

# Nymburk lan. Several notes on the units of modern period<sup>1</sup>

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**Abstract.** In this paper, we study the differences between Prague and Bohemia cubit and differences between lan of Wenceslaus Hájek of Libočany and lan of the Nymburk Revenue Registry of 1542. An edition from Nymburk Revenue Registry of 1542 and Bohemian Chronicle by Wenceslaus Hájek of Libočany is appended.

**Nymburský lán. Několik poznámek k novověkým jednotkám.** V tomto článku se zabýváme rozdílem mezi pražským a českým loktem a rozdílem mezi lánem Václava Hájka z Libočan a lánem použitým v knize nymburského městského důchodu z roku 1542. Studii doprovází edice nymburského důchodního registra z roku 1542 a pasáže z Kroniky české Václava Hájka z Libočan.

**Keywords:** historical metrology • Prague (Bohemian) cubit • lan • Nymburk Revenue Registry • Wenceslaus Hájek of Libočany • 1542

Until the reign of Maria Theresa, units of measurement, weight and volume differed not only from country to country, but even from city to city. Gustav Hofmann, in his unsurpassed work, was the last author to try to list the old units of measurement.<sup>2</sup> He also faced difficulties with the transfer of the old

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<sup>1</sup> The research was supported by the Norway Grants, under the contract No. NF-CZ07-ICP-3-237-2015 “Interdisciplinary education of junior historians of mathematics”.

<sup>2</sup> Gustav HOFMANN. *Metrologická příručka pro Čechy, Moravu a Slezsko do zavedení metrické soustavy* [Metrological manual for Bohemia, Moravia, and Silesia until the introduction of the metric system]. State Regional Archive in Pilsen – Museum of Šumava in Sušice, 1984. Hofmann’s handbook offers a list of various physical units. The first attempt to compile such a list was presented by August SEDLÁČEK. *Paměti a doklady o staročeských mírách a vahách* [Memoirs and evidence about old Bohemian measures and weights]. Prague, 1923. A general overview about the development of units of measure, weight, and volume is given in Ivan HLAVÁČEK –Rostislav NOVÝ –Jaroslav KAŠPAR. *Vademecum pomocných věd historických* [Vademecum of auxiliary sciences of history]. Jinočany, 2002.

measurements, weights and volume units into existing ones. The ambiguity of these transfers remains a problem for researchers. We can find some guidance in the so-called standards (*étalon*, *etalon*), measuring instruments, usually made of metal or metal alloys, which defined exact dimensions. In Bohemia and Moravia, it was mostly a unit of measurement called a cubit (*loket*), either Bohemian or Moravian. If these standards have been preserved, they are usually located at the entrance door to a town hall. Not many of them have survived, but they nevertheless confirm the fact that the unit of measurement of the same name differed from city to city. However, this is not a case of measurement errors, whether systematic, random, or absolute.

For that matter, Šimon Podolský of Podolí, a provincial surveyor, cartographer and painter, pointed out the problem of disunity of measures as early as in 1617. At that time he completed his book on provincial rates, which was not published until 1683. The author of this book also mentioned that during the Prague Castle fire in 1541, gauges with provincial rates were destroyed as well.<sup>3</sup> Many believe that the work of Šimon Podolský is the first compendium of units used, but it is not absolutely accurate. It is because Šimon Podolský of Podolí demonstrably proceeded from the Bohemian Chronicle by Wenceslaus Hájek of Libočan and even used the same wording. The chronicler and Catholic clergyman listed provincial units of measurement, weight and volume in the section of the book which describes the government of Přemysl Otakar II. Wenceslaus Hájek of Libočan awarded him with introducing the units across the kingdom. Šimon Podolský of Podolí even stated the year 1022 as the year of unification. Neither of these facts, however, is supported by archival sources.

Yet, we can not necessarily reject the piece of information by Wenceslaus Hájek of Libočan. It should be noted that only in the second half of the 13th century did the colonization of Bohemia and Moravia and founding towns occur. Locators who marked out towns had to know some units of measurement. This is confirmed by the urban character of towns, which is sometimes quite a regular plan, sometimes peculiarities of the landscape are taken into account, or the layout of the city was adjusted to fit older settlements. We do not have to continue in this direction, because these considerations are not the subject of this study.

<sup>3</sup> National Library of the Czech Republic, sign. XXIII. F. 7, *Knížka o měrách zemských Šimona Podolského z Podolí a jiné texty vztahující se k zemským měřám*. Praha 1683, (Book on measurement by Šimon Podolský and other texts related to provincial measurements. Prague 1683).

Wenceslaus Hájek of Libočan recorded contemporary units, even those that are normally not used. For example, he explained the origin of the smallest unit of length – the thumb (palec): “*The first four grains of barley are to be laid in a row, and their breadth is to be called a thumb.*”<sup>4</sup> Naming the unit reflects the oldest form of measuring, known since ancient Rome, where units of length were derived from the human body. This is also reflected in the oldest Bohemian units of length. We will come back to the issue of the unit called a barleycorn (ječné zrno, das Gerstenkorn).

Wenceslaus Hájek of Libočan stated that the Bohemian and Prague cubits had the same length, which we can, as we shall see, reasonably doubt. According to him, the length of this cubit was supposed to be 120 barleycorns. The provincial and forest strands were supposed to represent 42 cubits, i.e. 5,040 barleycorns, a morgen (jitro) was supposed to contain 5 strands (provazec), and a lan (lán) 60 morgens. He correctly deduced further conversion that one lan contains 12,600 cubits. What he did not calculate was that the length of one lan was supposed to be 1,512,000 barleycorns.<sup>5</sup>

Wenceslaus Hájek of Libočan knew area lans, even several of them – good arable Royal (720 patches (záhon)), priestly arable (660 patches), manor or yeomanly free (600 patches) and rural (480 patches). The patch was probably, because Hájek’s text does not explicitly imply this, one tenth of a unit called a hon, which was the same as a morgen. The chronicler states that “the length of a hon is five strands”. It follows that Hájek proceeded from the manor (yeomanly) lan.<sup>6</sup>

The chronicler also did not fail to point out the importance of measurers and what they should arrange for successful performance of their work: “*And special officials should be appointed for making measurement, who would take a special oath for it. There should also be a forest and land measurer; each one should have a chain strand,*

<sup>4</sup> Wenceslaus HÁJEK OF LIBOČANY. *Kronyka česká* [Bohemian Chronicle]. Prague, 1541, fol. 247v. The newest edition of this book was published by Jan LINKA (ed.). *Václav Hájek z Libočan – Kronika česká*. Praha, Academia, 2016.

<sup>5</sup> Ibidem.

<sup>6</sup> Ibidem, fol. 247v–248r. Gustav Hofmann states that there are different values of the area unit of patch, which he divides even closer to seven-furrow, seven-furrow ploughed, eight-furrow and eight-furrow ploughed. The unploughed seven-furrow patch mentioned by Hájek is equated to the value of 2.879 ares. Other values for different locations and different time periods are stated in the range of 2.428 to 5.9685 ares. Compare HOFMANN. *Metrological Guide*, pp. 98.

*so that dew or moisture did not make it shorter, nor drought make it longer. And the chain should be made of copper or brass not to rust due to rain or dew.”<sup>7</sup>*

## 1. A Prague (Bohemian) cubit

Gustav Hofmann stated the differences between cubits from region to region, and from town to town. He demonstrated that the Bohemian cubit was different from the Prague cubit. He even distinguishes the long Prague cubit and the short Prague cubit. There were also differences among provincial cubits. While for the Bohemian cubit, he specifies the length of 59.27 cm, the Moravian cubit was significantly longer: its length being 78.891 cm. According to the unification of the units of 1708, the Bohemian cubit was supposed to be three-quarters of the Moravian cubit.<sup>8</sup>

These differences have been confirmed by the latest research in the standards in Bohemia and Moravia. The standard in the Moravská Třebová gives 78.07 centimetres, and 77.59 centimetres in Kyjov. While the Moravská Třebová standard, which is dated 1626, was based on the Moravian cubit, the Kyjov standard was adjusted to the Vienna cubit (77.756 cm) sometime around 1765, at the time of the unification of units of measurement in the Austrian Empire.<sup>9</sup>

Similar research has been devoted to the reference standards in Bohemia. We know the galloon of Lesser Town, which was supposed to be the gauge for the Bohemian cubit, had a length of 58.9 to 59.1 cm. Even the iron standards of the Bohemian cubit, preserved at the New Town Hall and Prague Castle in Prague, in Mělník, in Bělá pod Bezdězem or in Litomyšl, give values between 59.14 and 59.72 cm.<sup>10</sup>

<sup>7</sup> HÁJEK OF LIBOČANY. *Kronyka česká*, fol. 247v.

<sup>8</sup> HOFMANN. *Metrologická příručka*, pp. 71–72.

<sup>9</sup> Petr CIKRLE – Jiří BUREŠ – Dana OLIVOVÁ. Hmotné doklady vývoje měř a vah na Moravě do konce 19. století [Material evidence of the development of measures and weights in Moravia in the 19th century]. In Radek SLABOTÍNSKÝ – Pavla STÖHROVÁ (eds.). *K historii průmyslu, exaktních věd a techniky na Moravě a ve Slezsku* [The history of the industry, the exact sciences and technology in Moravia and Silesia]. Brno, Technical Museum Brno, 2013, pp. 123–128.

<sup>10</sup> Petr CIKRLE – Jiří BUREŠ – Zdeněk CHARVÁT. Etalony starých délkových měř v českých zemích a jejich dokumentace [Standards of old units of measurement in the Czech lands and their documentation]. In Antonín ŠVEJDA (ed.). *Zeměměřičské práce, mapová dílna, osobnosti a sbírky* [Surveying, mapping workshop, personalities and collections]. *Z dějin kartografie a geodézie* [History of Cartography and Geodesy], 17. Rozpravy Národního technického muzea [Proceedings of the

## 2. Nymburk lan

We have to state that the adjective Nymburk was added to this lan by the author. In 1542, the lan was mentioned by a scribe in the book of the Nymburk municipal revenue. It enabled him to make a quick calculation and assessment of the St. George and St. Gallus interest. However, this Nymburk lan varied greatly from the lan described by Wenceslaus Hájek of Libočan, therefore we chose to distinguish it by the adjective Nymburk. The Nymburk scribe agrees with the chronicler that the *“morgen is five strands of length and one of breadth. A haler (halír) [to pay] for a strand.”*<sup>11</sup>

Unlike the chronicle, it is not quite clear from this text that this is an area unit of measurement. What is different about the Nymburk lan compared to Hájek’s lan is that *“the length of a strand is 43 cubits”*. A simple calculation leads us to the conclusion that one morgen was 215 square cubits. At the same time, the Nymburk scribe wrote that *“the length of a strand is 72 morgens”*. Unlike the chronicler, he thus counted the Royal lan. And here we come to another big difference. The Nymburk lan contained 15,480 cubits, i.e. 1,857,600 barleycorns. This calculation already shows that the Nymburk lan was almost a fifth longer than Hájek’s lan.<sup>12</sup>

## 3. Barleycorn

A barleycorn was not an original Czech unit. Since modern times it has been known in England and the German lands (Gerstenkorn). It also was not only a length and area unit, but also a unit of weight. We focus on the length unit, which may help us determine the transfer of the unit of barleycorn to the current units of length. And that will enable us to determine, at least generally, the length of a lan when converted to units of measurement that we are familiar with.

In a Welsh legal book from the 10<sup>th</sup> century, there is the first reference that the length of one inch corresponds to three barleycorns. Like in the text by Wenceslaus Hájek of Libočan, in the German lands it is reported that one thumb was supposed to measure four barleycorns. If we try to derive the possible length of the modern Bohemian barleycorn from the current Anglo-Saxon inch, we come to the number 3.386 cm.

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National Technical Museum], 223. Prague, National Technical Museum in Prague, 2014, pp. 245–260.

<sup>11</sup> State Regional Archive in Prague, State District Archives Nymburk headquartered in Lysá nad Labem, Archive of the Town Nymburk, Revenue Registry of 1542, fol. 14v.

<sup>12</sup> Ibidem.

If you look for a scientific study on barley grains, you won't find much help. The average length of such grains under the current Czech conditions is between 6.39 and 13.23 mm with a mean value of 8.895 mm. However, we are confident that during so called pre-White Mountain period, barley grains were of a different size. If we use this average value for the conversion, we get the value of 3.558 cm for the unit of barleycorn.<sup>13</sup> It is clear that neither of these conversions can be applied, since the resulting length of a Bohemian cubit would be approximately one metre (106.74 cm, or 101.6 cm).

The cultivating of barley had evidently influence on the size of corn. This can be proved also by comparing corns from wild and cultivated barley from archaeological excavations in the Middle East and in China around 5000 BC until the turn of the of the Era. Lengthening of the barley corn happened during the first centuries of its domestication, usually within five hundred years and a thousand years. In the next one or two millenia, the length of the barley corn became stabilised.<sup>14</sup>

As far as European conditions are concerned, during the individual excavations, the archaeologists found barley corn e.g. from 7<sup>th</sup> to 9<sup>th</sup> century in the Estonian Tartu,<sup>15</sup> from southern France from the 1<sup>st</sup> until the 10<sup>th</sup> century AD<sup>16</sup> and naturally also at other places. However, there are not so detailed studies as in the cases mentioned above. Despite the obvious merit of these findings, however, they do not contribute much to the history of the units of length, weight, and volume. The results namely confirm what could have been expected, namely that the size of barley corns differs not only based on the place, but also on the season and the year. It is influenced by the weather, soil quality and the technique of cultivation, and other conditions. We therefore cannot consider barley corn a stable measurement unit of unchanging size. As for Bohemia and Moravia, we

<sup>13</sup> Alena SÝKOROVÁ – Evžen ŠÁRKA – Zdeněk BUBNÍK – Matyáš SCHEJBAL – Pavel DOSTÁLEK. Size Distribution of Barley Kernels. *Czech Journal of Food Sciences* 27 (4), 2009, pp. 253.

<sup>14</sup> Dorian Q. FULLER. Contrasting Patterns in Crop Domestication and Domestication Rates: Recent Archaeobotanical Insights from the Old World. *Annals of Botany*, 100, 2007, s. 903–924.

<sup>15</sup> Andres TVAURI – Santeri VAHNANEN. The Find of Pre-Viking Charred Grains from Fort-Settlement in Tartu. *Estonian Journal of Archeology*, (20) 1, 2016, s. 33–53.

<sup>16</sup> Jérôme ROS – Allowen EVIN – Laurent BOUBY – Marie-Pierre RUAS. Geometric morphometric analysis of grain shape and the identification of two-rowed barely (*Hordeum vulgare* subsp. *distichum* L.) in southern France. *Journal of Archaeological Science*, 41, 2014, s. 568–575.

might only add that barley was known and cultivated here already in the neolithic period.<sup>17</sup>

It is possible to choose another conversion. Gustav Hofmann also mentioned the Bohemia area cubit (square cubit), whose value was supposed to be 0.3531 square metres. In this case, he proceeds from the value of one cubit being 0.5942 metres (rounded off to four decimal places) and raises this number to the power of two to obtain a cubit square. However, this consideration can not be correct, since the description of a Nymburk lan is based on a rectangle five strands long and one strand wide. According to this calculation, the strand for the length equals the area strand, or a square strand. It would also suggest that during the so called pre-White Mountain period, our ancestors did not count area measures based on a square, but on a rectangle with one side equals to 1.

Although we have two cases of a very detailed description of the lan unit, we cannot convert these area units satisfactorily to the current SI units. We can only confirm that, until the reign of Maria Theresa, units of length, area, weight and volume actually differed from town to town, and from manor estate to manor estate. Specifically, we can only confirm that the lan referred to by Wenceslaus Hájek of Libočan accounted for approximately 80 % of the value of the Nymburk lan. Or, if we want to be absolutely precise, it was 81.395 %, rounding the resulting number off to five decimal places.

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<sup>17</sup> Srov. např. Fratnišek KÜHN. Vývoj polních plodin a plevelů v ČSSR od neolitu po středověk. In *Sborník prací filozofické fakulty Brněnské univerzity (Studia minorae facultatis philosophiae Universitatis Brunensis E29*, 1984, s. 181–182.

## 4. Edition

*Original version, English translation follows:*

Státní oblastní archiv Praha, Státní okresní archiv Nymburk se sídlem v Lysé nad Labem, fond Archiv města Nymburka, Registra důchodní léta 1542, fol. 14v.

### Správa

Z lánu	28 grošů českých
A lán drží	4 čtvrti
Z půl lánu	14 grošů českých
Drží	2 čtvrti
Se čtvrti	7 grošů českých
A čtvrt drží	18 jiter
Z půl čtvrti	3 ½ groše českého
Z jitra	2 ½ denáru českého ½ halíře českého
Jitro jest pět provazců	zdejší a jednoho zšíří
Z provazce	halíř český

Lán drží	72 jiter
Půl lánu drží	36 jiter
Čtvrt drží	18 jiter
Provazec	43 lokty drží

*English translation:*

State Regional Archive in Prague, State District Archives Nymburk headquartered in Lysá nad Labem, Archive of the Town Nymburk, Revenue Registry of 1542, fol. 14v.

### Administration

Of a lan	28 Bohemian Groschen
And a lan contains	4 quarters
Of half the lan	14 Bohemian Groschen
Contains	2 quarters
Of one quarter	7 Bohemian Groschen
A quarter contains	18 morgens
Of half a quarter	3 ½ Bohemian Groschen
Of a morgen	2 ½ Bohemian Groschen ½ Bohemian haler

A morgen is five strands in length and one in breadth  
Of a strand Bohemian haler

A lan contains	72 morgens
Half a lan contains	36 morgens
A quarter contains	18 acres
A strand	contains 43 cubits

*Original version, English translation follows:*

Václav Hájek z Libočan, *Kronyka česká*, Praha 1541, fol. 247v–248r.

Míry zemské, lesní i dědinné

Nejprve aby čtyři zrna ječmenná vedlé sebe položena byla a ta jích širokost aby slula prst. Čtyři prstové vedlé sebe položení, ta širokost aby jmenována byla dlaň. Deset prstův vedlé sebe položených aby slula píd'. A tři pídí aby jmenován byl loket pražský (aneb český). Provazec zemský a lesní každý aby vzdýlí byl na dvačtyřicet loket a k tomu po každém provazci, když se měří, aby se přidalo „naděl Bůh“, a to jest vzdýlí na dvě pěsti aneb aby byl na dvě pěsti delší provazec [...] A když se naměří pět provazců, to aby sloulo jitro, a jitro aby mělo v sobě dvě stě loket a deset loket, a tak aby bylo v jitru šest set pídí a třicet pídí. A když se naměří pět jiter, to aby slulo prut. A v tom prutu bude pětmezcítma provazců. A prut bude míti v sobě tisíc loket a padesát loket. A tak v prutu bude tři tisíce pídí a půl druhého sta pídí. A když se naměří tři pruty, to sloutí bude čtvrt a bude v té čtvrti patnáct jiter a bude ve čtvrti sedmdesát a pět provazců a v čtvrti bude tři tisíce a půl druhého sta loket, a tak bude ve čtvrti devět tisíc a půl páta sta pídí. Když se naměří čtyři čtvrti, to sloutí bude lán a v lánu bude dvanáct prutů a bude v lánu šedesát jiter a bude v lánu tři sta provazců a bude v lánu dvanáct tisíc loket a šest set loket. A tak se dostane v lánu třicet a sedm tisíc pídí a osm set pídí.

Dědiny také všechny vorné aby na záhony rozděleny byly. Záhon každý jeden aby měl sedm brázd a druhý osm brázd, a tak v každé mírné roli aby bylo ve dvou záhoních patnáct brázd. V lánu dobrém vorném královském at' jest dvanáct kop záhonů. V lánu kněžském vorném aby bylo jedenáct kop záhonů. V lánu panském (neb zemanském) svobodném at' jest deset kop záhonů. V lánu sedlském platném at' jest osm kop záhonů. A tak v královském lánu bude pět tisíc brázd a čtyři sta brázd. V kněžském lánu bude čtyři tisíce brázd, devět set a padesát brázd. V zemanském lánu svobodném bude čtyři tisíce brázd a pět set brázd. V sedlském lánu podouročním bude tři tisíce brázd a šest set brázd [...]

Počítajíce pak na hony: hony jest pět provazců vzdýlí a bude v honech dvě stě loket a deset loket a tak v honech bude šest set pídí a třicet pídí. Kolečko plužné také aby bylo mírné, tak aby se v honech šedesátkrát obrátilo, v míli bylo šedesát honů, a tak bude v míli tři sta provazců a bude v míli dvanáct tisíc loket a šest set loket. A tak v míli bude třicet a sedm tisíc a osm set pídí [...]

*English translation:*

Wenceslaus Hájek of Libočan, *Kronyka Česká* (Bohemian Chronicle), Prague 1541, fol. 247v–248r.

Units of measurement of the land, forest and villages

The first four grains of barley are to be laid in a row, and their breadth is to be called a thumb. Four thumbs juxtaposed, the breadth is to be called a palm. Ten thumbs juxtaposed is to be called a span. And three spans are to be called a Prague (or Bohemian) cubit. The length of land and forest strand are each to be forty-two cubits, and, moreover, to each strand, when measured, to be added “Endowed by God”, and that is the length of two fists or a strand to be by two fists longer [...] And when five strands are measured, it is to be called a morgen, and a morgen is supposed to contain two hundred cubits, and ten cubits, and so it is supposed to contain six hundred spans and thirty spans. And when five acres are measured, they are to be called a perch. And that perch will contain twenty-five strands. And a perch will contain a thousand cubits, and fifty cubits. And so a perch will contain three thousand spans, and hundred and a half spans. And when three perches are measured, it will be called a quarter, and a quarter will contain fifteen morgens, and a quarter will contain seventy five strands, and a quarter will contain three thousand one hundred and fifty cubits, and so a quarter will contain nine thousand four hundred and fifty spans. When four quarters are measured, it will be called a lan and a lan will contain twelve perches, and a lan will contain sixty morgens, and a lan will contain three hundred strands, and a lan will contain twelve thousand cubits and six hundred cubits. And so a lan will contain thirty-seven thousand spans and eight hundred spans.

Also, all the arable villages are to be divided into patches. Each patch is to be divided into seven furrows, and the other one into eight furrows, and so in every moderate field there will be fifteen furrows. A good arable Royal lan is supposed to have twelve by sixty (seven hundred and twenty) patches. An arable priestly lan is supposed to have eleven times sixty (six hundred and sixty) patches. A manor (or yeoman) free lan is supposed to have ten times sixty (six hundred) patches. A rural collectible lan is supposed to have eight times sixty (four hundred and twenty) patches. So a royal lan will have five thousand furrows and four

hundred furrows. A priestly lan will have four thousand furrows, nine hundred and fifty furrows. A yeoman free lan will have four thousand furrows and five hundred furrows. A rural under-interest lan will have three thousand furrows and six hundred furrows [...]

Then, counting in hons: a hon is five strands long and a hon will contain two hundred cubits, and ten cubits, and a hon will be six hundred spans and thirty spans. A plough wheel should be modest, so that it turns sixty times in a hons, a mile should contain sixty hons, and so a mile will contain three hundred strands, and a mile will contain twelve thousand cubits and six hundred cubits. And a mile will contain thirty-seven thousand and eight hundred spans [...]

## Summary

Until the half of 18<sup>th</sup> century, there was no unified system of units of length, weight and volume. In this paper, author studies the differences between Prague and Bohemian cubit, differences between lan of Wenceslaus Hájek of Libočany and lan of the Nymburk Revenue Registry of 1542. He studies differences among standards (étalons) and discusses the possibility of basing the conversions on the size of barleycorns. Finally, he shows that in 16<sup>th</sup> century the computations of land areas were based on rectangles, not squares. An edition from Nymburk Revenue Registry of 1542 and Bohemian Chronicle by Wenceslaus Hájek of Libočan is appended.

## Resumé

Až do doby vlády Marie Terezie nebyly zavedeny jednotné délkové, váhové a objemové jednotky. V tomto článku se autor zabývá rozdílem mezi pražským a českým loktem a rozdílem mezi lánem Václava Hájka z Libočan a lánem použitým v knize nymburského městského důchodu z roku 1542. Zabývá se dále rozdíly mezi jednotlivými etalony a diskutuje o možnosti založit převody jednotek na velikosti ječných zrn. Konečně ukazuje, že v době předbělohorské se plošné míry nepočítaly na základě čtverců, ale obdélníků. Studii doprovází edice nymburského důchodního registra z roku 1542 a pasáže z Kroniky české Václava Hájka z Libočan.

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