

Archaeology of Conflicts

edited by
Pavel Drnovský – Petr Hejhal

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prof. PhDr. Václav Matoušek, CSc.

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How to build a redoubt?

Instructions from military manuals of the Thirty Years' War

Klára Andresová Skoupá

Redoubts count among field fortifications, which relatively often become the topic of research in archaeology of conflicts. However, many terrain elements which are still visible in the landscape must be compared to the information on how these redoubts looked at the time of their origin and how they were constructed. The most useful tools to describe particular redoubts undoubtedly are archival documents, plans or pictorial sources. Historical military and fortification manuals also can provide a great deal of relevant information. These manuals usually do not deal with the appearance and origin of individual fieldworks, but they describe which appearance, dimensions and construction types of redoubts were considered ideal at a given time.

The aim of the paper is to introduce the instructions related to the build-up of redoubts, which were published in fortification manuals from the time of the Thirty Years' War and from a few preceding and following years. The reason for writing this text is the planned recreation of a redoubt near Rakovník in the spring of 2021, shortly after the 400th anniversary of the Battle of Rakovník was commemorated.

The battle has taken place several days prior to the much more famous Battle of White Mountain (see Blažková et al. 2011). The redoubt will be built in accordance with the theoretical knowledge of that time, using the authentic methods. It should roughly resemble the redoubt Na Kokrdech, which is still visible in the above-mentioned battlefield (see Waldhauser 1997).¹ The construction that we will recreate in 2021 will be just smaller than the redoubt Na Kokrdech due to current legislation.

Historical books with passages about construction of redoubts or about field fortifications in general

Books of several military writers were studied in order to compare historical theoretical instructions for the build-up of redoubts. These authors were active in Central Europe at the time of the Thirty Years' War and shortly before and after the war. The following text will introduce the studied military theoreticians and their relevant works.

¹ However, it must be added that Waldhauser interpreted the site as a La Tène period structure, so-called Viereckschanze or four-corner rampart.

Giorgio Basta (1550–1607/1612?)² began his military career under the command of Alexander Farnese, Duke of Parma. Later he served in the army of Rudolph II in Transylvania, where he fought against Sigismund Báthory. After defeating Báthory, he governed Transylvania as Rudolph's vice-regent (see Arens 2001). However, his tyranny aroused a revolt, after which he returned to his military career and fought against the Turks in Hungary. When the fifteen-year-war has finished in 1606, he closed his military career and decided to publish his knowledge in the form of two military manuals (Janko 1875, 131; Frankenberger – Fidler 1997, 37; Kenyeres 2020). His manual *Il Maestro di Campo Generale*³ is dealing, among other things, with the problem of who should build field fortifications.

Similar problem was also addressed by **Buonaiuto Lorini** (1540?–1611) in his book *Fünff Bücher von Vestung Bauwen*⁴, but he focused on the construction of fortresses. In his publication we also find illustrations and characteristics of tools which are necessary for fortification building. Lorini counts among the most significant Italian fortification builders of the second half of the 16th century. He studied fortification architecture by visiting foreign fortifications. In these journeys, he let himself be hired for building, besieging and defending various fortresses. In 1580 he entered the service of the Republic of Venice, where he became one of the main military engineers. During his activity he has built and modernised many fortresses (Kupka 2005, 227–331; Doti 2006).

Basta provides information on the fortification diggers, Lorini informs about their work tools. However, we should primarily introduce authors whose treatises were dealing with redoubts and their construction. Some of the studied authors were educated architects with military experience, others practised another occupation and the fortification building was their hobby. Also among the professional fortification builders were many who studied natural sciences. In many cases we thus can talk about Renaissance men who were knowledgeable or proficient in a variety of fields.

Martin Eyland, probably the oldest among the authors, is almost unknown today. However, we can learn at least the basic information about him in his published manual. We know he was occupied with fortification architecture – above all with the Dutch style of fortification building. Eyland was active in Dresden in 1624, where his treatise *Compendium artis fortificatoriae*⁵ was published. In his work he does not pay much attention to redoubts, but his short information about them from 1620s differs from the facts in later treatises, which is of great benefit for a comparison with younger publications. The significance of the work for our further research is high because the given book is chronologically closest to building of the redoubt in Rakovník.

We do not know whether Martin Eyland was occupied with fortification architecture in his practice or whether he participated in some military campaign. Nevertheless, in the case of **Johann Pharamund Rummel** (1597–1661) we can say with certainty that fortification building was his secondary profession. This author was primarily an alchemist and physician and he is mainly known for his treatises about these two fields (Thorndike 1923, 192–194). However in addition to this, in 1632 he published a thin book *Compendium Fortificatorium*,⁶ in which he characterised the elements of permanent and temporary field fortifications of that time. The main aim of the book was to describe how to fortify a town within 48 hours.

² Literature presents different dates of death.

³ The book was first published in the Italian language in 1606. Subsequent Italian editions appeared in 1625 and 1626. German and French translations came out in 1617.

⁴ The work was first published in 1596 and then in the next year again. Supplemented and modified edition came out in 1609 – it no longer contained *five books*, but already *Six books on fortification building*. The first German translation of the original five books appeared in 1607. The subsequent German editions testified to considerable popularity of the book – it was published in 1616, 1621 and 1638.

⁵ In the same year, an almost identical treatise by him, *Modus artis fortificatoriae Belgicus*, was also published. Both books differ from one another only slightly in their titles, but their content, typography and illustrations are the same. The treatise (with the second title) was published in 1632 again.

⁶ The book was published for the first time in 1632 and for the second time in 1644.

Adam Freitag (1608–1650) had a different life experience. He was occupied with fortification building in practice and his contribution to this field has been highly appreciated to this day. He is the most significant personality among the studied authors. In his work he referred to treatises by Buonaiuto Lorini and his work has been in turn borrowed by the authors who followed. Adam Freitag was a native Pole, who participated in several campaigns and sieges in the service of Frederick Henry, Prince of Orange. He also took part in the construction of fortresses for defence against the Spaniards. After completing the medicine studies in Leiden, he returned to Poland and participated in a campaign to Smolensk. Later he has worked as a mathematics and astronomy teacher, physician and military engineer. His most significant treatise in the field of fortification building was *Architectura militaris nova et aucta*,⁷ in which he utilized his practical knowledge (Kupka 2005, 128–131).

One of the authors whose works were primarily based on Freitag's work and on treatises by other famous fortification builders⁸ was **Johann von Felden** († 1668). Little is known about his life. We know that he was a philosopher and lawyer and that he has worked as a mathematics professor at the University of Helmstedt (Felden 2020). It can be supposed that he had no practical experience with warfare, since his instructions in the work *Architectura Militaris*⁹ are only a compilation of older treatises about fortifications.

Georg Andreas Böckler (1617–1687) was a German architect of both civil and military buildings, but we know very little about his life. His name has been mainly associated with publications from the second half of the 17th century (L. 1875, 787–788; Klinckowstroem 1955, 371) thus his four-part treatise *Manuale Architecturae Militaris*, whose first volume was already published in 1645,¹⁰ is often forgotten. This work mainly contains the instructions which were already published by Freitag, but unlike Felden, Böckler does not officially acknowledge his source.

The last among the studied authors was the Pole **Józef Naronowicz-Naroński** (1610?–1678). His manuscript about the fortification building *Architectura militaris*¹¹ was written in the 1650s, however it still contains relevant facts about fortifications from the time of the Thirty Years' War because he also studied the works by Adam Freitag and by other contemporary and ancient authors. For example, he borrowed some of Freitag's illustrations for his book. However, it is obvious that his treatise did not copy the original but the author added many of his own ideas to the fortification knowledge of that time. Naronowicz-Naroński was not only a military architect, he occupied himself also with mathematics, land surveying and cartography. He created several maps of Polish regions (Naronowicz-Naroński 1957, VII–XXIV).

For the purposes of this paper we studied (besides the treatises by Basta and Lorini) the works by six authors from the 1620s–1650s, with the main focus on their chapters about the construction of redoubts. It turned out that some of the authors borrowed information from one another – whether they acknowledged the source or not. We can in principle follow up four relatively original streams of thought. Their representatives, which are to be emphasized, were Martin Eyland in the 1620s, Johann Pharamund Rhummel and Adam Freitag in the 1630s and Józef Naronowicz-Naroński in the 1650s. The works by these authors are always separated from each other by several years. Their instructions (apart from the slightly different plans for the layout of fieldworks) differ from one another mainly by the dimensions of the described redoubts. The analysis of these books has revealed that the

⁷ The book in German language was first published in 1631 and later again in 1635, 1642, 1654 and 1665. French translation came out in 1635, 1640 and 1688.

⁸ This information is directly stated on the front page of the 1648 edition: „Aus dem Freitagio und anderen guten Authoribus zusammen gezogen.“

⁹ The book was published two times – in 1643 and 1648.

¹⁰ After the first edition in 1645, the book was published again in 1659 and then once more in 1672.

¹¹ This work is part of Naronowicz's manuscript *Optica lubo perspectiva* from 1659, which is stored in Biblioteka Uniwersytecka in Warsaw. Commented edition is Naronowicz-Naroński (1957).

recommended dimensions for this type of fortification structures have diminished over the course of the Thirty Years' War.

Redoubt as a type of field fortification

Redoubt is an enclosed defensive element of field fortification with a square or rectangular layout. In the studied period, it was the most frequently used type of emplacement. Redoubts were usually equipped with gun batteries and provided shelter to infantry guards; they were also meant to protect the trench exits (Kupka 2002, 503). They may have also been a useful addition to approach trenches, as a fortified places manned with guards and providing retreat for diggers in case of an enemy attack (Freitag 1631, 146). However, several authors of that time considered them uncomfortable, regarded their construction as unnecessarily demanding and lengthy and recommended therefore to build different types of defensive structures (Eyland 1624, 95).

Johann Pharamund Rhummel mentioned that redoubts which were built during a siege were situated about one thousand paces, i.e. about 750 metres, away from the town (Chvojka – Skála 1982, 213).¹² When a fortification system was built, in which the redoubts were interconnected through a rampart, individual redoubts were situated at a distance of 40 to 50 tens of feet, that is, about 124 to 155 metres, from one another¹³. The number of soldiers who were meant to fit into a redoubt should, according to him, have been 25 to 50 men or more, respectively.¹⁴

Adam Freitag briefly mentioned how long a redoubt can survive in the landscape. At several places in his work he describes the elements of field fortification, which were built during siege of the Dutch town of Hertogenbosch in 1629, two years before his book was published. He wrote that two four-pointed star *schanzen* (earthworks very similar to redoubts) were laid out near the town, but they were almost completely destroyed at the time when the text was written (Freitag 1631, 147).¹⁵ Therefore, it is by lucky chance that some redoubts of that time are still visible in the landscape.

Conversion of historical units of length to contemporary ones

The most frequently mentioned unit in the passages about temporary and permanent fortifications within the studied sources is rod (*Rutte*). As regards the problems of work tools, the authors usually used feet (*Fuß*, *Schuh*) and inches (*Zoll*).

Historical units of length differed considerably in various regions.¹⁶ However, the authors of fortification manuals were aware of the then heterogeneity of measures, therefore they sometimes used copperplate

¹² None of the studied authors have specified the unit which they called „pace“. Therefore I decided to choose the length of 75 cm, which is in accordance with data in the cited dictionary of measuring units.

¹³ Rhummel at this place mentions *decemped* as the unit of length. I translate it from Latin as *ten feet*. However, it is well possible that the unit *decemped* rather referred to the unit *rod*. As it will be mentioned later, rod was sometimes divided for practical reasons into *ten feet* and not into twelve feet.

¹⁴ The author herewith means a redoubt with the side length of ca. 14–19 metres, see below in the text (Rhummel 1632, [17–18]).

¹⁵ The author unfortunately does not say whether these redoubts were pure earthworks or whether they were reinforced by wooden planks. The latter possibility would be better understandable because the mouldered wood would have loosened the sandy loam so that the structure lost its original shape.

¹⁶ For example, Chvojka and Skála (1982, 193, 205) stated that the length of one rod varied between 3 and 7,3 metres. The length of the analogous Bohemian *prut* has the value of 3,8–4,7 metres, but the relevant German *Rute*, which must be taken into consideration with German sources, is 3,1–7,3 metres long.



Fig. 1. An artillery redoubt built before the Battle of White Mountain. Source: Unknown author, 1st half of the 17th cent.: Depiction of the Battle of White Mountain in the Santa Maria della Vittoria Church in Rome. Second part (Secunda). Photo A. Vasari.

engravings to record the lengths which they mentioned in their texts. Of great benefit in this regard is the picture No. 33 in the copperplate engraving E in the 1631 publication by Adam Freitag *Architectura militaris nova et aucta*. An inconspicuous line segment at the bottom of the copperplate engraving signifies a half Rhineland foot. It measures 15.5 cm, therefore the **length of one foot**, according to Adam Freitag, is **31 cm**.¹⁷ The foot was usually divided into 12 inches (Chvojka – Skála 1982, 103),¹⁸

¹⁷ The same foot length that was used in historical fortification architecture is also stated by the editor of the work by Naronowicz-Naroński, Tadeusz Nowak (Naronowicz-Naroński 1957, 153).

¹⁸ However, the possibility of division into 10 inches is also mentioned.

which is depicted on the measuring scale of the copperplate engraving M. **One inch**, according to Freitag, is thus **2,58 cm** long.

The **length of one rod** should be 12 feet, that is, **372 cm**. However, in the chapter titled aptly *How big is a Rhineland rod* (Freitag 1631, 30), the author warns us about a problem which often arises with fieldworks: Since the dividing by twelve is not very easy, rods are often divided into ten feet. In this case the rod length remains always the same, that is, 372 cm, but the foot length changes – in the case of a **rod of ten feet** it would measure **37,2 cm**. Nevertheless, we will keep working with standard rods of twelve feet.

How to measure out a redoubt in open terrain

It was already mentioned that redoubts are always square or rectangular in shape. Therefore, of crucial importance for laying out a redoubt in open terrain is the ability to draw a line segment of desired length and measure out a right angle. A tool suitable for both of these measurements is surveyor's chain.

Freitag mentioned that the on-site measurements were made with a tapered wooden stick with iron fitted point. The stick was connected with a metal chain or brass wire with foot and rod markings (Freitag 1631, 55). Elsewhere he writes about the well-known principle of how to easily measure out a right angle: It is necessary to draw a Pythagorean triangle whose sides are formed by 3, 4 and 5 units (here ideally rods). Such a triangle is always right (Freitag 1631, 146–147). With this in mind, we can easily measure out a square or rectangular layout of a redoubt using only a simple instrument composed of a chain and a wooden stick.

Who should build a redoubt

We can say with some exaggeration that all adults in the army of the Thirty Years' War were competent to build redoubts. We know that fortifications were sometimes built by the soldiers themselves and sometimes by specialised fortification diggers. We can see groups of these diggers for example in the illustrations by Jost Amman (1539–1591) in military manuals by Leonhardt Fronsberger (1520–1575) from the second half of the 16th century (Fronsberger 1573, illustration before XLVa).

Giorgio Basta (1607, 35) in his treatise *Il Maestro di Campo Generale* highly recommends that military camps are fortified by diggers and not by soldiers. Soldiers are, according to him, tired after marching the whole day and carrying their weapons. The soldiers' work is cheaper – in fact unpaid. However sometimes it could end up being far more expensive if they work as diggers: The consequence of their low-quality work might be that the enemy overcomes their fortification and causes huge damages. From Basta's fiery argumentation is clear that fortifications of that time were built both by paid diggers and by unpaid soldiers. The imperial general clearly expressed his preferences but the real decision depended solely on particular military commanders who provided for the staffing of fortification works.¹⁹

Official records reveal that women also sometimes participated in fortification building. For example, when the fortifications around the Prague Castle have been completed in 1639, it was ordered that if the number of summoned diggers is not sufficient, the work shall be offered to wives of captive or killed

¹⁹ On this problem see e.g. Andresová (2019, 174).



Fig. 2. Group of fortification diggers in a 1564 illustration by Jost Amman. Source: Fronsberger, L. 1573.

soldiers (Líva 1954, 39). From this we can infer that these women already had some experience with fortification works, which they probably earned by building field fortifications.

Redoubts thus may have been built by experienced diggers, soldiers and by camp followers - men or women. However, the ideal number of staff needed for construction of one redoubt is not mentioned in literature of that time. Different is the case with fortress building, where for example Buonaiuto Lorini mentions that diggers should work in groups of fifty people within a sector ten metres long (Lorini 1607, 122). This information, however, cannot be considered to apply to the construction of a field redoubt, whose dimensions are much smaller so that also a smaller number of staff is needed.

Regarding the characteristics and purpose of redoubts, we can suppose that the number of diggers usually depended on how quickly the redoubt had to be built, how large it had to be and how many workers were available.²⁰

Work tools

The description and characteristics of work tools which were necessary for building a fortress or field fortification are mainly contained in books by Adam Freitag and Buonaiuto Lorini. Helpful is the

²⁰ From the available sources we only seldom learn about how many people participated in digging. However, we are at least roughly informed about the number of diggers in particular armies. For example, we know that the imperial army of 12 000 men, marching to Čáslav in September 1618, comprised a company of hundred and fifty diggers (Knápek 2017, 89).

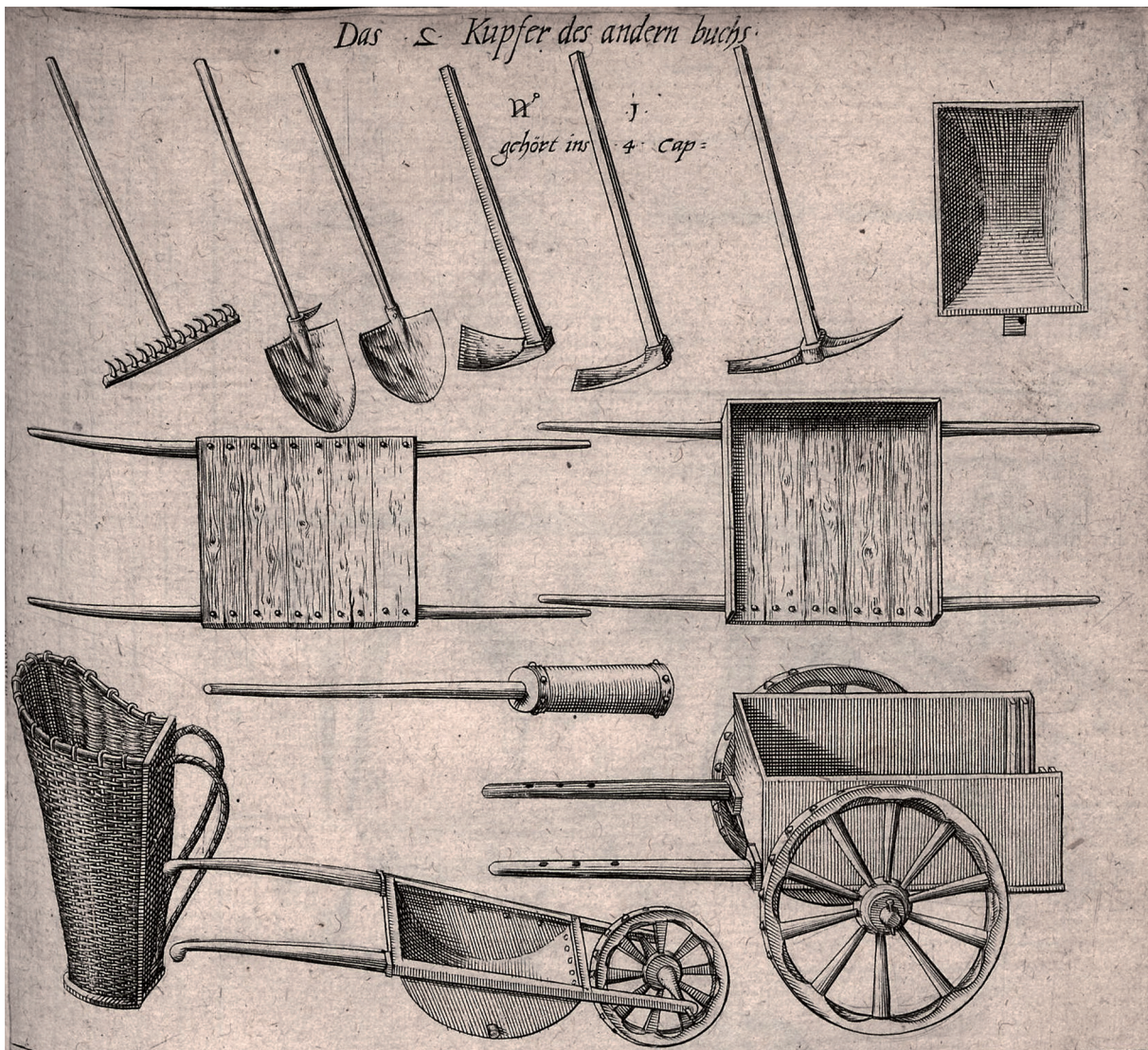


Fig. 3. Fortification building equipment according to B. Lorini. Source: Lorini, B. 1607.

chapter by Freitag (1631, 67–68) dealing with proper equipment of a carpenter's yard. Illustration M depicts the tools and equipment in a measuring scale which is marked out in the copperplate engraving.

The carpenter's yard (*Zimmerhoff*) contains many tools used for various purposes. Their enumeration also comprises "earthwork digging equipment", namely "shovels, spades, hoes, picks, iron crowbars, battering rams, hewing knives, wheelbarrows or two-wheeled carts". The illustration is attached to the book because "some pieces ... for digging earthworks ... are made in various ways and called by various names. They are described in the text and depicted in the copperplate engraving to avoid mistakes." The line segment in the middle of the copperplate engraving is a measuring scale with marks representing feet. From this scale we can infer individual dimensions of the historical work tools.

The illustration portrays and describes in captions two types of shovels, trowel, spade, iron crowbar, axe, pick, hoe, battering ram, hewing knife (for the making of earthwork baskets) and a wheelbarrow.

Buonaiuto Lorini, unlike Freitag, does not name particular dimensions of tools, but describes in detail the way of how some of the implements were used. It is interesting to compare his illustration to

that one in Freitag's work: Although his treatise was published almost thirty years earlier than Freitag's and Lorini thus describes older facts, he already depicts more modern shovels with all-metal blade instead of metal-edged wooden shovels.

Lorini (1607, 127–128) writes that “shovel and hoe are two tools by which a fortress can be both built and demolished”. Unlike Freitag, he pays attention to rakes, which he considers essential for levelling the ground and removing stones. He also briefly deals with the benefits of a wheelbarrow, which enables a convenient transport of dug-up earth.

Dimensions of redoubts

The dimensions of redoubts, which were recommended by military manuals, have gradually diminished over the course of the Thirty Years' War. The oldest among the studied authors, Martin Eylend (1624, 95), wrote in 1624 about redoubts, whose side length usually was 8 to 15 rods, that is, 29 m 76 cm to 55 m 80 cm.

In the 1630s, the most significant among the studied personalities was Adam Freitag, who described **square redoubts** with the side length of **4–6 rods**, that is, **14 m 88 cm to 22 m 32 cm** (Freitag 1631, 146). These data were later adopted by Johann von Felden (1643, [90]) and Andreas Böckler (1659, 204) in the 1640s.²¹ However, the latter author mentioned not only standard redoubts of the above side length but also larger structures, whose side length might have been up to 10 rods, that is, 37 m 20 cm (Böckler 1659, 204). Johann von Felden (1648, [90]) came to the conclusion that if somebody wanted to build a redoubt whose side length is smaller than 4 rods, such fortification would be useless in defence.

However, Józef Naronowicz-Naroński (1957, 149) did not think so in the 1650s. In his work he wrote about small redoubts with the side length of 2–4 rods (7 m 44 cm to 14 m 88 cm) and about large redoubts with the side length of 5–7 rods (18 m 60 cm to 26 m 4 cm). Nevertheless, the theory of gradually diminishing size of redoubts must be verified by archival sources and archaeological excavations.

Besides square redoubts also rectangular redoubts were built. These two types did not exhibit notable differences in their size. Exact dimensions of rectangular redoubts were stated by Adam Freitag and after him also by authors, who adopted the information from his works for their own treatises. The perimeter of a rectangular redoubt, according to Freitag (1631, 146), measured 12–20 rods, that is, 44 m 64 cm to 74 m 40 cm, where the length of the **narrow sides** was **at least 2 rods**, that is, **7 m 44 cm**.²²

The remaining dimensions of redoubts were not frequently mentioned in historical manuals. We find them only in the works by Freitag (1631, 148) and then the same by Böckler (1659, 209). The bottom part of the rampart is said to have been 14–20 feet wide (4 m 34 cm to 6 m 20 cm), the height was 8–10 feet (2 m 48 cm to 3 m 10 cm) and the width of the upper part was 4–6 feet (1 m 24 cm to 1 m 86 cm). Inside the redoubt, the rampart was backed by two or three steps (as necessary) of 2–3 feet in width (62 cm to 93 cm). The trench is said to have been 15–24 feet wide (4 m 65 cm to 7 m 44 cm). Its depth was determined by the quality of soil and by other conditions – the authors did not specify them.

The **width of the entrance** to the redoubt depended on whether the fort was intended for infantry or for artillery. If it was intended for an infantry guard, the entrance should have been only 2 feet (62 cm)

²¹ Redoubts of similar size were described at the same time also by Rhummel (1632, [18]). He wrote about redoubts with the side length of 4, 5 and 6 tens of feet, that is, 13 m 95 cm to 18 m 60 cm. (However, it is also possible that these tens of feet – *decemped* – in fact refer to rods. If so, then these redoubts would be of the same size as those mentioned by Freitag).

²² The same is also stated by Felden (1643, [90]) and Böckler (1659, 205).

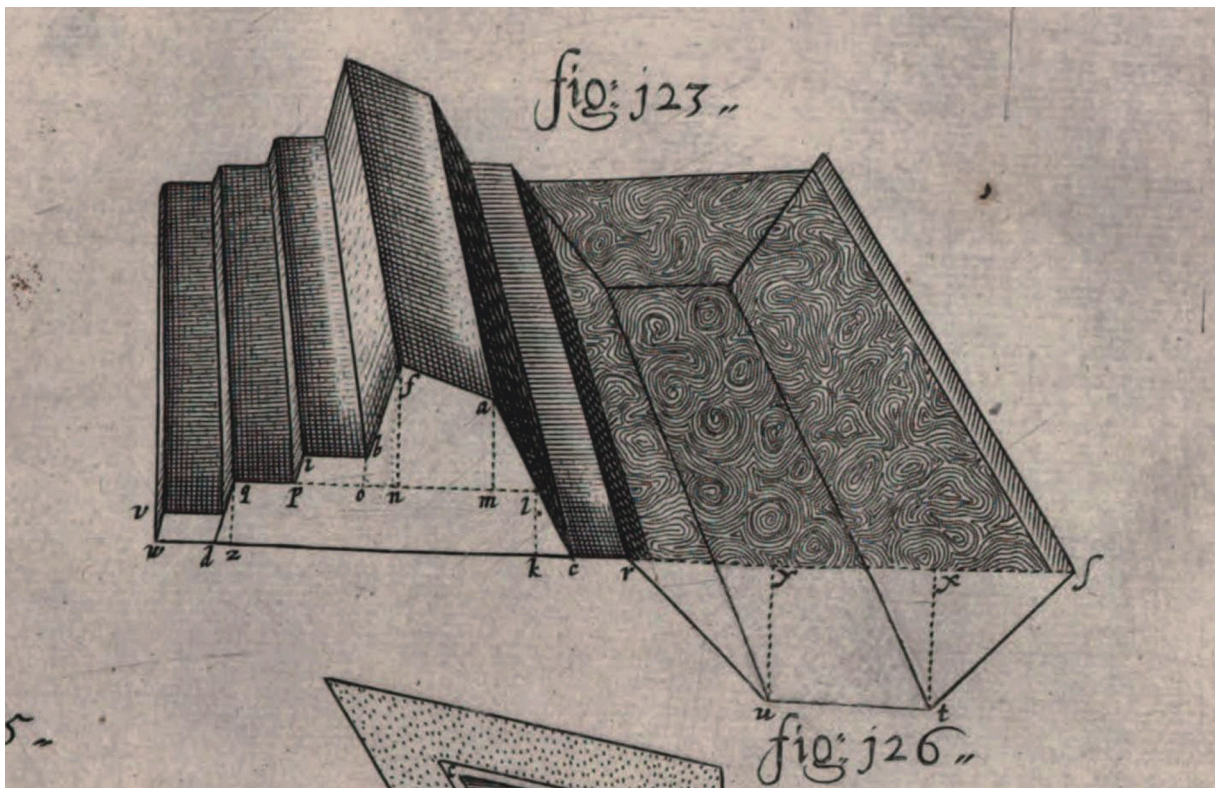


Fig. 4. Recommended section through the rampart and ditch of a redoubt. Source: Freitag, A. 1631.

wide to be walked through. If cannons were positioned inside the redoubt, the entrance had to be wide enough to drive through a cannon and a wagon with necessary equipment. The redoubt has been closed by a gate which at the same time also functioned as a drawbridge across the trench and was nailed together from two boards. A supporting wooden post is said to have been driven into the middle of the trench to prevent the drawbridge from breaking when being crossed (Freitag 1631, 149; Böckler 1659, 209–210).

Two ways of building a redoubt

There are two basic ways of building redoubts, which depend on the quality of soil on the construction site. The first type of redoubts corresponds to true **earthworks**, where the ramparts can be piled up if a quality soil is available. The working sequence during construction of these redoubts is not paid much attention by the historical authors, because it only involved digging a trench and piling up a rampart (Freitag 1631, 147; Böckler 1659, 205).

The second type corresponds to redoubts built **from wooden planks** and filled with earth. They were built in places where the soil is too sandy and where no turf is available to reinforce the ramparts. This type of field fortifications is relatively thoroughly described by Adam Freitag and after him almost identically by Georg Andreas Böckler. The planks used for construction should be made from spruce or fir wood, their thickness should be at least 1,5 inches, that is, 3,87 cm. Also necessary are logs with a diameter of about a half-foot, that is, 15,5 cm.

The authors exemplify this type by a redoubt with the side length of 4 rods, that is, 14 m 88 cm. First of all, a square ground plan is measured out and then four logs are driven into its corners. Between

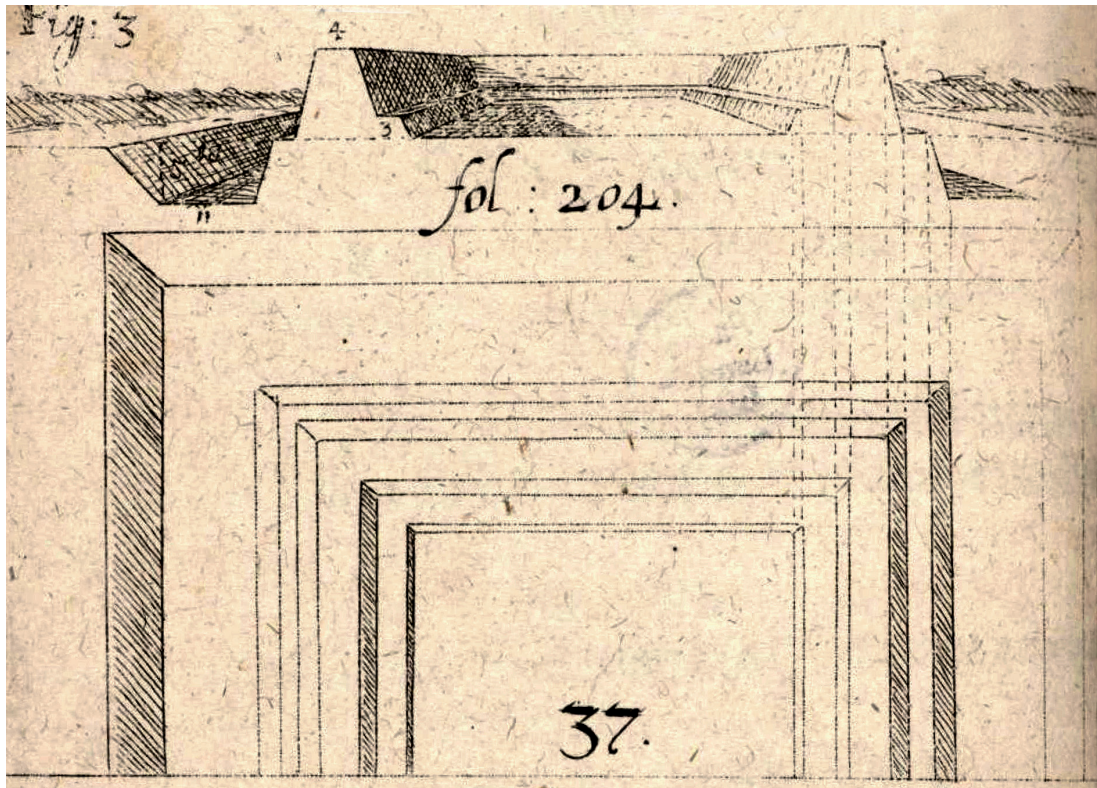


Fig. 5. Section through a redoubt and top view of a redoubt. Source: Böckler, G. A. 1659.

these logs at the perimeter of the square, furrows are dug out in which the prepared planks are embedded “as when an ordinary garden fence is made” (Freitag 1631, 147).²³ Böckler does not mention any additional logs, but Freitag (1631, 147) writes about another four logs inside the corners of the redoubt, placed besides the former four logs. Between them another furrow for an internal row of planks is dug, which should be situated one foot, that is, 31 cm from the external planks. The space between these two rows of planks is then filled with tamped soil and sand. Ideal height of this type of the redoubt is 6 feet, that is, 186 cm (Freitag 1631, 147; Böckler 1659, 205–206). Its walls allegedly had to be thick enough to block the musket bullets (Freitag 1631, 147).

Adam Freitag (1631, 147) gives an example of a plank redoubt, namely a field fortification which was built during siege of the Dutch town of **Hertogenbosch** in 1629. It had an rectangular shape, its long sides measured 42 feet (13 m 2 cm) and narrow sides 27 feet (8 m 37 cm). The height of the redoubt was 6 feet (186 cm). However, the above-mentioned redoubt has been improved during the siege: The height was increased by 1,5 feet (i.e. 46,5 cm; the new height was 232,5 cm), one step was added to the inside, and the trench was widened by six feet to reach the total width of 24 feet (7 m 44 cm). The rampart was dressed with **assault stakes** at the height of six feet.

These plank redoubts are usually not preserved in open terrain. The reason thereof might be the fact that after the planks, which held the redoubt together, have mouldered away, the low-quality sandy loam spilled out and the original shape of the redoubt has disintegrated.

²³ We unfortunately do not know what the author meant. In the studied period, garden fences were built both from vertical and from horizontal planks. It depended on what was needed at a given moment. To the best of my knowledge, from the time of the Thirty Years' War so far no plank redoubt was found preserved in open terrain.

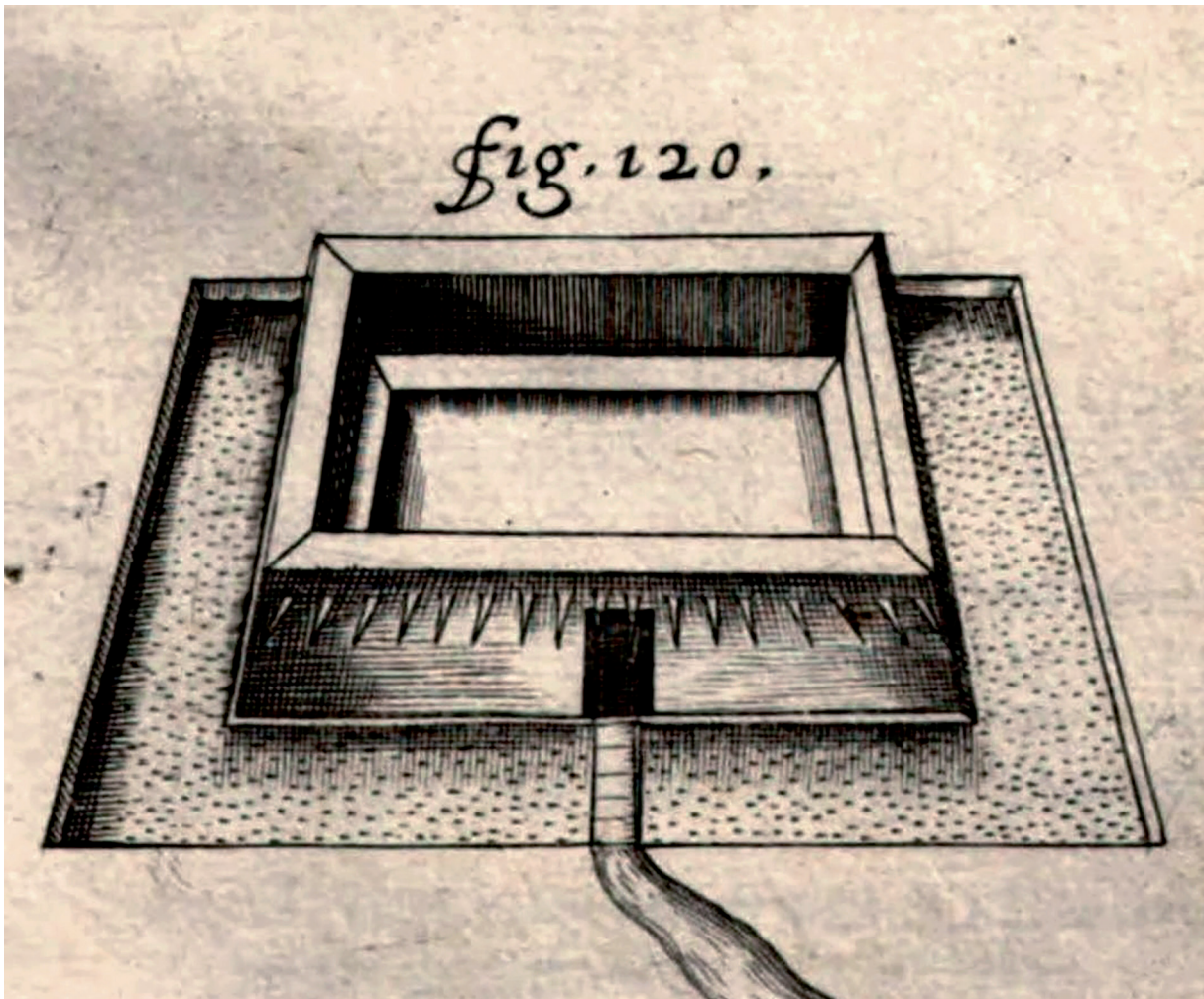


Fig. 6. A redoubt equipped with assault stakes. Source: Freitag, A. 1631.

Similar types of fortifications

Relevant historical manuals often deal with constructions similar to redoubts. For example, **half-redoubts** are laid out on a ground plan in the shape of an isosceles right-angled triangle.²⁴ Half-redoubts are usually situated in the vicinity of trenches and are intended to defend them. Another reason for building half-redoubts is the fact that their construction costs less time, labour and money than the construction of a whole redoubt (Freitag 1631, 146). Their longest side usually measures 6–7 rods, that is, 22 m 32 cm to 26 m 4 cm (Freitag 1631, 146; Felden 1643, [90]; Böckler 1659, 205). According to Naronowicz-Naroński (1957, 151), half-redoubts are mainly built near the walls of camps and are called “teeth”. Their size should correspond to the size of a given camp – larger camp should have larger half-redoubts than a smaller camp.

Another fortification elements similar to redoubts are the so-called **star schanzen** (*Sternschanzen*), which are sometimes called star-shaped redoubts (Naronowicz-Naroński 1957, 149, 151) or *estoile* (Freitag 1631, 147; Böckler 1659, 207), which is a French word for star. Their layout is usually based on square or regularly pentagonal ground plan. All sides are angled sharply inwards in the middle so

²⁴ Kupka (2002, 417–418), unlike the authors of the studied period, described half-redoubts as trapezoidal elements of field fortification.

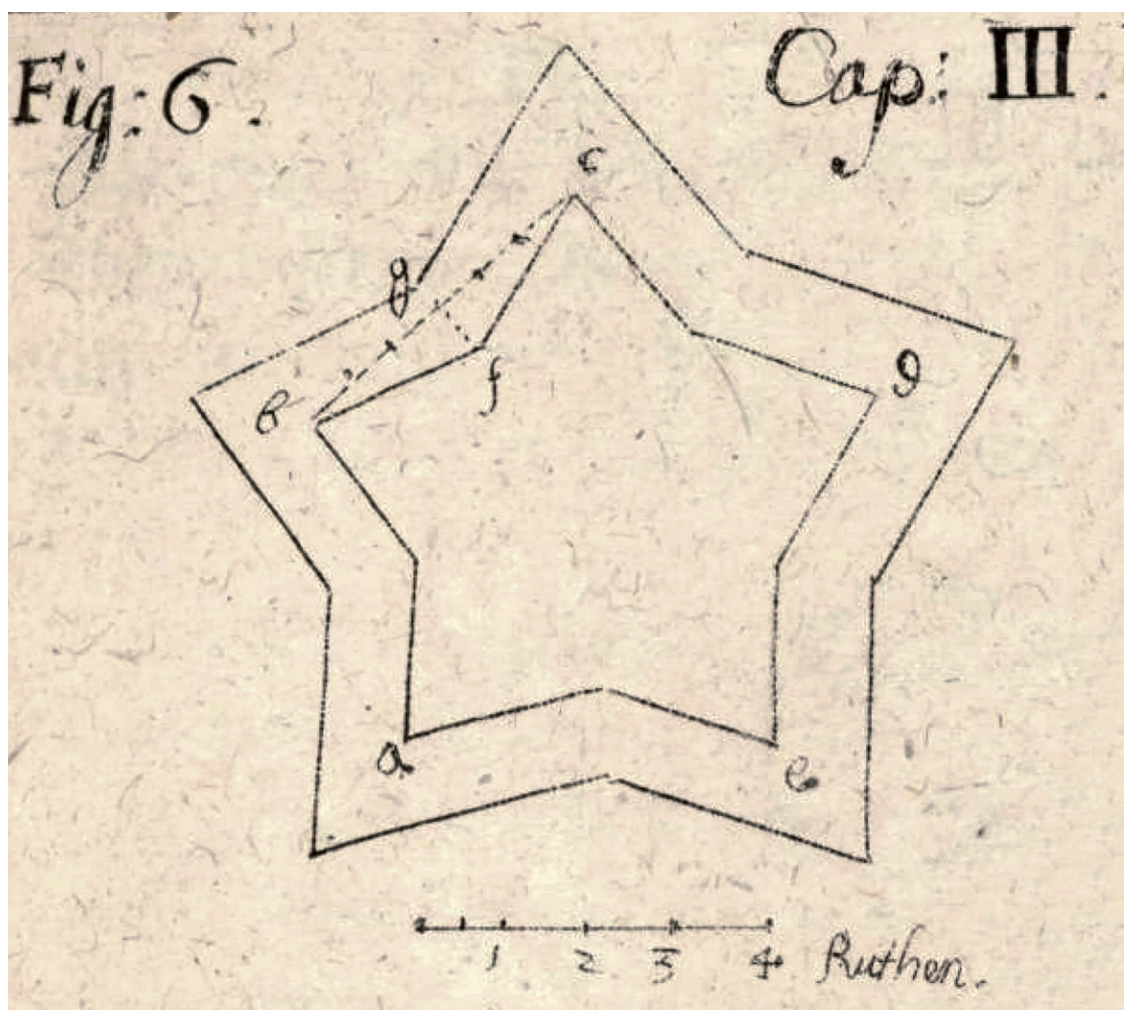


Fig. 7. Five-pointed star schanze. Source: Böckler, G. A. 1659.

that a star-shaped plan is formed. In the case of a square plan, the sides are angled inwards by one quarter of their length,²⁵ in the case of a pentagon they are angled inwards by one sixth of their length (Freitag 1631, 147–148; Felden 1643, [91]; Böckler 1659, 209). The manuals also mention six-pointed star schanzen, whose layout is derived from a regular hexagon. However, such constructions are said to be not very frequent and the authors therefore do not address them in detail (Freitag 1631, 148).²⁶

Adam Freitag (1631, 148) in his treatise refers to the conclusions by Buonaiuto Lorini and theorizes about the purpose of building these star-shaped constructions. He closes his considerations by the conclusion that when these small forts-schanzen are up to 9 feet (279 cm) high and their walls are up to 4–5 feet (124–155 cm) thick, then they are more efficient than redoubts. However, he adds that

²⁵ Naronowicz-Naroński (1957, 149–151) mentioned a different type of construction of a four-pointed star-shaped redoubt. Instead of bending the sides sharply inwards the basic square, so that the resulting feature was smaller in plan than the original square, Naronowicz-Naroński widens the original square by extending each of its sides by one-third of its length, thanks to which the resulting feature is larger in plan than the original square. However, both types of constructions give rise to installations of relevant ground-plan.

²⁶ Naronowicz-Naroński (1957, 150–151) also mentions three-cornered redoubts (although he himself remarks that they are not really widespread) and seven-cornered redoubts (which he does not address in more detail). Detailed descriptions of the construction of these redoubts are contained in all of the referenced manuals. At this place it is not necessary to deal with them because they are only marginally related to the topic of this study.

they should not be built in areas where the threat level is too high – in such places he recommends field forts with bastions.²⁷

Rakovník redoubt: Past and future

The aim of this study is to prepare source materials for the recreation of a redoubt near Rakovník. In the end we would therefore like to present the original redoubt that was located on the site Na Kokrdech in the vicinity of the town of Rakovník. The studied fortification evidently utilised the relics of an older earthwork. The area was already inhabited in the 3rd–1st centuries BC (La Tène period). Previous excavations have also revealed that the site has been used again in the 15th century (Blažková et al. 2011, 10).

In the autumn of 1620, a square redoubt of about 37 x 37 m in size was built at the given place.²⁸ Its size thus corresponds to redoubts described by Martin Eyland in 1624 (Eyland 1624, 95).²⁹ The redoubt was not reinforced by wood, it was pure earthwork. Nevertheless the redoubt was preceded by an older palisade, therefore it is well possible that some remnants of wooden posts were utilised for the construction of the fortification or were at least respected by the new structure (Blažková et al. 2011, 10).

In 2021, we plan to build a similar redoubt near Rakovník, but approximately half the size. The main reason for making the construction smaller is the observance of current legislation and the effort to use an area smaller or equal to 300 m². The structure will thus remind of redoubts which have been described in publications from the 1630s, above all in the book by Adam Freitag (1631, 146).³⁰ The other dimensions of our redoubt also will correspond to dimensions of redoubts mentioned at that time.

Conclusions

After having analysed the fortification manuals from the 1620s–1650s, we can say that redoubts belonged to the most popular and most frequently used field fortification elements. They usually were square or rectangular in plan and represented either pure earthworks or earthen fortifications reinforced by wooden planks. Their recommended dimensions have gradually diminished over the course of the studied period. While Martin Eyland in the 1620s designed redoubts with the side length of ca. 30 to 56 m, Józef Naronowicz-Naroński in the 1650s already mentioned redoubts with the side length of about 7,5 m, which would have been unimaginable for the authors a few years earlier.

However, the military and fortification manuals do not only describe the construction of redoubts but sometimes also inform us who built the field fortifications, how they were measured out in open terrain or which work tools have been used at that time. These facts can be drawn not only from the texts of these manuals but also from their relatively detailed accompanying illustrations.

The aim of this paper was to find out how the problem of redoubt building was approached in historical theoretical literature about fortification architecture. In order to learn the facts about the

²⁷ Square forts with small bastions in the corners are also mentioned by Eyland (1624, 95), who adds that relevant field fortification elements are built in the Netherlands.

²⁸ It is the side length measured from the rampart crown. The dimensions are based on the 2015 LIDAR images by Jan Čibera. John (2019, 395) mentions a size of “about 50 x 50 m”. Blažková et al. (2011, 10) write about dimensions of ca. 40 x 40 m.

²⁹ Eyland mentioned redoubts with the side length of about 30 to 56 metres.

³⁰ Freitag writes about redoubts with the side length of about 14,5 to 22,5 metres.

build-up of redoubts at the time of the Thirty Years' War, it is necessary to compare the detected instructions with other sources, above all with archival documents and archaeological finds.

The results of presented analysis will be used for the recreation of a redoubt near Rakovník in 2021. Various groups of people will participate in construction of the redoubt. Their spectrum shall at least partly resemble the groups of people who have built redoubts four hundred years ago. These groups thus shall include both professionals and enthusiasts with different occupations. The completed redoubt should then be preserved on site for several years to come, which will enable to follow up its gradual degradation in time. This process will provide further information on the problem of redoubts at the time of the Thirty Years' War.

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Klára Andresová Skoupá
Historický ústav Akademie věd České republiky, v. v. i.
Prosecká 809/76
Praha 9 – Prosek, 190 00
andresova@hiu.cas.cz