt the *Bellifortis* manuscript by Konrad Kyeser. This manuscript was most probably written between 1402 and 1405. Konrad Kyeser, who was born in 1366 in Eichstätt in Bavaria, was connected with the University of Law in the Old Town of Prague, where he graduated in 1390. Konrad Kyeser, who had war experience from the 1396 crusade against the Ottoman Empire, probably served as advisor to Bohemian and Roman King Wenceslas IV. At first he wanted to dedicate the *Bellifortis* manuscript to this king, partially because the book was written during his stay in Bohemia. Eventually the manuscript was dedicated to Roman King Ruprecht III. This was probably connected with the arrest of Wenceslas IV by his brother Sigismund, later Roman Emperor and Bohemian King, in 1402. There is an indication that Konrad Kyeser, who sided with Wenceslas IV, was exiled from Bohemia after 1402.

This manuscript is the first demonstrable sign of knowledge about rocketry in Bohemian noble and university circles, at least from the court circle around Wenceslas IV. Kyeser's manuscript dealt with fireworks for warfare and fireworks for pleasure. There is a description of several types of rockets—a vertical flying rocket, a horizontal flying rocket, a rocket launched by a tensed rope, and a rocket launched to deliver a message. It is not known if any of these rockets was actually used. However, some knowledge of rocketry was present in Bohemian court circles at the beginning of the 15th century.²

The first known manuscript of Bohemian provenance describing how to make a small rocket is that of Vavřinec Křička z Bitýšky. Vavřinec Křička's manuscript primarily describes how to cast the muzzle of a gun and/or water tubes for fountains in bronze. Only one page deals with the rocket. It is a simple description in old Czech of how to prepare an entire bronze tube and how to fill it with gunpowder. It is worth noting that there is nothing significant that could be added by contemporary understanding. The manuscript was most probably written about 1569–1576.³

Fireworks started to be common in Bohemian and Moravian noble circles from first half of the 16th century. It was a period of Bohemian history accurately described by Czech cultural historian Zikmund Winter as the “Golden Period of Czech Towns.” For example, the private diary of Count Adam Junior of Valdštejn mentioned how small rockets, from fireworks displayed on 24 July 1607, set fire to five houses in Hradčany, now a municipal district in Prague.⁴

Apart from fireworks it is known that there was also an interest in using rockets for warfare: at least the members of the ruling Habsburg Dynasty were

keen on this subject. There is one manuscript from 1601 preserved in the Library of the Military Historical Institute in which several rockets are described as well. The manuscript is handwritten in German and, unfortunately, the author is unknown. Interesting is a description of a high-attitude rocket with stabilizer (Das ein Regettlenn mit dem Schwancz in die höechenn Fliege). Among the documents relating to this royal family, held in the Prague National Archive, there is a book titled *Novissimum fundamentum et praxis artilleriae, oder Nachtzigesterbesten Mannier neu vermehrter und gantz Grundlicher Unterricht*, written by Captain Ernst Braun from Danzig (now Gdańsk in Poland). This six-volume work was printed in 1682 by Johann Friedrich Gräfen, comprising an entire encyclopedia of the contemporary understanding of artillery warfare, including the use of rockets.⁵

A regular Rocket Unit was created in the Austrian Army after the Napoleonic Wars. The Austrian Army used rockets, developed by Sir William Congreve, in regular army units called Feuerwerks-Corps from 1817 and in the navy from 1821 (later known as Raketeur-Corps from 1851 and Raketeur-Regiment from 1857). The man behind the implementation of rocket weaponry in the Austrian Army was Major Vinzenz von Augustin. Major Augustin was impressed by the use of British rockets during the Battle of Leipzig (also known as the Battle of the Nations, which took place 16–18 October 1813). He persuaded Field-Marshal Count Jan Josef Václav Radecký of Radeč (Radecký of Radeč was born in Bohemia and came from an old Bohemian noble family), then Chief of Staff to Austrian Army Generalissimo Prinz Karl Friedrich Schwarzenberg, and also convinced Austrian Chancellor Prinz Klemens Wenzel von Metternich of the need to recruit rocket troops to the Austrian Army.

Congreve rockets were improved in the Austrian Army (and later in the Austro-Hungarian Army). But after the 1866 war, army command decided that rocket troops had no future in the Austro-Hungarian Army. The last combat use of rockets is documented in the Austro-Hungarian Army in 1869.⁶

The Pioneering Era of Modern Rocket Development

The birth of Czechoslovakia in 1918 brought with it a great interest in aviation, which was significantly sponsored by the Czechoslovak government. But there was no interest in nascent rocketry. If it were not for two enthusiasts born in Western Bohemia—Ludvík Očenáček and Vladimír Mandl—there would be practically no connections between Czechoslovakia and rocketry. Of course it could be mentioned that Frank J. Malina lived with his parents from 1920 to 1925 in Czechoslovakia and read Jules Verne's novel *From the Earth to the*

Moon when he was 12 years old, which greatly affected his future, but such information is really on the margins of this comprehensive research.⁷

The Czech inventor and entrepreneur Ludvík Očenášek was born on 4 August 1872 in Kříše, Western Bohemia, then in Austria-Hungary. He had no university degree and was literally a self-made man who, later in his career, completed his education at a middle vocational school. His wide range of interests is unbelievable. He designed an aircraft rotary engine in 1905, similar to most Gnome-type wide rotary engines. This engine survives in the National Technical Museum collection in Prague. Očenášek constructed an aircraft in 1910–1911 and successfully took off in it in 1911. After it crashed, he abandoned experiments in aviation. It seems the main reason for this was his lack of money.

Ludvík Očenášek was, without doubt, a patriot who fought extensively for Czech and Czechoslovak independence and before and during World War I took part in actions against the Austro-Hungarian Empire. He was in close contact with the subsequent Czechoslovak President Tomáš Garrigue Masaryk and other influential leaders of the Czech National Movement. According to his own Memoirs (the first version written in 1919 and the second and last in 1928), he invented an artillery weapon that he called Vzdušné torpedo (aerial or flying torpedo), which was in fact a rod-like rocket carrying explosives, launched from a simple carriage without a muzzle. Ludvík Očenášek was evidently successful in sending plans for such a “torpedo” through Switzerland to France in March 1915. Delivery was secured by Dr. Josef Scheiner, then Chairman of Czech Sokol Organization (Česká obec sokolská). The plans were also secretly shipped to Italy via Dr. František Kadeřábek, who later served as a Czechoslovak diplomat abroad. Očenášek was duly arrested and investigated for plotting against the Austro-Hungarian Empire, but nothing was proven. In the last days of World War I, he successfully tapped communications between the Berlin and Vienna War Ministries.⁸

From 1928 Očenášek corresponded with Hermann Oberth, a leading German expert in rocketry at that time, and later invited him to Prague. This meeting actually took place. Ludvík Očenášek reached his zenith in rocketry in 1930, when he successfully launched seven solid-propellant rockets on 2 March. Unfortunately there is no information, apart from that which claims that some of these rockets reached an altitude of some 2,000 meters (6,562 feet). It is evident that his main goal in rocketry was to invent a kind of “postal rocket” to deliver mail from Europe to the United States. In the second half of the 1930s, he was involved in the development of hydrodynamic and jet-powered boats. Očenášek supposedly tried to invent some rocket weapons for the Czechoslovak Army, but specific data is missing. There are some suspicions that Ludvík Očenášek was

also involved in the construction of what was known as TRUL (technické raketové útočné letadlo, technical rocket attack plane), which was, in fact, an early type of anti-aircraft rocket. Tests were probably carried out in Přeborn in 1934 and 1935. It is known that the designers Václav Kolář and Václav Smolík were involved, but there is no mention that Očenášek actually took part. It should be noted that this information is based on the recollections of Roman Vlach, published in 1961, and there is a lack of supplementary evidence. Očenášek's plans were halted by the Nazi occupation of the Czech lands on 15 March 1939.

It can be added that Ludvík Očenášek refused to collaborate with Nazi Germany on the development of rockets. He was active in the anti-Nazi resistance, and at the age of 72 he was wounded in a fight during the Prague Uprising of May 1945. After World War II, he patented several new inventions. He died on 10 August 1949. His obituary was printed, for example, in the *New York Times* on 13 August 1949.⁹

Dr. Vladimír Mandl was born on 20 March 1899 in Pilsen. He was the son of a local attorney. Vladimír seemed to be keen on engineering, but studied at the Charles University Faculty of Law in Prague. He graduated in 1921, but maintained his interest in engineering and particularly in flying. He was successful in obtaining his pilot's license and his scientific career combined law and engineering. Beginning with the 1933–1934 academic year, Dr. Mandl started to teach courses, as Associate Professor, on Industrial Law at the Czech Technical University Faculty of Mechanical and Electrical Engineering in Pilsen. Mandl also participated in building the aeronautical collection of the National Technical Museum in Prague. As late as September 1940 Mandl wrote to Vladimír Karmazín, Curator of the Aviation Collection at the National Technical Museum in Prague, about the completion of the Czech Aviation Museum.

Of the scientific works of Vladimír Mandl, the most significant is his book written in German titled *Das Weltraum-Recht: Ein Problem der Raumfahrt*.⁸ Mandl was the first in the world to focus on the issues of space law, so it is no wonder that he had no success with this book. Printed in 1932, only 25 copies were sold during 1932 and 1933, out of 450 published, although his progressive study had an audience after World War II. The same year he published a book in Czech titled *Problém mezihvězdné dopravy* (The Problem of Interstellar Transport). He is well-described as the "Father of Space Law."¹⁰

Mandl was also active in engineering. He patented his High Altitude Rocket Project (vysoko stoupající raketa) with the Czechoslovak authorities on 25 September 1933. The patent had protection from 15 May 1935. Mandl fully described his rocket in a book published in Germany in 1934, but there is no evidence that anybody ever tried to construct this rocket.¹¹

Unfortunately Vladimír Mandl also went down in history as one of the most influential Czech intellectuals with strong anti-Semitic opinions. He mainly wrote in the nationalist oriented daily *Venkov*. His anti-Semitic articles started to appear there from December 1938, after the Munich Crisis and the occupation of parts of Czechoslovakia by Nazi Germany, Hungary, and Poland. It is worth noting that there is no evidence that Mandl collaborated with the Nazis. He died on 8 January 1941 in Pilsen.¹²

These two were literally the first heralds of the coming new age of astronautics in Czechoslovakia, though they were themselves outside the mainstream of Czechoslovak industry and science at that time. Neither of them had any successors.

World War II and the Rocket Industry

Nazi Germany occupied Bohemia and Moravia on 15 March 1939, and the so-called Protectorate of Bohemia and Moravia (Protectorate Böhmen und Mähren) was created. It comes as no surprise that the highly developed Czech industry was used by the Nazis for military production. Among other things, casings were produced for V-1 and A-4/V-2 rocket missiles at Vítkovice Iron and Steel Works and at Wikow Factory in Prostějov. One A-4/V-2 casing made at Vítkovice has survived in the National Technical Museum collection in Prague.

Due to Allied bombing, the Nazis transferred some important factories and research institutes into Bohemia and Moravia, far behind the frontline and in relative safety. The Wilhelm Schmidding Factory, formerly from Cologne (Köln am Rhein), opened a new factory in Podmokly in Northern Bohemia. The primary objective of this factory was to develop a rocket engine and the appropriate fuel. Experiments were performed with liquid, solid, and gas fuels.

Artillery rockets were developed and constructed at the Brno Ammunition Works (Zbrojovka Brno) and the Škoda Works in Pilsen (Škoda Works Plzeň) from 1942. Unguided artillery missiles developed at both factories were almost ready to go into mass production and only the end of World War II stopped these projects. It is worth noting that the development of rockets at the Skoda works was of interest to American scientists after May 1945, when the territory was liberated by U.S. forces. Explosia Semtín, the largest prewar producer of explosives, later amalgamated with the Brno Ammunition Works and Škoda Works and was involved in research into rocket fuel, particularly solid propellants.¹³

What was known as Waffunion Skoda-Brünn was created in 1943. This amalgamation actually brought together the laboratories and research centers at Škoda Works Pilsen and the Brno Ammunition Works, while the Research and

Development Center at Explosia Semtín and Optikotechna Přerov were incorporated later. A new research center for rocketry found convenient space in the old buildings of the former Institute of Mining Engineering (Vysoká škola báňská) in Příbram, some 50 kilometers southwest of Prague.

This new research center reached its peak in 1944, when the German Jet Engine and Rocket Research Institute was transferred there from Grossendorf. This Institute was headed by Rolf Engel, a collaborator of Hermann Oberth from the 1930s, who later became an SS member, with the rank of SS-Hauptsturmführer. His assistant was a Swede, N. W. Larssen. Many Czech technicians and scientists worked there. Engineers Jan Stalšovský, Miroslav Tayerle and Arnošt Zbožínek were especially involved in rocketry. They performed individual calculations and basic research for the Germans without knowing any more about the subject of research. It was the same situation as this at the Brno Ammunition Works and the Škoda Works, where nobody knew the exact purpose of the casings that they were producing.

Scientists at the Příbram Research Center worked on many rocket projects. One of the most influential on the later development of space rockets was described after the end of World War II by Swedish scientist Nils Werner Larssen as the V-101 rocket:

This weapon, in the planning stage only, was being developed at the Příbram [Příbram] Experimental Center by Dr. Boedenwadt, Dr. Teichmann, Dr. Kalschauer and Engineer Thomas. It is a giant rocket, of a total weight of 140 tons, of which 100 tons were to be taken up by the fuel. It was to have a length of 30 m and a diameter of 2.8 m. It was to attain a velocity of 2,000 km per hour and an altitude of 200 km. Its maximum range was calculated to be 1,800 km. It was to be fired by a catapult mechanism, also rocket-operated.¹⁴

Shortly before the end of World War II, the German scientists left the research center in Příbram and practically all the documentation was destroyed. Rolf Engel escaped, and after World War II was involved in rocketry in France. From 1951 he led rocket development in Egypt.¹⁵

Post-War Attempts to Create a Rocket Industry

After World War II, the Czechoslovak aircraft industry had other problems besides rocket development. The aircraft industry reached its peak in Bohemia and Moravia in January 1945, when 120,399 employees were involved. All production of planes, engines, and spares naturally went to the Nazi Luftwaffe. After the end of World War II, a great depression hit the aircraft industry. The number

of employees fell to 14,159 in February 1946 and 3,868 in May 1947. The Czechoslovak authorities endeavored to save some positions for specialists and looked for ways to revive the aircraft industry. There were some attempts to get involved in the development of jet fighters (for example the planned Czechoslovak Letov L-52 jet fighter) and jet engines, but practically no interest in rocketry.¹⁶

Only one institution tried to capitalize on German research into rocketry under the Protectorate after World War II. This was the Military Technical Institute (Vojenský technický ústav), particularly its Department Six. It is not surprising that this Institute has its official headquarters in the former Wilhelm Schmidding Factory in Podmokly. Although Czechoslovak technicians found numerous spares for planes and helicopters under production, and some rocket parts, in former Nazi factories, very little rocket research documentation survived. Only a few pieces of information remained, with no significance for rocket development.¹⁷

Some attempts at rocket development were made. It is worth noting that these primarily involved experiments involving rocket fuel and associated devices. There is a strong suspicion that this actually involved the research previously performed by Explosia Semtín and Zbrojovka Brno during World War II. For example, Brno Ammunition Works patented a Device for Securing Missile Propellant (Zařízení k zajištění hnací náplně pro raketové střely).¹⁸

Under an agreement among the Warsaw Pact nations during the 1950s, all space rocket research and development was left to the Soviet Union. Czechoslovakia was permitted to perform research on field rocket artillery weaponry, and primarily developed artillery multiple launch rocket systems (MLRSs). The development of antiaircraft rocket systems was of marginal interest. The Czechoslovak Rocket Research and Test Institute was created in 1963.¹⁹

The situation seemed to have changed in the late 1950s, when U.S. nuclear weapons were deployed in what was then West Germany and Italy. The Political Board of the Central Committee of the Czechoslovak Communist Party began to study possible ways of creating a rocket industry, but practically nothing was actually accomplished. The only significant project involved the development of the Sokol I and Sokol II meteorological rockets in 1960, but this project did not result in any practical use and the first Czechoslovak meteorological rockets were not launched until 1965. These were the Sonda meteorological rockets, but their successful launch lies beyond the scope of this study, which only aims to clarify the beginnings of rocket development in the Czech lands (Czechoslovakia).²⁰

Endnotes

- ¹ Vratislav Vaníček, *Velké dějiny země Koruny české. Part II (1197–1250)* (Paseka Praha Litomyšl, 2000), ISBN 80-7185-273-2, pp. 352–361.
- ² The original manuscript is held in Niedersächsische Staats- und Universitätsbibliothek, Göttingen, Cod. Ms. Philos. 63. See also Lynn White Jr., “Kyeser’s *Bellifortis*: The First Technological Treatise of the Fifteenth Century,” *Technology and Culture*, Vol. 10, No. 3 (July 1969): pp. 436–441; see also David Nicolle, *Nicopolis 1396, Campaign No. 64* (Osprey Publishing, 1999), ISBN 1-85532-918-2; see also “Album seu Matricula Facultatis Juridicae Universitatis Pragensis ab Anno Christi 1372 usque ad Anno 1418,” *Codex Diplomaticus Universitatis Ejusdem. Pars I* (Pragae Typis Joan: Spurny, 1834), p. 77.
- ³ The original manuscript is held in Národní knihovna Praha (The National Library of Prague), sign. XVII.B.17, Vavřinec Kříčka z Bitýšky—Návod k lití a přípravě děl, kulí, hmoždířů, zvonů, konví, ke zdvihání vody, k vodotryskům a p. četnými pérokresbami opatřený, fol. 12r. The original text is as follows: “Raketle dělati. Nejprve uděláš formu z mědi tak jak jest vyrejsováno i ty k tomu potřeby z dřeva a vezmeš papír a budeš na to dřevo vinauti, aby byl tak velkej jako forma a uděláš s tlausti [s tloušti? - pozn. ed.] na tom dřevě, aby tam moci vešlo a budeš tam točiti, aby se v hromadě držel. Potom vezma knytel a strunu i zatáhneš na konci, kde má býti k zapalování a potom vezma prachu suchého a zetřeš jej drobně a vundaje ten papír zase do formy a pospodu také zase dáš ten kus, který se tam strká, a nasypeš toho prachu maličko do tý trubice a budeš na stemfl bítí paličkau a tak vždy pomalu až nabiješ všecku a na vrchu potom také zase papír ztlučeš co nejtauze, aby prachu nebylo viděti a prach co nejtauze, tehdy se neroztrhne, nabiješ. A potom kleje rozhřeje i pomazeš ty trubičky. Potom přivážeš prautky k ní a pustíš dada na prachovnu pospodu prach.”
- ⁴ Marie Koldinská and Petr Mata, editors, *Deník rudolfinského dvořana. Adam mladší z Valdštejna 1602–1633* (Argo Praha, 1997), ISBN 80-7203-170-8, p. 143. For more on rocketry in the Czech Lands in the 16th and 17th Centuries see Michal Plavec, “Raketle, regytle, či rachejtle? Rakety v českých zemích v době předbělohorské,” *Journal Dějiny vědy a techniky* 3 (2013), pp. 180–188.
- ⁵ Knihovna Vojenského historického ústavu Praha (Library of Military Historical Institute Prague), sign. IIR D479, Ein Whaar Probiertt und Practitiertt geschribnes Feuer Buech 1601, pp. 385–391. The book written by Ernst Braun is held in the Národní archiv Praha (National Archive Prague), fond Ředitelství císařských soukromých a rodinných statků Praha, sign. ATS společná 203, kn.č. 161.
- ⁶ Mario Christian Ortner, “Die Entwicklung Moderner Kriegeraketen im 19. Jahrhundert,” in Werner Freistetter and Christian Wagnsommer, editors, *Raketen – Weltraum – Ethik. Beiträge zum Seminar Ethik im Weltraum 14–16 April 2009*, ISBN 978-3-902761-01-9, pp. 13–25; Bruno P. Besser, “Austria’s Ascent into Space: A Short Historical Account,” *Proceedings of the Concluding Workshop The Extended ESA History Project*, ESA SP-609 (Paris, France: ESA Headquarters, 13–14 April 2005), ISBN 92-9092-920-0, p. 44.
- ⁷ Frank J. Malina, “On the GALCIT Rocket Research Project 1936–38,” in Frederick C. Durant III and George S. James, editors, *First Steps toward Space: Proceedings of the First and Second History Symposia of the International Academy of Astronautics at Belgrade, Yugoslavia, 26 September 1967, and New York, U.S.A., 16 September 1968, Smithsonian Annals of Flight Number 10* (Washington, DC: Smithsonian Institution Press, 1974), p. 113. [republished as *First Steps Toward Space* (San Diego, California: Published for the American Astronautical Society by Univelt, Inc., 1986), AAS History Series, Vol. 6].

- ⁸ Ludvík Očenášek, *Před desíti lety. Rozšířený spisek Na pomoc Dohodě* (Smíchov: Knihotiskárna Pragotisk Peroutka a spol, 1928), pp. 5–76.
- ⁹ Documents relating to the life of Ludvík Očenášek are preserved in the Archiv Národního Muzea Praha (Archive of the National Museum, Prague), fond Očenášek Ludvík. See also Rudolf Pešek and Ivo Budil, “Ludvík Očenášek: Czech Rocket Experimenter,” in Durant and James, *First Steps toward Space*, pp. 157–165.
- ¹⁰ Vladimír Mandl, *Das Weltraum-Recht: Ein Problem der Raumfahrt* (Berlin: J. Bensheimer Mannheim, Leipzig, 1932); Vladimír Mandl, *Problém mezihvězdné dopravy* (Praha, 1932). See also Vladimír Kopal, “Vladimír Mandl: Founding Writer on Space Law,” in Durant and James, *First Steps toward Space*, pp. 87–90. Private documents relating to the life of Vladimír Mandl were preserved in the Archiv Národního Technického Muzea v Praze (Archive of the National Technical Museum of Prague), but this file went missing when the archive files were damaged during the great “centennial” Prague flood of 2002.
- ¹¹ Úřad Průmyslového Vlastnictví Praha (Industrial Property Office, Prague), Patentový spis č. 52236. JUDr. Vladimír Mandl. Vysokostoupající raketa. Přihlášeno 14. dubna 1932. Chráněno od 15. května 1935.
- ¹² See Petr Bednařík, “Antisemitismus v českém tisku v období druhé republiky,” in V. Hamáčková, V. Hanková, and M. Lhotová, editors, *Židé v Čechách* (Židovské muzeum Praha, 2007), ISBN 978-80-86889-58-0, pp. 32–45. For example, he wrote an article titled “Národní profil (National Profile),” which was published in *Venkov*, Number 292 (11 December 1938): p. 4, as follows: “Rasovou čistotu v demokracii dlužnou chápají jako vztah jednotlivců k formám citění, myšlení a konání, které vyplynuly ze schopností a potřeb určitého národa na určitém území na základě jich dějinného vývoje. Nerozhoduje tudíž prosté biologické hledisko, nýbrž kultura v nejširším slova smyslu. Nikoli animální jsoucnost individua, nýbrž jeho uplatnění v rozmanitých životních oborech. Ale tu nelze popírati, že právě nearijci tvořili povětšinou v našem národě složky velmi málo přizpůsobivé národnímu citění, myšlení a konání. Jejich zvláštnosti znamenaly potud nebezpečí pro náš osobitý vývoj. Metody, které vnesly v obor hospodářský, zejména na poli svobodných povolání, působily zde rozvrat a úpadek právě takový jako cizorodé ideologie v oboru užší kultury. Volání po očistě v tomto směru jest oprávněno, již proto, aby byla umožněna hospodářská a kulturní činnost státních občanů, o jichž národní ryzosti nemůže býti pochyby. [...] Proti živilům přímo státně nespolehlivým musíme postupovati naprosto bezohledně. Přijímajíce nové příslušníky, brániti se musíme nearijcům, protože podle zkušeností bývá u nich nepoměrně méně účinným proces národní asimilace. Všem státním občanům bez rozdílu jsme oprávněni uložiti taková omezení, aby rozpinavosti menšiny netrpěla státotvorná většina, ať v tom či onom směru.”
- ¹³ *Studie o technice v českých zemích 1918–1945 VI. Část 2* (Národní technické muzeum Praha, 1995), pp. 739–741.
- ¹⁴ Cornell University, Law Library, Donovan Nuremberg Trials Collection, Batch 13, Vol. XCI, No. 46, p. 8.
- ¹⁵ Creating the New Research Center for Rocketry, Národní Archiv Praha (National Archive, Prague), fond Německé státní ministerstvo, sign. 110-7/38; See also, for example, Michael J. Neufeld, “Rolf Engel vs. German Army: A Nazi Career in Rocketry and Repression,” *History and Technology*, Vol. 13 (1996): pp. 53–72; or Heinz Horeis, *Rolf Engel, Raketenbauer der ersten Stunde* (Technische Universität München, 1992).

- ¹⁶ Národní archiv Praha (National Archive, Prague), fond Ministerstvo dopravy I 1945–1953, kart. č. 845, Porada o situaci v leteckém průmyslu konaná dne 23. II. 1946 v budově ministerstva průmyslu, s. 1–5; *ibid.*, Zápis o schůzi Leteckého poradního sboru z 14. května 1947, s. 3–4. For experiments involving the development of jet planes see *ibid.* Přehled vývojových prací v letectví za rok 1947, list č. 1.
- ¹⁷ Documents of Vojenský technický ústav survived in Vojenský ústřední archiv/Vojenský historický archiv Praha (Military Central Archive/Military Historical Archive, Prague) fond Vojenský technický ústav 1945–1953.
- ¹⁸ Úřad průmyslového vlastnictví Praha (Industrial Property Office, Prague), Patentový spis č. 78660. Zbrojovka Brno, národní podnik. Zařízení k zajištění hnací náplně pro raketové střely. Přihlášeno 13. prosince 1947. Chráněno od 15. července 1949.
- ¹⁹ František Ludvík, “Raketová technika,” in *Studie o technice v českých zemích 1945–1992 II* (Encyklopedický dům Praha, 2003), pp. 1556–1562. Národní Archiv Praha (National Archive, Prague), fond Komunistická strana Československa. Ústřední výbor Předsednictvo ÚV KSČ 1962–1966, arch.j. 35/8, Předsednictvo ÚV KSČ dne 27. srpna 1963. Zajištění výstavby Výzkumného a zkušebního raketového ústavu ministerstva národní obrany.
- ²⁰ Národní archiv Praha (National Archive, Prague), fond Komunistická strana Československa. Politické byro ÚV KSČ 1954–1962, Schůze PB ÚV KSČ ze dne 5. ledna 1960. Projekt meteorologických raket SOKOL I a SOKOL II.