

Krumphau, Fireworks, and Gap Crossings: Medieval *Fechtbücher* as Warfare Manuals

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Abstract – A number of late medieval *Fechtbücher* – commonly referred to as “fight books” – either contain or are bound with additional material, such as gunpowder formulations or engineering solutions in the broadest sense. This article focuses on one of these engineering solutions: gap crossings. Gaps – rivers, ditches, trenches, moats, etc. – have always been a challenge for the military commander. We shall compare the solutions found in the extended *Fechtbücher* to contemporary tactical tracts and narrative sources to assess whether the solutions offered there are realistic. The fact that they are is further evidence that the early *Fechtbücher* can be understood as elements of general warfare manuals.

Keywords – *Fechtbuch*; Medieval Warfare; Medieval Tactics; Medieval Military Organisation; Vegetius; *Bellifortis*; *Pulcher Tractatus*; Christine de Pizan; Bridges

In transitu fluuiorum gravis molestia negligentibus frequenter emergit.
Vegetius¹

I. INTRODUCTION

I.1. *Fechtbücher* in the Context of Military Literature

A number of the *Fechtbücher* produced in Germany in the fifteenth century contain not only individual weapons techniques, but either include or are bound with treatises on gunpowder, artillery and firearms, or with engineering drawings showing siege-related engines and devices, gap crossing solutions, as well as miscellaneous subjects, from diving apparatus to baffling contraptions.

Why would this be? The proposition we are offering is that the authors or compilers of the manuscripts intended to create generalist handbooks for warfare, not just presentation pieces or vanity projects – further items in a prince’s *Kuriositätenkabinett*.² For this to be correct, the solutions offered must be realistic and must work; they cannot be akin to depictions of unicorns, part of cultural tradition but never actually seen. We shall test this question by comparing the solutions set out in the manuscripts with both tactical literature and historical sources.

¹ Vegetius, *De re militari*, 3:7, p. 89: ‘The crossing of rivers often causes great problems to the unprepared.’ Translations are mine unless otherwise stated.

² A question raised by Purton, *Military Engineer*, p. 14.

We have decided to focus on gap crossing solutions because – unlike say the brisance of gunpowder formulations, the viability of hoists, or the effectiveness of scythed trolleys – the question of whether they worked is amenable to a source-based, desktop study.³ Also, the other non-fencing content like siege engines or artillery-related devices are applied in isolation, by and among specialists or in narrowly circumscribed locations. Gap crossings on the other hand involve a complex interplay between command, reconnaissance, fighting troops, logistics, and engineers, as I learnt from my own experience as an infantry officer, modest and purely peacetime though it was.

In the typology developed by Jaquet, a *Fechtbuch* combining content other than personal armed or unarmed combat, or bound with such material, would fall into the ‘miscellany’ category.⁴ There are only few *Fechtbücher* miscellanies in this technical sense which contain gap crossing solutions, not enough to provide a sensible sample. Having said that, our modern typology is one imposed by us on a very heterogenous corpus;⁵ it is not one contemporaries consciously employed, at least not until the later sixteenth century. We propose to take a step back and view the corpus in its entirety.

It is not our objective to perform a comprehensive review of German war-related treatises. This has already been done by Rainer Leng in his two-volume work *Ars belli*, where he details each manuscript’s contents and analyses its possible sources.⁶ For the purposes of this study, it is also not necessary. Rather, we propose to build on the work done by Leng and analyse a sample with diverse content, and also ask whether the subject-matter selection adhered to a common canon.

Our focus will therefore be on selected fifteenth- and early sixteenth-century German works from this broader set, of which *Fechtbücher* form a subset. Can it be shown that the gap crossing solutions are realistic and reflective of military practice, based on theoretical treatises and narrative sources drawn from a wider time and geography? If it can, it would provide further evidence that the witnesses in the corpus were intended by their authors (also) as practical military manuals.⁷ It might explain why two such different personalities as Ludwig von Eyb, an experienced commander from the nobility, and Hans Talhoffer, a renowned fencing master and commoner, would combine fencing instruction and warfare-related engineering solutions in the same book.

³ See the discussion with Leng, *Ars belli*, pp. 48-50.

⁴ Jaquet, ‘European Fight Books’, pp. 6-8.

⁵ Jaquet, ‘European Fight Books’, p. 6.

⁶ Leng gave his work the generalist title “*Ars belli*” for a reason – *ibid.*, pp. 44-46.

⁷ Bearing in mind that even if such a purpose is shown as credible, it is still controversial how that purpose was achieved. I.e., was it the intent that recipients on their own could by study of the manuscript assimilate the lesson, or was the text meant as an *aide-mémoire* for an author-led seminar of sorts? I am grateful to Matthias Guckenbiehl for pointing this out.

I.2. Gap Crossings

No budding army officer or student of military history needs to be told that gap crossings are among the greatest challenges to the commander. John Hosler of Command and General Staff College at Fort Leavenworth KS explains:

Gaps are linear obstacles or gaps natural and manmade, wet or dry and variable in size. ... A gap crossing is projecting combat power across a linear obstacle. Such operations must address a threefold problem: first, to move combat power to the near side of the gap in safety; second, to cross the gap; and third, to reform combat power on the far side. ...

Unless adequately considered in preplanning, such crossing and reforming can potentially interrupt operational flow. If a unit arrives before the crossing is prepared, it is forced to halt and break formation. This reduces the tempo of the operation and invites new or further enemy attacks. The danger remains once the crossing begins because the soldiers and equipment are necessarily squeezed through a narrow aperture, which reduces maneuverability. Reforming ranks on the other side are also vulnerable to assault. Moreover, if the crossing itself takes too long, the army risks losing the initiative.⁸

Overcoming the gap often involves technical means – the construction of a bridge over a river (a wet gap) or a ditch (a dry gap) – for which engineering specialists are required; constructing the crossing takes time, and the mentioned narrow aperture of the crossing means that bringing the entire army to the other side is a slow and organisationally complex effort. It is also a situation where the troops are highly vulnerable because they are of necessity concentrated in one predictable place, and because the first to cross and the last to cross are severely understrength, so easily prey to a well-timed attack.

The commander of an army on the move is well advised to send out units, typically light cavalry, to reconnoitre the route of march. Even if no enemy action is expected, the commander needs to know whether the chosen route can accommodate the army's transports, especially important once gunpowder artillery, with its extraordinarily heavy loads, forms an integral part of the forces. Are there any bottlenecks? If the road needs to be improved or bridges strengthened, the commander must have this information – and the reconnaissance units need the expertise to make this judgement. Engineers may need to be despatched to perform the required works, sufficiently ahead of time to permit

⁸ Hosler, 'Gap-Crossing Operations', p. 59, referencing the now-superseded 2008 US Army Field Manual 3-90.12. I am grateful to John Hosler for sensitising me to the subject during discussions at the IMC in Leeds in 2019 and sharing his research.

a smooth progress of the host. It may be necessary to detail a force to provide protection to the engineers.

Of particular concern are choke points, usually caused by the terrain, at locations where the army *has to* pass through; a narrow valley, a causeway across a swamp, a mountain pass, or a ford or bridge across a river. The commander may find it necessary to seize these choke points before the main army moves, to ensure the enemy does not occupy them and to keep them passable. If a bridge has been destroyed, it may be the job of engineers to re-open the crossing.

But beyond this obvious application, engineers may be called upon to create alternatives to choke points, such as opening up mountain passes for wheeled transport and artillery that were formerly limited to sumpters, or creating alternative river crossings, thus enabling tactical or even operational surprise.⁹ In the Middle Ages, rivers were also important transportation corridors with a much greater capacity than the road network.¹⁰ Control of a bridge meant not only control of the crossing, but also control of the river traffic passing under it.¹¹

Throughout history, from Julius Caesar's victory at Bibracte (58 BC) to the *Grande Armée's* travails crossing the Beresina (1813) to Operation Market Garden (1944), and more recent events, contested gap crossings have been the scene of pivotal battles.¹²

I.3. Late Medieval Military Literature

There is a considerable amount of military-related literature originating in Catholic Europe from the thirteenth century onwards, beginning with redactions or translations of Vegetius, dealt with in more detail below. Another Classical author known and used in the Middle Ages was the Roman engineer, politician, and military officer Sextus Iulius Frontinus (c.40-103). His *Strategemata* are a collection of short anecdotes from Roman military history – often just a sentence or short paragraph – arranged according to thematic chapters. Medieval authors occasionally used Frontinus without realising it or

⁹ As with the campaign of the French king Francis I into Italy in 1515 leading up to the battle of Marignano, circumventing the Swiss forces guarding the established passes. Rodt, *Bernerisches Kriegswesen*, 2:141-42. Christine de Pizan, in her chapter technically on river crossings, also makes this point, see de Pizan, *Fais d'armes*, p. 226. Machiavelli (*Arte della Guerra*, p. 234 / Book 5) relates another episode from Caesar's Gallic Wars, where Caesar achieved tactical surprise over Vercingetorix by surreptitiously building a bridge and managing to cross a river uncontested.

¹⁰ For this reason, the *Pulcher tractatus* advises setting up camp along rivers. *Pulcher tractatus*, cap. 14 / p. 49.

¹¹ Settia, *De re militari*, pp. 247-48.

¹² Hosler discusses four critical gap crossing actions during the Crusades; Caesar's victory at Bibracte is adduced by Machiavelli, *Arte della Guerra*, p. 195 (Book 4).

wrote in his style, but he has not received the same modern academic attention as Vegetius.¹³

There are also more original productions like the *Enseignements* of Theodore Palaiologos, Marquis of Monferrat, as well as miscellaneous other works, like the military sections of the Castilian *Siete Partidas*, the recuperation genre (literature on the arrangements necessary for reconquering the Holy Land after the loss of Acre 1291), or Iberian, Italian, and Swiss city ordinances on recruitment, organisation, and kit.¹⁴ In the late fourteenth and early fifteenth century, works dedicated to tactical instruction appear especially in France and in Northern Italy.

By the middle of the fifteenth century, this corpus is supplemented by sometimes voluminous works reflecting the author's personal experiences and passing their lessons learnt on to others – sometimes within the family, but not necessarily. The form for these collections may be a commonplace book or *Hausbuch*, a journal recording memorable events affecting the family. Some late fifteenth-century manuscripts mark a transition from the miscellanies of the *Hausbuch* to a military-focused but still idiosyncratically selective work, like the *Kriegsbücher* of Philipp von Seldeneck or of Ludwig von Eyb from the late fifteenth century,¹⁵ or more informally a document such as Dolnstein's sketchbook.¹⁶

Paul Dolnstein is an interesting person. In civilian life, he seems to have been a civil engineer, and in charge of building a bridge across the Elbe at Torgau for Prince Elector Frederick the Wise of Saxony. But he also repeatedly signed up as a *Landsknecht*, and as such participated in the siege of Montfort in the Netherlands in 1491, in the Swedish Campaign in 1502-1503 (during the course of which he was knighted by the King of Denmark), and in the Landshut Campaign in 1504.¹⁷ At some point in his life, he wrote a short account of his military experiences, with several illustrations. Gap crossings do not feature in his sketchbook, but he had the skillset a commander needed to evaluate the state of bridges on an army's route of march.

¹³ Leng, *Ars belli*, pp. 63-65.

¹⁴ A review of some of these texts with Gassmann, 'Pulcher tractatus', pp. 106-15.

¹⁵ Leng, *Ars belli*, pp. 97-100.

¹⁶ Skjelver, *Dolnstein*.

¹⁷ Skjelver, *Dolnstein*, pp. 9-12.

II. TACTICAL LITERATURE

II.1. Vegetius' *Epitoma de re militari*

Publius Flavius Vegetius Renatus lived in the second half of the fourth century; in a military context, his *De re militari* was used throughout the Middle Ages.¹⁸ Innumerable copies survive, and he was regularly excerpted, summarised, edited, and translated, and referred to, into modern times. A 1535 edition printed in Paris combines Vegetius' *De re militari*, Frontinus' *Strategemata*, Aelianus Tacticus' *De instruendis aciebus*, and Modestus' *De vocabulis rei militaris*, together with 120 illustrations for which the *Bellifortis* very likely served as one of the sources.¹⁹ Vegetius probably did not hold active command, he is referenced here because he is amply quoted and translated from the late thirteenth century onwards.

For Vegetius, engineers were a routine branch of service in the Roman Legion.²⁰ Since military organisation in the European Middle Ages had changed fundamentally, three Vegetian gap crossing methods not dependent on the Legion's *fabri* are here explained in more detail.

When crossing a ford, Vegetius advises placing a line of cavalry both upstream and downstream along the ford; the upstream line breaks the power of the river's flow, and the downstream line catches equipment, animals, or men swept along during the crossing.²¹ For cavalry wanting to cross a river, Vegetius tells the troopers to construct rafts to bear their clothes, weapons, and saddles, and then swim the river with their horses, pulling the rafts across.²² He also recommends stocking boats and timber to be able to quickly construct a boat or pontoon bridge.²³ All three suggestions would have been instructive for the medieval commander, and are occasionally found elaborated in medieval or early modern texts. Horses are anyway strong swimmers, and swimming as an individual skill is routinely mentioned in medieval military or knightly training manuals.

II.2. The *Pulcher Tractatus de Materia Belli*

The short tract *Pulcher tractatus de materia belli*, an original summary and reworking of Vegetius' teachings on land battle, was written by an anonymous author in Northern Italy

¹⁸ Leng, *Ars belli*, pp. 65-69; Purton, *Military Engineer*, pp. 8, 21-22.

¹⁹ Vegetius, *De re militari*.

²⁰ Vegetius, *De re militari*, 2:10, 11 / pp. 47-48 (Vegetius, *Military Institutions*, pp. 61-63).

²¹ Vegetius, *De re militari*, 3:7 / pp. 89-90 (Vegetius, *Military Institutions*, p. 109); Settia, *De re militari*, p. 249, with references to examples where this device was used.

²² Vegetius, *De re militari*, 1:10 and 3:7 / pp. 5, 89-90 (Vegetius, *Military Institutions*, pp. 20-21, 110); Settia, *De re militari*, p. 252.

²³ Vegetius, *De re militari*, 3:7 / pp. 89-90 (Vegetius, *Military Institutions*, pp. 109-10).

in the late thirteenth or very early fourteenth century.²⁴ The author strongly emphasises the need for careful reconnaissance of the planned route of march.²⁵ In a chapter focusing on a safe withdrawal, he recommends dispatching detachments to secure both sides of river crossings to prevent an enemy from occupying them and so blocking the withdrawal, or from staging an ambush;²⁶ this mirrors the advice to the friendly commander wishing to best the enemy.²⁷ Also, the logistical challenges and delays in effecting the river crossing of a large army could be a contributing factor to a small but well-organised force defeating a bloated one, as in the case of Darius or Mithridates.²⁸

II.3. Christine de Pizan's *Livre des fais d'armes et de chevalerie*

Christine de Pizan (c.1364-1430) was born in Venice and came to France when her father was appointed physician and astrologer to King Charles V. Her father ensured a comprehensive education, and she married a French courtier, but was widowed in 1389. Without other income, she turned to writing and became a noted poet. She was also an author in the newly developing genre of instructional works on military science, where – like her contemporary military-oriented male authors like Honorat Bouvet, Geoffroi de Charny, or Jean de Bueil – she wrote in the vernacular.

Her work *Le Livre des fais d'armes et de chevalerie* (The book of feats of arms and chivalry) of 1410 bears no introduction or dedication, so it is not clear whether it was written for a particular purpose or occasion.²⁹ It comprises four books. In the first two, Christine excerpts and comments the received texts from Antiquity, primarily Vegetius' *De re militari*, Frontinus' *Strategemata*, and Valerius Maximus. The third book is essentially a dialogue with her predecessor and mentor, Honorat Bouvet, and his main work, *Arbre des batailles* (Tree of battles), on the laws of war. The fourth book continues on the laws of war theme, dealing with specific situations.

In the chapter of her *Livre des fais d'armes* entitled 'Cy parle de passer ost par fleuves et rivieres' (Here [we] talk about crossing the army across rivers and streams),³⁰ Christine reuses Vegetius' advice on the same subject; in an earlier chapter, she also recommends swimming as part of the education of the young nobleman.³¹ Overall, de Pizan is selective about the Vegetius subject-matter she does include, and she stresses that

²⁴ Gassmann, 'Pulcher Tractatus.'

²⁵ *Pulcher tractatus*, cap. 13, pp. 48-49.

²⁶ *Pulcher tractatus*, cap. 24 *in fine*, p. 55.

²⁷ *Pulcher tractatus*, cap. 22, p. 54.

²⁸ *Pulcher tractatus*, cap. 11, pp. 46-47.

²⁹ de Pizan, *Fais d'armes*, p. 13.

³⁰ de Pizan, *Fais d'armes*, pp. 224-26.

³¹ de Pizan, *Fais d'armes*, pp. 199-200.

she was guided by the advice of contemporary practitioners who had been impressed by her earlier writings.³²

In addition to the Vegetian suggestions and, one may infer, similarly informed by her practitioner interlocutors, de Pizan recommends having on hand prefabricated gap crossing solutions. One such example is a string of empty barrels secured by ropes that can be unrolled across a stream and laid with planks to form a bridge – a device that makes its appearance in the pictorial record discussed below in Part III as well as the chronicle of the siege of Neuss discussed in Part V.1. She also advises stocking lumber for pilings as well as transoms, girders, planking, and railing, on the line elaborated by Fronsperger, also discussed below, in Part IV.3.³³

Gap crossings (as well as overcoming choke points), Christine de Pizan warns, are all easier said than done – getting it right requires experience, practice, and preparation.³⁴

II.4. Niccolò Machiavelli's *Dell'Arte della Guerra*

Niccolò Machiavelli (1469-1527) was active as a Florentine diplomat and statesman during the early Italian Wars; the political turmoil of the time affected him personally, and he was distressed by the devastation the foreign interest-fuelled mercenary bands and internecine strife wrought on Italy. He published prolifically on various subjects, especially on statecraft, where his *Il Principe* (The Prince) on the governance of monarchies is probably his most well-known work; its counterpart on the governance of republics, the *Discorsi sulla prima deca di Tito Livio* (Discourses on the First Ten Books of Titus Livy), is less well known, though it is admittedly also more turgid than *The Prince*.

The seven books of *Dell'Arte della Guerra* (On the Art of War) are cast in a dialogue, and principally extoll the virtues of a strong citizen militia infantry, as modelled by the Roman republic, and in Machiavelli's day exemplified by the Swiss. Its military lessons focus on general tactics; gap crossings are addressed in the context of choke points generally. A commander needs to avoid being trapped at gaps and can achieve tactical surprise through surreptitious crossings. He is therefore well advised to provide his force with the means to do so.³⁵ Asked about fords, Machiavelli's alter ego refers to Vegetius'

³² de Pizan, *Fais d'armes*, pp. 45, 166-67 (I, 1), 327 (II, 20).

³³ de Pizan, *Fais d'armes*, pp. 224-25.

³⁴ de Pizan, *Fais d'armes*, p. 225; Braasch, 'Military Engineers', pp. 314-15; Hosler, 'Gap Crossing Operations', p. 58.

³⁵ Machiavelli, *Arte della Guerra*, pp. 232-35; on 233-34 (Book 5): 'Passansi ancora i fiumi che non si guadagnano, con ponti, con barche, con otri; e però è bene avere ne' suoi eserciti attitudine a potere fare tutte queste cose' ('Rivers that cannot be forded are crossed by bridges, by boats, or other means; it is therefore good to have in one's armies the ability to do all these things').

advice on posting cavalry upstream and downstream from the ford proper, mentioned above.³⁶

II.5. Sidebar: Diversion of Rivers

Vegetius further advises to divert the waters of a large river upstream, to reduce the flow downstream and allow it to be forded.³⁷ Christine de Pizan also refers to this technique, and adduces as an historical example an episode where the Persian king Cyrus diverted the Euphrates in his war against the Babylonians.³⁸ De Pizan may have gotten her sources garbled – Frontinus provides as examples stratagems of both Alexander the Great and Semiramis against Babylon involving the Euphrates,³⁹ whereas Cyrus is supposed to have diverted the Tigris.⁴⁰ Machiavelli too refers to diversions, though it is stated in the manner of an *obiter dictum*, without Classical or contemporaneous precedent.⁴¹

River diversions at this large scale are predicated on a geography featuring flat plains with shallow, slow-flowing rivers.⁴² The Seventh Crusade, in Egypt, offers an example where one side manipulated the hydrology to gain a tactical advantage, though in the opposite direction. As the crusaders were building a causeway across the Tanis in the Nile delta, the Arab defenders diverted more water into the stream, which eroded the opposite bank and so widened the Tanis as the causeway advanced.⁴³

That such stratagems were not unknown in Europe is evidenced by the account of King Stephen's attempted siege of Bristol in 1138. One option for the besieging army was to dam the River Avon downstream of the town, but the barons in the king's council of war reviewed the engineering challenges and concluded that the depth and flow of the river argued that such an endeavour would consume an unreasonable quantity of materials. Even then, it was unlikely to succeed. If the account is to be believed, the technical expertise on the issue resided with the barons. In any event, King Stephen evidently accepted their conclusion, and raised the siege of Bristol.⁴⁴

³⁶ Machiavelli, *Arte della Guerra*, p. 233 (Book 5); see fn. 21.

³⁷ Vegetius, *De re militari*, 3:7, p. 89.

³⁸ de Pizan, *Fais d'armes*, p. 225.

³⁹ Frontinus, *Strategemata*, 3:7, p. 166.

⁴⁰ de Pizan, *Fais d'armes*, notes *ad* 1:17, line 25, on p. 520.

⁴¹ Machiavelli, *Arte della Guerra*, p. 233 (Book 5).

⁴² Vegetius already says it only works when the terrain is flat, see *De re militari*, 3:7, p. 89.

⁴³ Hosler, 'Gap Crossing Operations', p. 63; the Crusaders gave up on the causeway and tried something else.

⁴⁴ *Gesta Stephani*, pp. 42-43. Another attempt, by William of Monferrat in 1279, to divert water from the Adda into the Lambro to prevent the latter from being fordable, apparently also failed, see Settia, *De re militari*, pp. 263-64. A diversion, more successful, was executed by the Burgundians

III. GAP CROSSING SOLUTIONS IN GERMAN MANUSCRIPTS

Gap crossing technology comes in two basic categories: general supplies like lumber, pontoons, fastenings, and tools needed to construct a solution *ad hoc*; and ready-made elements. This latter category yields some interesting solutions that have found their way into illustrations in war-related manuscripts and print. The variety is great, from rolls of reed matting that can be laid down to stabilise swampy ground, to roadbeds tied onto barrels to lay across a stream, or wagons with folding bridges that can be pulled into a stream bed and folded out onto the banks either side.

None of the sources are dedicated solely to gap crossings, they all deal with a wide variety of military (and civil) engineering problems. Again, especially in the later works, the key role of artillery is evident in the preponderance of technical solutions to lifting and shifting heavy loads like gun barrels with cranes, hoists, and block-and-tackle assemblies.

III.1. Conrad Kyeser's *Bellifortis*

Conrad Kyeser was born 1366 in Eichstätt and likely studied medicine there. In 1389 he joined a military expedition to Italy, and in 1394 marched with a Bavarian contingent in King Sigismund of Hungary's ill-fated expedition against the Turks, which came to a disastrous end with the battle of Nicopolis 1396. Out of favour with Sigismund and embroiled in political machinations, Kyeser was interned in 1402. Here he first wrote the *Bellifortis*, and in 1405 secured the services of specialist draughtsmen to illustrate the work. He died in 1405 or soon after, still interned.

The *Bellifortis* is the first work of its genre, and either influenced or was outright copied, in whole or in part, into numerous military and fighting-related manuscripts of the fifteenth century. A fine example combined with a *Fechtbuch*, though without gap crossings, is Hans Talhoffer's 1459 Ms. Thott.290.2^o;⁴⁵ another is the *Kriegsbuch* of Ludwig von Eyb, discussed below. A 1535 printed volume published in Paris binds Vegetius with Frontinus and other Classical works, and contains illustrations obviously inspired by *Bellifortis*,⁴⁶ as well as others not found there.

during the siege of Neuss, discussed below in Part V.1. Purton, *Military Engineer*, p. 216, refers to other nobility with engineering skills.

⁴⁵ Ms. Thott.290.2^o; having said that, fols 14^{r-v} of MS Thott show some gap crossing elements. Other Talhoffer manuscripts also contain *Bellifortis*-type drawings, but not as many or as elaborate; Leng, *Ars belli*, p. 138. Matthias Guckenbiehl at TU Dresden is currently researching the *Bellifortis* elements of MS Thott, and I am grateful for his pointers.

⁴⁶ Vegetius, *De re militari*. Two of the illustrations involve gap crossings: a mechanically unfolding bridge on p. 163 (which is not from *Bellifortis*, but appears in Philipp Mönch's book, see below), and a boat bridge on p. 172.

Bellifortis does not contain many gap crossing solutions, but two are shown here. They are both bridges with ramps folding out from a central element. In the first instance the central element is on wheels (Fig. 1),⁴⁷ while the other floats on barrels (Fig. 2).⁴⁸

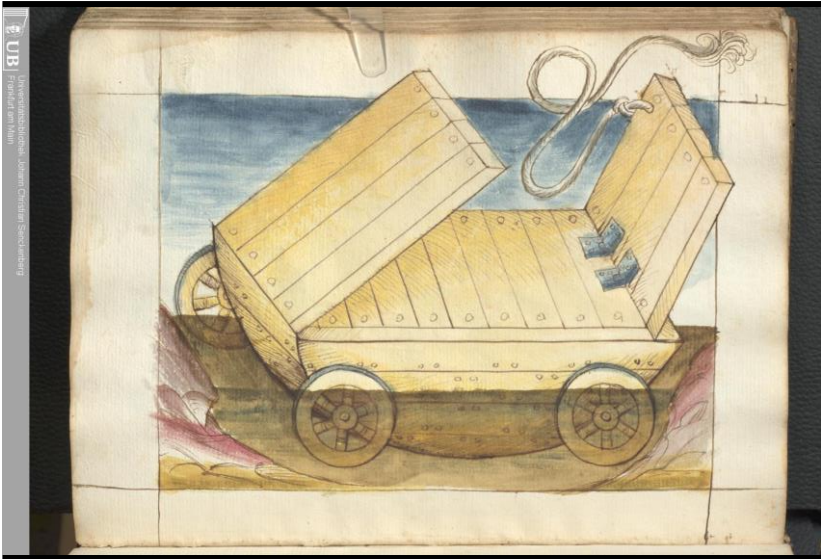


Fig. 1. *Bellifortis*, wagon to be pulled into a ditch, with fold-out ramps.
Frankfurt a.M., Universitätsbibliothek J.C. Senckenberg, Ms. germ. qu. 15, fol. 118^r/p.
238. Courtesy of University Library J.C. Senckenberg, Frankfurt a.M. (public domain).

⁴⁷ This same illustration is also found in MS Thott, fol. 40^r.

⁴⁸ Leng, *Ars belli*, pp. 109-49. The version of the *Bellifortis* referenced here contains only the illustrations, no text, see Ms. germ. qu. 15. Both illustrations are also in the *Kriegsbuch* of Ludwig von Eyb (UER Ms.B 26, Fig.1: fol. 155^r/p. 291, Fig. 2: fol. 144^r / p. 269).



Fig. 2. Bellifortis, raft to be placed into a ditch, with fold-out ramps.
 Frankfurt a.M., Universitätsbibliothek J.C. Senckenberg, Ms. germ. qu. 15, fol. 120^v/p.
 242. Courtesy of University Library J.C. Senckenberg, Frankfurt a.M. (public domain).

III.2. Anonymous War Technology Illuminated Manuscript

This codex was produced between 1420 and 1440 in the Upper Rhine region and was kept at the Monastery of Rheinau; it contains barely any text, but a wealth of illustrations on various war-related technologies, many of them involving gunpowder. By style and content, it does not appear to be derived from the *Bellifortis*.⁴⁹ We have selected two illustrations. The first one (Fig. 3) shows reed matting being unrolled: these may be the *graticci di legname* Machiavelli recommends laying down when a ford is swamped in order to aid the cavalry to cross.⁵⁰ The second one (Fig. 4) shows two men swimming.

⁴⁹ Leng, *Ars belli*, pp. 417-22; Ms. Rh. hist. 33b.

⁵⁰ Machiavelli, *Arte della Guerra*, p. 235 (Book 5). Reed matting being unrolled is also in von Eyb's *Kriegsbuch*, see UER Ms.B 26, fol. 147^v/p. 276.



Fig. 3. *Anonymous manuscript, reed matting being rolled out.*
Zürich, Zentralbibliothek Zürich, Ms. Rb. hist. 33b, fol. 143r.
Courtesy of Central Library Zurich (CC BY-NC 4.0).



Fig. 4. Anonymous manuscript, two men swimming.
 Zürich, Zentralbibliothek Zürich, Ms. Rb. hist. 33b, fol. 155r.
 Courtesy of Central Library Zurich (CC BY-NC 4.0).

III.3. The *Büch der stryt und bu^ochßen* of Philipp Mönch

Not much is known about Philipp Mönch; he was in the service of the Count Palatine by the Rhine from the late fifteenth century into the early sixteenth century, and in 1509-1510 in the service of William III, Landgrave of Hesse. He wrote his *Kriegsbuch* in 1496 – in its front, he included a picture of himself, dressed in a fur-trimmed robe.⁵¹

Mönch gave his book the title *Book on Combat and Firearms*; the content focuses on artillery, devices for lifting and moving heavy loads, and miscellaneous other matters.

⁵¹ Leng, *Ars belli*, pp. 255-57; Heidelberg, Cod. Pal. germ. 126, fol. 1v.

His drawings are meticulous, with correct perspective, and often show enlargements of particularly intricate mechanisms incorporated into his devices.

The first illustration from Mönch's *Kriegsbuch* (Fig. 5) features a mobile unfolding bridge which can lay down a crossing from one side of the gap, similar to the one shown in the printed 1535 Vegetius and not derived from *Bellifortis*.⁵² The second illustration (Fig. 6) shows a prefabricated bridge consisting of planks secured by ropes and laid over barrels – a solution described by Christine de Pizan and apparently applied at the siege of Neuss.⁵³



Fig. 5. Mönch, mechanism for laying a bridge from one side. Heidelberg, Universitätsbibliothek Heidelberg, Cod. Pal. germ. 126, fol. 21r. Courtesy of University Library Heidelberg (public domain).

⁵² Vegetius, *De re militari*, p. 163.

⁵³ See above, Part II.3 and below, Part V.1.

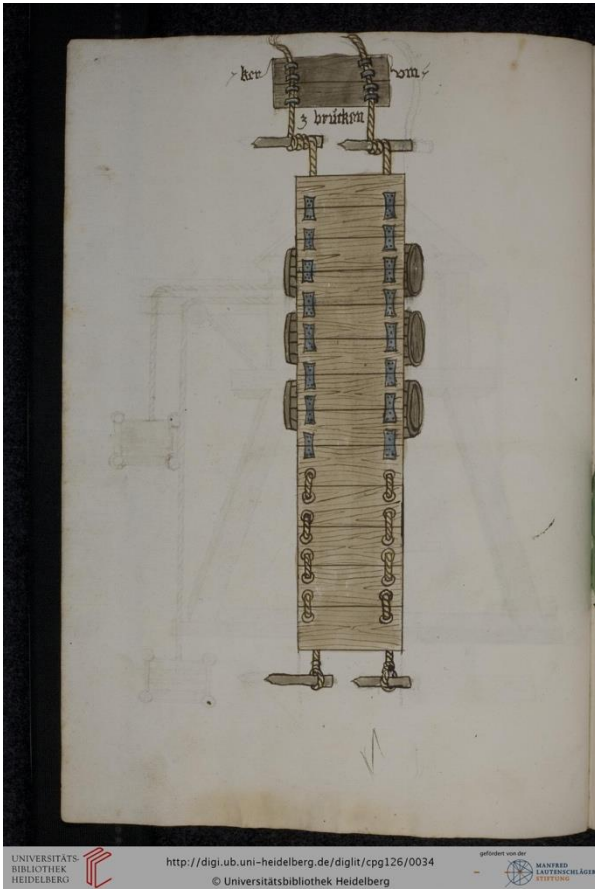


Fig. 6. Mönch, fold-out bridge on barrels.

Heidelberg, Universitätsbibliothek Heidelberg, Cod. Pal. germ. 126, fol. 10^r. Courtesy of University Library Heidelberg (public domain).

III.4. The *Kriegsbuch* of Ludwig VI von Eyb the Younger (1450-1521)

The von Eybs were old-line Franconian ministerial petty nobility. Ludwig the Younger's father, Ludwig V von Eyb the Elder (1417-1502), saw military and civilian service first with Margrave Frederick I of Brandenburg-Ansbach and later Margrave and Prince Elector Albrecht Achilles of Brandenburg, where the younger Ludwig was able to accompany his father on campaign.

Like his father, Ludwig VI served various princes in capacities where his duties included administrative, legal, fiscal, and military matters, mostly in the Palatine. In 1503, he led his Palatine troops in some minor actions in a war against Nuremberg and Brandenburg. Though he inherited the family estates in 1502, adding them to his own

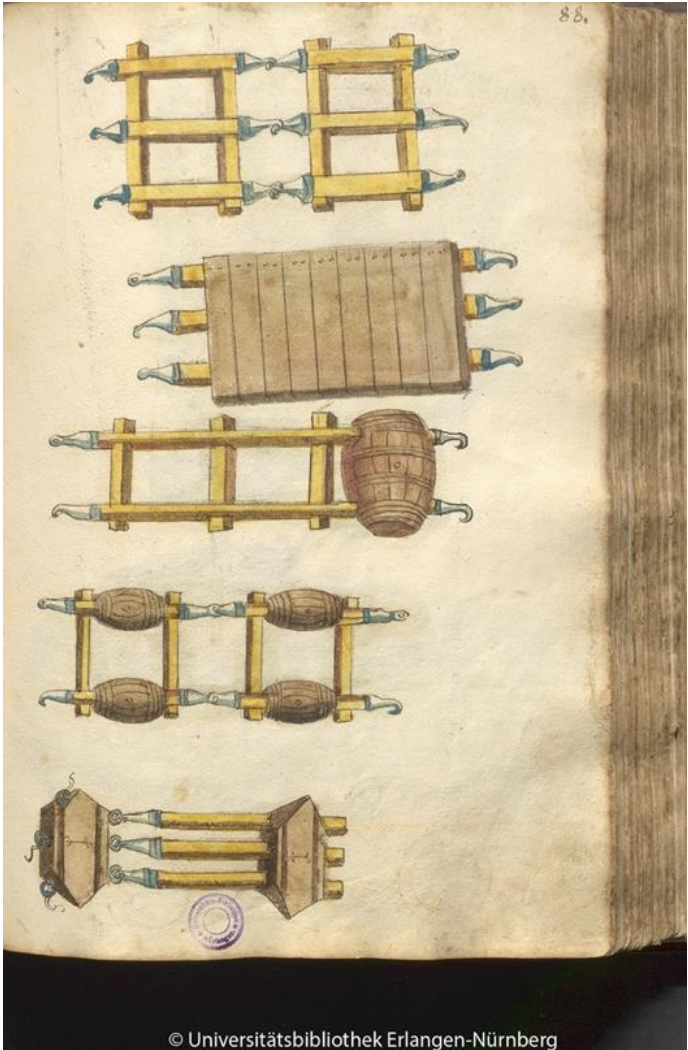
substantial acquisitions, he continued to act as senior official, briefly for the Margrave of Brandenburg, but mostly for the Count Palatine.

Of Ludwig's literary production, few works have survived. One survivor is the immensely entertaining biography of fellow Franconian Wilwolt von Schaumberg, the brother of the husband of one of Ludwig's sisters. It relates Wilwolt's swashbuckling chivalric exploits as soldier, diplomat, traveller, and tournament fighter. Another is his *Kriegsbuch*, from 1500 or shortly thereafter, where the first part is a fight book detailing techniques in wrestling, longsword, and other weapons. The second part consists of illustrations, many of them taken from *Bellifortis*, but also much expanded – the boat bridge in Fig. 9, for instance, is similar to the one shown in the printed 1535 Vegetius, and is not found in *Bellifortis*.⁵⁴

Presented here are three pages. They all set out gap crossing solutions, though how exactly they were supposed to be used is sometimes baffling as there is no explanatory text. In Fig. 8, the first two images from the top probably show flotation device elements, which might be combined to support bridges, rafts, or ferries, with the second one from the top representing inflatable skins. Fig. 9 at the top evidently depicts a boat bridge.⁵⁵

⁵⁴ Leng, *Ars belli*, pp. 269-73; UER Ms.B 26.

⁵⁵ Vegetius, *De re militari*, p. 172.



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Fig. 7. von Eyb Kriegsbuch, various ready-made bridging solutions. Erlangen, Universitätsbibliothek Erlangen-Nürnberg, UER Ms.B 26, fol. 88r. Courtesy of University Library Erlangen-Nuremberg (public domain).



Fig. 8. von Eyb Kriegsbuch, various ready-made bridging solutions.
 Erlangen, Universitätsbibliothek Erlangen-Nürnberg, UER Ms.B 26, fol. 88v.
 Courtesy of University Library Erlangen-Nuremberg (public domain).



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Fig. 9. von Eyb Kriegsbuch, boat bridge .
 Erlangen, Universitätsbibliothek Erlangen-Nürnberg, UER Ms.B 26, fol. 89r.
 Courtesy of University Library Erlangen-Nuremberg (public domain).

IV. MILITARY ORGANISATION – SAPPERS AND ENGINEERS

A commander's ability to implement a gap crossing solution relies on the ready availability of materials and specialists, which should be visible in an army's organisation and supplies. This part of the article reviews whether there is evidence for such preparatory arrangements, without which both the tactical advice set out in Part II and the solutions mentioned in Part III are purely theoretical.

Generally, digging is an inextricable part of military activity. The author of the *Pulcher tractatus* describes the infantryman's lot as to 'wield weapons, carry loads, and dig'.⁵⁶ For bigger jobs – fieldworks for artillery emplacements, undermining walls, siege engines, or improvised bridges – specialists are necessary.

IV.1. *Guastatores* and *Zappatores*

The city-states of thirteenth-century Italy have left us voluminous documentation on the make-up of the forces they raised for their campaigns. At their core were the mounted *milites*, and the *pedites* with their crossbows, pavises, and pikes. Additionally, we regularly find contingents of *guastatores*, auxiliaries armed with shovels, picks, axes, and similar tools, with the express task of systematically devastating (as their name implies) the enemy countryside's trees, vineyards, and so on. Notionally, and already at the time, it is difficult to categorically differentiate *guastatores* with their purely destructive function from the *zappatores* (literally "pick-wielders"), sappers assigned to digging defensive ditches and more generally easing progress.⁵⁷ In response to a call-up in 1334, Treviso sent 157 *guastatores* to assist the troops near Brescello, where they dug ditches, constructed siege machines, and erected fortifications. Expressly among their orders in this campaign was the following: 'Fit etiam quidam pons de sandonibus super Padum qui nondum est completus, sed cito perficietur versus Viadanam et versus partem Cremonae.'⁵⁸

IV.2. The *Kriegsbuch* of Philipp von Seldeneck

Philipp von Seldeneck (1440-1532) descended from old-line Franconian petty nobility. In around 1460, Philipp acquired fiefs in the Palatinate, and in 1465 was made *Erbküchenmeister des Reiches* (Hereditary Steward of the Holy Roman Empire). He participated in the Battle of Seckenheim in 1462 at the side of the victorious Friedrich *der Siegreiche*, Prince Elector and Count Palatine;⁵⁹ which other campaigns he participated in is unclear, though his activities evidently kept him in fine fettle.

The *Kriegsbuch* attributed to Philipp von Seldeneck was compiled from several standalone documents dating from between 1460 and 1510, and comprises two chapters on wagon forts (*Wagenburgen*), the *Kriegseid der Eidgenossen* (War oath of the Swiss), the *Eid*

⁵⁶ *Pulcher tractatus*, cap. 5, p. 43: 'cui gestare ferrum, fossam facere, onus ferre consuetudo est.' For a discussion of the English combat engineers during the Hundred Years' War see Braasch, 'Military Engineers'.

⁵⁷ A *zappa* is a pickaxe. Settia, *Rapine*, pp. 55-56; Varanini, 'Esercito del comune di Treviso', pp. 61-63. Also with Machiavelli, *Arte della Guerra*, pp. 221-23 (Book 5).

⁵⁸ Varanini, 'Esercito del comune di Treviso', p. 62: 'The bridge of rafts across the Po should be made, which has not yet been completed, but should be finished quickly in the direction of Viadana and the Cremona side.' Further instances of boat bridges with Settia, *De re militari*, pp. 258-59.

⁵⁹ Neubauer, *Seldeneck*, pp. 230-39.

der *Kriegsknechte* (Oath of the lansquenets), a *Kriegsordnung der Fußstruppen* (War Regulations for the Infantry), a *Feldbestellung der Reiterei* (Battle Order of the Cavalry), and an *Ordnung für große Heere und Schlachten* (Regulation for Large Armies and Battles). It is very likely that Philipp himself oversaw the compilation of the manuscript, which is bound with other material (it is preceded by a German translation of Vegetius). The final three documents started off as letters written by Philipp to his son Friedrich at the latter's request, and copied into the manuscript by Hans, another of Philipp's sons.⁶⁰

Seldeneck focuses on wagon forts (*Wagenburgen*), dealt with in two of his four chapters. Still, early in the first chapter, Seldeneck advises the inclusion of 'vier prucken, gemacht mit balckenn oder tremen vnnd mit prittern, das je ein wagen ein prucken tragen moge; das man damit die zeil der wegen vber grabenn oder moße gefuren moge'.⁶¹

IV.3. The *Kriegsbuch* of Leonhard Fronsperger

Leonhard Fronsperger (c.1520-1575 – the spelling is inconsistent) is known to have been attached to the Habsburg Imperial army between 1553 and 1573, participating in numerous campaigns and winning a promotion to provost general in 1566. His *Fünff Bücher vonn Kriegs Regiment und Ordnung* (Five Books on Conduct and Organisation of War) is a comprehensive treatment of military organisation and preparation.⁶²

As it pertains to the subject matter of this article, Fronsperger begins with the stocking of the arsenal, where he recommends keeping quantities of entrenching tools as well as rope, block and tackle, hoists, and similar provisions, as well as a *Schiffbrücken* (boat bridge) along with its wagon and bridge timbers.⁶³

In a subsequent chapter on the wagon train required for a campaign, the second paragraph instructs the commandant to have two wagons with bridges at the very front, just behind the *Rennfählein* (mounted troop at the front of the vanguard), so that if the army encounters a ditch that cannot be waded or ridden across, the bridge may be laid over it so that the army can pass.⁶⁴ Wagons loaded with entrenching and woodworking tools as well as ropework feature later in the same chapter.⁶⁵

Fronsperger follows this up with a chapter specifically 'Die Schiff brücken belangend' (concerning boat bridges). Recognising that a campaign into foreign lands will

⁶⁰ Neubauer, *Seldeneck*, pp. 14-22; Leng, *Ars Belli*, p. 295.

⁶¹ 'Four bridges, made with beams or trusses and with boards, so that each one wagon should carry one bridge; so that one with them may conduct the wagon train across ditches and muddy stretches'; Neubauer, *Seldeneck*, p. 68.

⁶² Leng, *Ars Belli*, pp. 304-08.

⁶³ Fronsperger, *Kriegs Regiment und Ordnung*, fol. 15^v.

⁶⁴ Fronsperger, *Kriegs Regiment und Ordnung*, fol. 20^r.

⁶⁵ Fronsperger, *Kriegs Regiment und Ordnung*, fol. 21^v.

very likely sooner or later encounter a still or flowing body of water, and that a boat bridge is very expensive to maintain, he sets out the necessary equipment. At least thirty sturdy boats are needed, their dimensions being sixteen to eighteen foot (*Schub*) in length and of at least seven to eight foot beam. They must be loaded and transported with care, along with all the timber and furnishings necessary to lay a bridge sturdy enough to allow the passage of artillery, cavalry, infantry, and sundry others. Each of these boats must be loaded on its own wagon (upside down, so the rain does not fill it) and pulled by four horses, with its own crew.⁶⁶

In a later chapter, Fronsperger also advises the provision of a good number of leather sacks that can be inflated, roped together, laid with planks, and so form an impromptu raft, and combined to make a bridge or a ferry. The advantage of this tool is that deflated, the sacks fold up neatly and do not take much space.⁶⁷

On completion of a campaign, the *Schantzmeister* (commander of the sappers) is entitled to all the timber that was involved in the action, and he may sell it to whomever he pleases.⁶⁸

IV.4. The *Kriegsordnungen* of Count Reinhard zu Solms

Count Reinhard zu Solms (1491-1562) followed in the military footsteps of his father Count Philipp zu Solms, who was adviser to Emperors Maximilian I and Charles V, as well as Prince Elector Frederick the Wise of Saxony. The family were old-line high nobility with lands in central Hesse.⁶⁹ Between 1516 and 1522, Reinhard joined Franz von Sickingen, but then pulled back from participation in the latter's military adventures. Philipp had initiated the modernisation of the bastions of the Solms' *Residenzstadt* Lich, which Reinhard completed in the 1520s, as well as then the fortress at Hanau. Reinhard's expertise was sought for the modernisation of the defences of Ingolstadt in 1539-1542, which led to further commissions. From the 1540s, Reinhard was again in the field on Holy Roman Emperor Charles V's side and participated in numerous actions and sieges.

Reinhard wrote several texts on warfare and the nobility, the main work being his eight-volume *Kriegsordnungen*, written together with Konrad von Boyneburg and Duke Philipp Eberhard of Cleves, and self-published in 1559-60. The *Kriegsordnungen* cover *Kriegsregierung nach alter Teutschen Ordnung* (War regulations according to old German practice); officers' functions; artillery; firearms; undermining; and mustering. The seventh

⁶⁶ Fronsperger, *Kriegs Regiment und Ordnung*, fols 22^{r-v}.

⁶⁷ Fronsperger, *Kriegs Regiment und Ordnung*, fol. 106^v; see above Fig. 8 from the Eyb *Kriegsbuch* for an example of a solution using inflated skins.

⁶⁸ Fronsperger, *Kriegs Regiment und Ordnung*, fol. 28^r.

⁶⁹ Joachim Meyer's 1560 *Kunst des Fechtens* is dedicated to Otto von Solms, the grandson of Reinhard's younger brother, see Norling, 'Joachim Meyer's Fencing Treatise to Otto von Solms'.

volume consists of a set of cards to be used to experiment with order of march and battle array. The final volume gives instructions on sieges.⁷⁰

The sections on engineering are contained in the third book of the *Kriegsordnungen*, which is about the artillery. It is clearly the artillery, with its heavy loads of guns, shot, and powder, and its requirements for prepared and protected emplacements, that makes the highest demands of the engineers. The short paragraph on the *Schiffbrückenmeister* (master of the boat bridge) instructs him and his wagons to be available to support the *Zeugmeister*, the officer in charge of the artillery.⁷¹ In Book 7, one of the cards in each of the black and the red deck show two *Schiffbrücken*,⁷² and the order of battle of Emperor Charles V's campaign in France 1554 includes twelve wagons with boat bridges, each drawn by six horses.⁷³

As a fascinating further insight, Solms also appreciated that a commandant needs to have a good tactical grasp of when and how to deploy his gap crossing means. In the catalogue of criteria for the selection of the *Büchsenmeister*, one question is whether he has wartime experience in using boat bridges.⁷⁴

IV.5. *Schaufelbauern*

Swiss mustering rolls from the sixteenth century – mirroring the Northern Italian cities' practice from two centuries earlier – include units described as *Schaufelbauern* (literally “shovel farmers”; the term is not derogatory). Their main job was to ease the progress of the host by evening out roads and removing obstacles. In addition to their personal weapon, as a rule a sword, they carried implements such as picks, shovels, spades, and axes. They had their own commander, non-commissioned officers (*Rottmeister*), musicians, and standard, thus marking them as respected elements of the host, not mere servitors.⁷⁵ In Berne, the *Hauptmann* of the *Schaufelbauern* corps was organisationally subordinated to the *Bauherr*, the member of the governing executive responsible for the city walls and hence also the artillery.⁷⁶ In Basel as well, the detachment of *Schaufel- und Bickelbauern* was

⁷⁰ Leng, *Ars Belli*, p. 309-15.

⁷¹ Solms, *Kriegsordnungen*, Book 3, fol. 11^v.

⁷² Solms, *Kriegsordnungen*, Book 7, fols 5^r, 8^v.

⁷³ Solms, *Kriegsordnungen*, Book 7, fol. 11^v.

⁷⁴ Solms, *Kriegsordnungen*, Book 7, fols 5^r, 8^v.

⁷⁴ Solms, *Kriegsordnungen*, Book 3, fol. 16^v.

⁷⁵ Machiavelli (*Arte della Guerra*, pp. 221-23 (Book 5)) recommends having soldiers do these jobs, and not hive them off to menials – they are not beneath the soldier's dignity, and the commandant should not bloat his force with non-combatants who will only get in the way when the enemy is encountered.

⁷⁶ Rodt, *Bernerisches Kriegswesen*, 2:141-45 and 2:175-76; Elgger, *Kriegswesen*, p. 144. See also the section on *Schanzbaurn* with Fronsperger, *Kriegs Regiment und Ordnung*, fols 29^v-30^v.

initially included with the artillery, but from 1534 constituted a separate troop of *Génie* with its own *Hauptmann* and standard.⁷⁷ Zurich's archives paint a similar picture, and a Zurich *Reisrodel* of 1490 has the sappers march just behind the mounted tip of the vanguard, as also recommended by Fronsperger.⁷⁸

Easing progress could also involve constructing bridges. In a 1511 campaign against France in the Ticino, the French had torn down the bridge across the Tresa and dammed the waters. Hans Heyd from Fribourg and his *Rottgesellen* swam the river, chased away the French on the other side, then used the timbers of a slighted house to reconstruct a bridge to allow the Swiss forces to continue their march toward Varese.⁷⁹

Given the prevalence of lakes and rivers in Switzerland, it is somewhat surprising not to find more explicit mention of pontoniers; Geßler suggests this may be due to a need for stable bridges to transport the heavy artillery, but already Christine de Pizan in the early fifteenth century says that improvised bridges could and needed to be constructed to a high standard that allowed intensive usage.⁸⁰ Fronsperger explicitly states they had to be sturdy enough to allow the passage of artillery.⁸¹ Pontoniers only make their appearance in the eighteenth century as a separate speciality of the *Génie*.⁸² But again, that does not mean the issue was not recognised; in anticipation of hostilities with the Catholic cantons (which then materialised in the First Villmergen War of 1656), the two Protestant powers Berne and Zurich conducted what one might call a general staff survey of the river crossings the allies would depend on and identified the Reuss bridge at Mellingen as being of strategic importance. A joint 1620 memorandum had Zurich pre-position boats upstream in the event the bridge was destroyed or lost.⁸³

⁷⁷ Geßler, 'Basler Wehr- und Waffenwesen', pp. 24-25, 39, 41, 44, 55. *Génie* is the generic francophone term for military engineers (sappers, pontoniers, miners, etc.).

⁷⁸ Zurich generally Geßler, 'Zürcherische Genietruppen', pp. 11-29; on the 1490 *Rodel* *ibid.*, p. 14.

⁷⁹ Stettler, *Schweizer Chronik*, 1:448-449. Elgger, *Kriegswesen*, pp. 144-45, mentions several other instances from the fifteenth and sixteenth centuries, including the Swiss constructing rope bridges while on campaign in Italy.

⁸⁰ Geßler, 'Zürcherische Genietruppen', p. 26; de Pizan, *Fais d'armes*, p. 225; the improvised bridge at Neuss was expressly capable of supporting cavalry and wagons, see Part V.1.

⁸¹ Fronsperger, *Kriegs Regiment und Ordnung*, fol. 22r.

⁸² Geßler, 'Zürcherische Genietruppen', pp. 26-28.

⁸³ Geßler, 'Zürcherische Genietruppen', pp. 18, 27.

V. REVIEW, *A BRIDGE TOO FAR*, AND CONCLUSION

V.1. Gap Crossings in Military Historiography

Military historiography on gap crossings falls into a gap of its own;⁸⁴ historians tend to focus on battles, or on circumstances which made success in battle or a war possible – logistics, organisation, numbers, armaments. Unless a gap crossing is contested – as was, for example, Napoleon’s crossing of the Beresina – and outside of monographs about a campaign like Julius Caesar’s autobiographical Gallic Wars, it is unlikely that military historians will focus on it.⁸⁵ However, a gap crossing may in itself set the scene for a battle by surprisingly placing an army where it should not have been, forcing the other side, which was keen to avoid a direct confrontation, to give battle. Marignano is a case in point; the Swiss were guarding the wheeled transport-capable passes across the Maritime Alps to prevent Francis I from bringing his artillery into Lombardy. Francis had his engineers open up previously unpassable roads, to surprise the Swiss in the plains and set up his signal victory of 1515.⁸⁶

William the Breton’s description of the 1202 Normandy campaign of Philip II Augustus, King of France, offers further examples, with several of the solutions discussed in the manuals brought into play. First, Philip attacked Gournay-en-Bray. Above the town was a large reservoir; the king had the dam containing the reservoir breached. The ensuing flood devastated the country around Gournay and swept away its defences.⁸⁷ Having occupied the now defenceless town, the king moved on to besiege Castle Gaillard, located on an island in the Seine.

In preparation for the siege, the garrison of Gaillard had destroyed one of the local bridges across the Seine, leaving intact only the one the castle controlled. They also drove stakes into the Seine to prevent the river being used by the king’s boats, and so hamper the supply of the royal army. Philip Augustus’ engineers built a pontoon bridge (and William is at pains to specify that it was a pontoon bridge, not a boat bridge) across the Seine to allow the king to besiege the castle from both sides of the river. At one point, a sally by the castle garrison against one of the bridgeheads caused a panic, the king’s camp followers stampeded the bridge and damaged it. However, the damage was quickly repaired and enabled reinforcements from the other side to re-secure the bridgehead.

⁸⁴ Purton, *Military Engineer*, p. 2. Purton’s monograph deals generally with numerous aspects of military engineering and military engineers, with occasional references to bridges and gap crossings.

⁸⁵ Settia (*De re militari*, pp. 247-73) dedicates a chapter to rivers in warfare, especially in Italy.

⁸⁶ On Francis’ campaign, see fn. 4 above. Further examples from the Hundred Years’ War with Braasch, ‘Military Engineers’, pp. 316-18.

⁸⁷ William the Breton, *Vie de Philippe-Auguste*, pp. 223-24.

To tackle the stakes hampering his shipping, the king selected strong swimmers from among his troops to dismantle the obstacles.⁸⁸

The 1474-75 siege of Neuss by Duke Charles the Bold of Burgundy also offers examples of hydraulic engineering and bridge-building. Neuss had directed the waters of two rivers toward the town to fill the moat; Burgundian engineers redirected them into the Rhine, depriving the moat of water.⁸⁹ Downstream from Neuss was an island in the Rhine. Recognising its tactical importance, Charles captured it and built two bridges. According to Wierstraat's verse chronicle, they were made of wine barrels laid over with boards and tightly secured each end. The bridge was solid enough to allow riders and wagons to cross.⁹⁰

No doubt (and this is supported by the organisation of the subject-matter in the sources), the advent of gunpowder artillery played a major role in the urgency of gap crossing solutions; both infantry and cavalry can if need be wade or even swim across a river, and the engines required for pre-gunpowder sieges – trebuchets, cats, siege towers, battering rams, ladders – could be built from materials available in the environs of the town or castle besieged.⁹¹ While initially the projectiles could be fashioned from locally available stone, the need to bring along the far more efficient and precise calibrated iron shot and specialised gunpowder supplies added yet another logistical layer. Moving artillery pieces and paraphernalia required good roads and strong bridges, which in turn required engineering experts and specialised tools.

V.2. *A Bridge Too Far*

Terrain modifications on the battlefield need not be elaborate to have a decisive effect. All they need do is disrupt the enemy's formation, slow them down, channel them, cause them to concentrate in a place of prepared fire. While above-grade obstacles are more easily reconnoitred, below-grade obstacles – gaps – whether specifically created or pre-existing like drainage ditches or sunken lanes, come as a nasty surprise to the unprepared, as Vegetius put it.⁹²

The most famous mediatic depiction of the importance of gap crossings in war is probably the 1977 film *A Bridge Too Far*, after Cornelius Ryan's book of the same title.

⁸⁸ William the Breton, *Vie de Philippe-Auguste*, pp. 226-29; Purton, *Military Engineer*, p. 125.

⁸⁹ Wierstraat, *Histori des beleegs von Nuis*, 427-443 (pp. 524-25).

⁹⁰ Wierstraat, *Histori des beleegs von Nuis*, 444-458 (pp. 525-26); Purton, *Military Engineer*, pp. 270-71.

⁹¹ Purton, *Military Engineer*, p. 11.

⁹² A ditch or trench sufficiently discombobulated the attacking Meccans, allowing Mohammed to defend Medina in 627; ditches dug by the defending Flemings contributed to their victory over the French knights at the Battle of the Golden Spurs outside Courtrai/Kortrijk in 1302; and skilful incorporation of existing ditches and a sunken lane into Bicocca's defences led to the French-Swiss defeat in 1522.

It tells the story of Operation Market Garden, the 1944 effort by the Western Allies to capture all crossings from the Belgian-Dutch border up to the crucial bridge across the Rhine at Arnhem. Market Garden failed in its main objective of securing the bridge at Arnhem, but both the book and the film show well the tactical importance of even small bridges, and the considerable ingenuity, organisation, and effort required to make or replace crossings capable of moving an army.

One of the key tools in the Allies' toolbox was the British Bailey bridge, a flat pack truss bridge readily and rapidly assembled with minimal heavy equipment from modular prefabricated parts. Another tool was the armoured vehicle-launched bridge, a fold-out bridge mounted on a tank chassis that could be moved into place to cover small gaps; yet another model, the Churchill Ark, would drive into the gap and fold out ramps both ends. To a greater or lesser degree, all of these designs are present in *Bellifortis* and its relatives, sometimes showing remarkable inventiveness and engineering sophistication.

It is not enough to have the means; it is just as important that they be available quickly, to minimise the delay and disruption caused by a gap.⁹³ As reflected in Fronsperger's *Kriegsbuch*, an army on the march is a cumbersome beast, and he advised that two of the prefab bridges should be at the front of the column, just behind the *Renntähnlein*. Maybe if Lt Gen Brian Horrocks had read Fronsperger, he would not have had his Goatley boats at the back of a column dependent on a single road, causing a nearly one-day delay at Nijmegen.⁹⁴

V.3. Conclusion – *Fechtbücher* Compilations as General Warfare Manuals

The *Fechtbücher* that prompted this article were all produced in the period from the second half of the fifteenth to the first half of the sixteenth century. During this period, armies transitioned from the strictly medieval host, smaller in number and limited to infantry and cavalry, where logistics could in a pinch be managed with sumpters, to the form they would keep until World War I.

At the beginning, we posed three questions: Do the solutions work? Can we understand the manuscripts as general warfare manuals? And is there a common canon for the content covered? By focusing on gap crossings, we believe it is possible to give clear answers.

The wide range of subject matters covered in the sources in Part III appears to be typical for the time,⁹⁵ but there is no common canon. If we consider specialist areas

⁹³ Hosler, 'Gap Crossing Operations', p. 59.

⁹⁴ Ryan, *A Bridge Too Far*, pp. 456-58.

⁹⁵ See e.g. the discussion on the spread of the *Bellifortis* and its association with other content with Leng, *Ars belli*, pp. 423-40. The derivation – frequently fragmentary – is not always clear, and there is room for the existence of further works which might have served as sources, but which have been lost or have not yet been identified.

such as individual weapons techniques or gunpowder formulations as subsets and the universe of warfare-related advice as the union of all sets, then the content of each manual represents a different intersection of the various sets. By the mid-sixteenth century then, works become more focused and specialised; the later *Fechtbücher* are limited to individual weapons techniques, and the military manuals focus on specific subjects such as artillery or cavalry. The odour of alchemy around the early gunpowder texts gives way to sober recipes and calculations of trajectory.⁹⁶

In terms of the practicality and practicability of the solutions offered, the consistency between the theoretical works, the pragmatic texts, the narrative sources, and the technical illustrations argues persuasively that the solutions did work.⁹⁷ Moreover, many of the historical narratives cited predate the fifteenth century, so that the depictions in the manuals can be understood as recording solutions that were part of the inventory of warfare know-how; they were not invented by the authors of the manuscripts.

The technical aspects of the solutions in some instances reveal considerable intellectual effort. In addition, much thought went into preparation and reflection on the tactical context, as when Fronsperger advises that a set of ready-made bridges should in the order of march come just after the *Rennfähnlein*, the cavalry troop riding ahead of the main host; or when Solms requires that familiarity with the tactical use of gap crossing solutions should play a role in the selection of the *Büchsenmeister*.

In an earlier article, my co-author and I surmised that the value of the advanced fencing training elaborated in the *Fechtbücher* lay not only in the improved personal fighting ability, but also in training an appreciation for timing, for recognising opportunities and seizing them. They trained the real-time digestion of information while under stress, and a spatial awareness of the forces confronting each other in the theatre of war.⁹⁸ Seeing *Fechtbücher*, at least those of the fifteenth century, in this larger context explains their inclusion with other military-related texts, and the inclusion in some of the *Fechtbücher* themselves of material that could be considered extraneous. Before specialisation set in by the sixteenth century, a military leader was expected to have an all-round education in all warfare-related matters.

⁹⁶ Leng, *Ars belli*, pp. 279-83, 398-402.

⁹⁷ Purton, *Military Engineer*, pp. 272-73, 208: The style of the depictions is meant to combine all relevant aspects of the mechanism into one illustration rather than observe correct perspective.

⁹⁸ Gassmann and Gassmann, 'Mos Geometricus', pp. 197-98.

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¹⁰⁰ The work as such does not have a title, each of the books has its own title page though they are bound in one volume.